Hemostasis of Acute Lower Gastrointestinal Bleeding

15

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Introduction

In the management of acute lower gastrointestinal (GI) bleeding, colonoscopy is the test of choice in most patients. Over a decade ago, colonoscopic intervention for diverticular hemorrhage was demonstrated to be effective, with no rebleeding or surgery necessary in patients treated endoscopically [1]. Colonoscopy offers both diagnostic and therapeutic capabilities, with its diagnostic yield ranging from 74 % to 100 % in the setting of lower GI bleeding [2]. This wide range in yield is partially explained by different diagnostic criteria, and often if no definite source is found, bleeding is attributed to a putative lesion (e.g., diverticulosis) if blood is present in the GI lumen. The rates of detecting definite stigmata of hemorrhage (active bleeding, non-bleeding visible vessel, or adherent clot) are lower at 22–42 %. An adult or pediatric colonoscope may be used to perform colonoscopy in lower GI bleeding. The advantages of using a larger channel colonoscope include enhanced suction capability and passage of larger instruments through the working channel. A water-jet pump is essential to allow efficient cleaning of the colon, in addition to precisely pinpointing an actively bleeding site (Video 15.1). In addition, a large caliber endoscope suction device can be coupled directly to the entrance port of the channel of the colonoscope to provide more powerful suction.

Careful examination of the colon must be performed during both insertion and withdrawal because the nature of GI bleeding can be intermittent. Special attention should be given to areas containing fresh blood and/or clots. Vigorous washing must be performed to remove adherent blood, clots, and debris on insertion. Inspection under water may be particularly helpful to allow localization of active bleeding. In areas with multiple diverticula, every effort should be made to irrigate and inspect each diverticulum for stigmata of bleeding and/or active bleeding. Opiates have been reported to reduce visibility of angiodysplasias and naloxone may enhance their visualization, although the latter is not typically done in clinical practice [3]. If no bleeding site has been identified in the colon, the terminal ileum should be intubated to document whether blood is present. If no blood is present in the terminal ileum while blood is visualized in the colon, this implies a colonic source of bleeding.

Visualization of active bleeding, a non-bleeding visible vessel, or an adherent clot

Electronic supplementary material: The online version of this chapter (doi:10.1007/978-1-4939-3085-2_15) contains supplementary material, which is available to authorized users. Videos can also be accessed at http://link.springer.com/chapter/10.1007/978-1-4939-3085-2_15.

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L.M. Wong Kee Song et al. (eds.), *GI Endoscopic Emergencies*,
DOI 10.1007/978-1-4939-3085-2_15

necessitates treatment to arrest bleeding or prevent rebleeding. All the hemostatic tools used in upper GI bleeding are available for lower GI bleeding, including injection therapy, thermal therapy, clip placement, and band ligation. In contrast to upper GI bleeding where evidence-based data suggest combination therapy to be superior to epinephrine injection alone and the other modalities are effective as monotherapy [4], similar data are lacking for lower GI bleeding.

Hemostatic Devices for Lower GI Bleeding

Injection Therapy

Epinephrine injection therapy is often used to slow the rate of active bleeding and before removal of adherent clots by cold snare guillotine (Video 15.2). The mechanisms of action include tamponade effect on the blood vessel and transient vasoconstriction. Epinephrine injection is typically performed using a dilution of 1:10,000. An injection needle is primed with dilute epinephrine loaded into a syringe that is attached to the needle handle. When the needle is near the target lesion, an assistant advances the needle out of the outer sheath to a preset distance. Similar to bleeding peptic ulcers, injection is performed in a 4-quadrant fashion around the bleeding site in 0.5–2 ml aliquots. Epinephrine should not be injected directly into a non-bleeding visible vessel. Although there are no data to suggest that combination therapy is superior to epinephrine injection alone in lower GI bleeding, the latter is typically used as a precursor to another more definitive treatment modality (as in upper GI bleeding). Most injection catheter needles are 7 Fr in diameter, although 5 Fr and 10 Fr catheters are available. The sheaths and needle lengths vary, as well as the needle gauges, ranging from 19 to 25 G. With regard to adverse events, needle failures have been reported and epinephrine can cause cardiac arrhythmias and hypertension [5].

Thermal Therapy

Thermal therapy is particularly useful for non-bleeding visible vessels, angiodysplasias, radiation proctitis, and postpolypectomy bleeding sites. Both contact and noncontact thermal therapies are available, with one or the other favored in specific situations. Contact thermal therapy is typically performed using devices, such as the heater probe, the bipolar electrocoagulation probe, and the monopolar hemostatic grasper, for coaptation and coagulation of vessels. The heater probe and bipolar probe are equally efficacious and are available in 7 Fr and 10 Fr, with built-in irrigation ports. Irrigation helps visualize the target lesion and allows for a lesser traumatic detachment of the probe from the desiccated tissue. In contrast to the settings for upper GI bleeding, the thermal probe is applied with light to moderate contact pressure for 1–4 s at 10–15 J (heater probe) or 10–15 W (bipolar probe) [6].

The heater probe directly generates heat from an inner heating coil with outer Teflon-coated aluminum cylinder. In contrast, bipolar coagulation probes indirectly generate heat by passing electrical current through the tissue. Because an electrical circuit is completed between 2 closely spaced electrodes in the tip of the probe, no grounding pad is necessary. Adverse events of bleeding and perforation as a result of contact thermal therapy have been reported to occur, with a 2.5 % perforation rate following treatment of colonic angiodysplasias [7].

The hemostatic grasper is similar to a monopolar hot biopsy forceps, except the jaws are flat and the device is rotatable. The technique is to grasp the blood vessel and to gently pull or "tent" the lesion prior to application of current, with suggested settings of 50 W and 1–2 s pulse duration using a soft coagulation mode [5]. This method is often used during endoscopic submucosal dissection (ESD) and endoscopic mucosal resection (EMR) when active bleeding occurs or a visible vessel is seen, as this technique allows for rapid sealing of the vessel while keeping the dissected or resected site clean (Video 15.3).

Argon plasma coagulation (APC) is noncontact thermal therapy using electrically ionized argon gas (plasma) that flows from the tip of the probe to nearby tissue. As the tissue desiccates and loses electrical conductivity, the plasma seeks and coagulates adjacent non-desiccated tissue. This protective property minimizes deep tissue injury. Depth of coagulation varies with the generator power setting and flow rate, duration of therapy, and probe distance to lesion. Current generators allow automatic selection of settings by location, which are preprogrammed with the appropriate flow rate. Because the tip of the probe needs to remain about 2–8 mm from the target lesion and touching the mucosa may result in localized pneumatosis and possibly perforation, the endoscopist requires fine control over the endoscope to maintain optimal distance, which is made even more challenging in the setting of vigorous peristalsis [5]. One helpful technique involves gently touching the lesion with the tip of the probe and then backing the probe away slightly before depressing the foot pedal for APC activation. Often, the tip of the probe will need to be removed for cleaning built-up coagulum, which hampers conductivity. Argon gas rapidly accumulates within the GI lumen during APC and should be intermittently suctioned. The colon should not be fully distended during APC therapy to avoid thinning further the colonic wall and increasing the risk of perforation.

APC probes are single-use devices available in various lengths, diameters (5–10 Fr), and firing directions (straight, side, and circumferential). Circumferential firing probes are most versatile and suitable for radiation proctitis. Straight- or side-firing probes are appropriate for targeting single arteriovenous malformations. Perforations have been reported with APC, including colonic explosion in inadequately cleansed colons [8]. Therefore, a full colon preparation with polyethylene glycol or saline-based solution is mandatory prior to APC use. Rare adverse events, such as pneumomediastinum, pneumoperitoneum, and submucosal emphysema, have been described following APC [9].

Mechanical Hemostatic Devices

Mechanical hemostatic devices include clips, bands, and detachable loops. Currently available through-the-scope (TTS) clips are rotatable and/or capable to reopen, with different delivery catheter lengths and jaw widths (Table 15.1). The handling and deployment of a clip typically involves the following steps: advance the clip out of the sheath (if present), open the jaws, position the opened jaws onto the targeted lesion with pressure, close the jaws, and deploy the clip. At this point some clips are fully deployed, while others require further manipulation of the handle to deploy the clip. This final step (if applicable) is important to ensure the clip is detached from the catheter before withdrawing the latter into the endoscope. Otherwise, the clip may be wrenched from the lesion, precipitating bleeding.

Table 15.1 Selected through-the-scope clips

Clip	Width of open jaws (mm)	Rotatable	Reopening capability	MRI[a] conditional
Resolution Clip (Boston Scientific, Inc.)	11	No[b]	Yes	Yes
QuickClip 2 (Olympus Corp.)	9	Yes	No	No
QuickClip 2 Long (Olympus Corp.)	11	Yes	No	No
Instinct clip (Cook Endoscopy, Inc.)	16	Yes	Yes	Yes

[a]*MR* magnetic resonance imaging
[b]Some rotation capability feasible with protective sheath off

Familiarity in the use of a chosen clip device is, therefore, essential. The application of suction before closing the clip helps draw more tissues within the opened jaws, and generally soft pliable tissue is necessary for successful clip closure. Targeted clip placement of a visible vessel within a large fibrotic ulcer base may rupture the vessel and precipitate bleeding since the prongs of the clip may not anchor into fibrotic tissue.

Clip deployment is targeted at the bleeding lesion or visible vessel. Additional clips can then be placed on each side of the clipped lesion to ligate the feeding vessel. If the first clip is placed on one side of the vessel, the second clip is placed on the other side to ensure hemostasis. Thus, two to three clips are typically placed to target a bleeding source (Video 15.2).

Recently, over-the-scope clips (OTSC) have become available for treatment of focal bleeding lesions, typically in cases refractory to standard endoscopic therapies. Although the majority of the OTSC experience to date has been in the management of upper GI bleeding, there are several reports regarding the successful use of OTSC in lower GI bleeding [10].

Endoscopic band ligation (EBL) is typically used for esophageal variceal bleeding, although there are reports of successful banding for diverticular bleeding [11]. The bleeding diverticulum should be marked with a tattoo or clip to aid in subsequent identification, and over-suctioning excess tissue into the banding cap should be avoided to prevent entrapment of the entire colonic wall, which could lead to delayed perforation [12]. EBL requires withdrawal of the colonoscope after site marking for device loading and reinsertion of a gastroscope loaded with the banding apparatus to the bleeding site for band deployment. The logistics of instrument withdrawal and reinsertion may not be feasible in some settings.

Detachable loops or snares for ligation are particularly useful for constricting and tamponading the stalk of large pedunculated polyps before polypectomy. These nylon loops open to a diameter of 3 cm and once lassoed around the stalk, they are tightened to achieve hemostasis or cyanosis of the polyp, followed by loop release. Positioning the loop around the lesion may be difficult because of its floppy nature, and gradually opening the loop over the lesion may help with positioning. If needed, a loop-cutting device can section maldeployed loops. The loop can inadvertently cut through the stalk by constricting the loop too tightly. In contrast, premature loop deployment will result in inefficient tightening of the target lesion, and this can be avoided by slowly tightening and assessing the appearance of the lesion for ischemic change prior to release of the loop. Postpolypectomy loop placement to control active bleeding from a residual stump is feasible as long as enough stalk remains for capture by the loop.

Non-endoscopic Therapy for Lower GI Bleeding

Angiography

Similar to colonoscopy, angiography can be both diagnostic and therapeutic in lower GI bleeding. It is particularly useful in patients with ongoing bleeding whose colons are unprepped and in those with severe bleeding, which would likely limit visualization during colonoscopy. Angiographic vasopressin infusion is not commonly used due to its high bleeding recurrence rate and complications [13]. Super-selective microcatheter embolization is usually performed for hemostasis using small 2.5–3 Fr microcatheters that are advanced through larger catheters and through which various embolic agents can be deployed, including microcoils, microparticles, and glue. Initial clinical success with this technique is achieved in over 95 % of patients, with a rebleeding rate of about 22 %. The major concern with angiographic intervention lies in its potential for serious adverse events in about 17 % of cases, including bowel ischemia and infarction, hematoma, thrombosis, and vascular dissection [14].

Surgery

Surgical resection is the last resort for ongoing lower GI bleeding that is refractory to less invasive endoscopic and angiographic management,

since it carries substantial morbidity and mortality, especially in emergent situations. Blind segmental resection is not recommended due to its high rate of recurrent bleeding, morbidity, and mortality. Segmental resection is preferred with lower rebleeding rates ranging from 0 to 14 %. Subtotal colectomy carries the lowest rebleeding rate (<5 %), but with higher morbidity than targeted segmental resection.

Specific Causes of Lower GI Bleeding

The differential diagnosis of acute lower GI bleeding is broad, although the vast majority of such bleeding is due to diverticulosis, ischemic colitis, angiodysplasias, neoplasia, and hemorrhoids (Table 15.2) [15]. The cause of lower GI bleeding remains uncertain in about 12 % of cases. The use of specific hemostatic tools for the most common lower GI bleeding lesions is highlighted here.

Diverticular Bleeding

Multiple endoscopic options are available for treating a colonic diverticulum with active bleeding or stigmata of recent bleeding, including epinephrine injection, thermal coagulation, mechanical therapy, or a combination thereof [12]. Once a bleeding diverticulum is identified, the location should be marked with a submucosal injection of a tattooing agent to localize the bleeding area if subsequent endoscopic or surgical therapy becomes necessary. Alternatively, a clip can be placed next to the site to mark its location, although the clip is not meant to be served as a permanent endoscopic or fluoroscopic marker.

Epinephrine injection in four quadrants can control bleeding or close the mouth of the diverticulum by tamponade. A bleeding or nonbleeding visible vessel can be identified at the neck or at the dome of the diverticulum. Adherent clots can be removed using the cold snare guillotine technique (similar to the technique for upper GI bleeding), and any underlying lesion should be treated appropriately. TTS clips can be placed directly on the culprit vessel (Video 15.4) or used to close the entire diverticulum (Fig. 15.1) [16]. One study suggests that clip placement targeted at the vessel is more effective than closing the entire diverticulum in a "zipper" fashion [17]. If utilized, contact thermal therapy should be applied carefully, particularly in the dome of the diverticulum. The suggested treatment settings for bipolar coagulation are a power of 10–15 W and short 1–2 s pulse duration, with light to moderate probe-tissue contact pressure (Video 15.5). If clips or thermal therapy are not feasible due to difficult access, particularly in a narrowed, angulated sigmoid colon, EBL can be considered (Fig. 15.2). The band ligation cap is useful in this setting to facilitate access to the bleeding diverticulum. An area adjacent the bleeding diverticulum should be marked with a tattoo or clip to aid visual identification when an upper endoscope loaded with the banding device is subsequently introduced (Video 15.6).

Table 15.2 Etiology of lower gastrointestinal bleeding

Source	Prevalence (%)
Diverticulosis	17–44
Colonic angiodysplasia	2–30
Ischemia	9–21
Malignancy	4–14
Hemorrhoids/anorectal lesions	4–11
Postpolypectomy	6
Unknown	8–12

Angiodysplasias

At colonoscopy, an angiodysplasia has a characteristic appearance of a 2–10 mm, red, fern-like, flat lesion with ectatic vessels radiating from a central vessel. Poor bowel preparation and use of meperidine and other opiates, which transiently decrease mucosal blood flow, could potentially hinder the identification of angiodysplasias. If there is a history of guaiac-positive stool or iron deficiency anemia, angiodysplasias should be treated even if not actively bleeding.

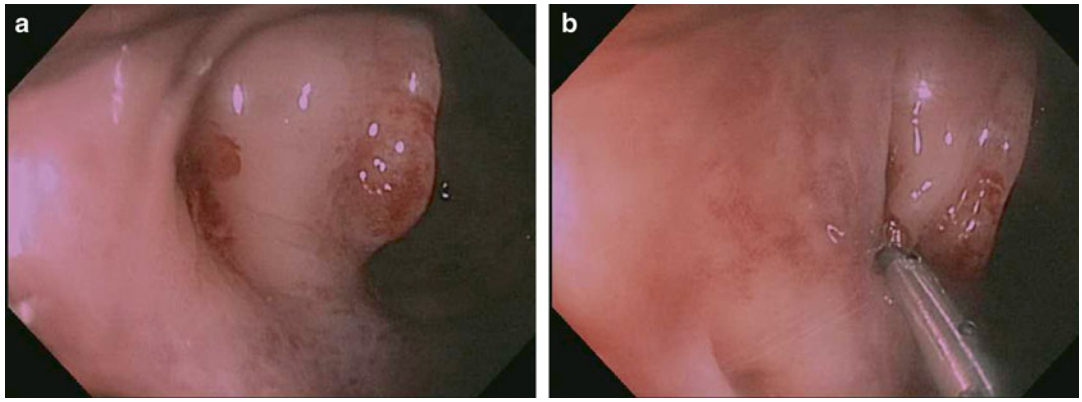

Fig. 15.1 (**a**) Diverticulum with stigmata of recent bleeding. (**b**) Clip placement for closure of diverticulum

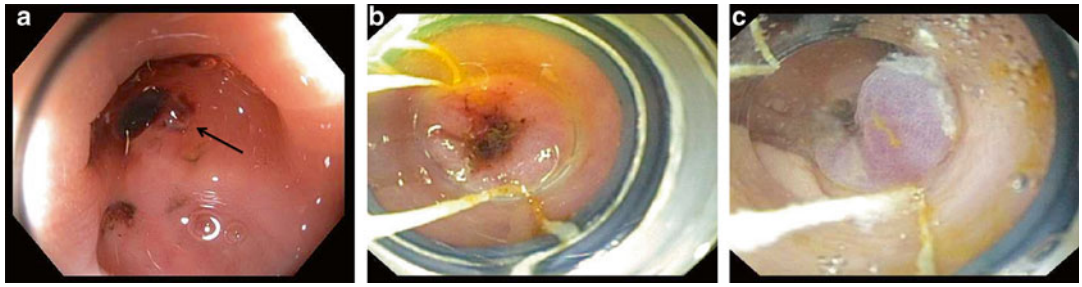

Fig. 15.2 (**a**) Diverticulum with visible vessel in the dome. (**b**) Endoscopic band ligation performed. (**c**) Appearance of post band ligation

Angiodysplasias without evidence of GI bleeding should not be treated.

Bleeding angiodysplasias can be treated with a variety of thermal therapies [12]. Clips may not be effective for angiodysplasias and are not typically used. Contact thermal coagulation begins with the outer feeder vessels and progresses toward the central vessel, although the focus should be on the central vessel. However, APC is more popular than contact thermal methods, with a reported 77–83 % success rate (Fig. 15.3) [18]. Over-insufflation of the colon should be avoided before and during therapy as it can increase the risk of perforation due to thinning of the colon wall. For a very large angiodysplasia, injecting epinephrine near the center vessel can shrink the size of the lesion and decrease the amount of coagulation needed.

There is a potential role for medical treatment of angiodysplasias, particularly when numerous and diffuse, although most of the data are from studies of small bowel angiodysplasias. Octreotide administered subcutaneously in doses ranging from 100 μg to 500 μg two times a day may decrease the need for transfusions [19]. Thalidomide at a dose of 100 mg orally once a day may also decrease the rebleeding rate from angiodysplasias [20]. A randomized trial of estrogen-progesterone treatment for 1 year did not decrease the rebleeding rate from angiodysplasias, with higher morbidity and mortality [21, 22]. Hormone therapy may decrease bleeding from telangiectasias in patients with Osler-Weber-Rendu disease.

Ischemic Colitis

Endoscopic evaluation with sigmoidoscopy or colonoscopy is used to confirm the diagnosis of

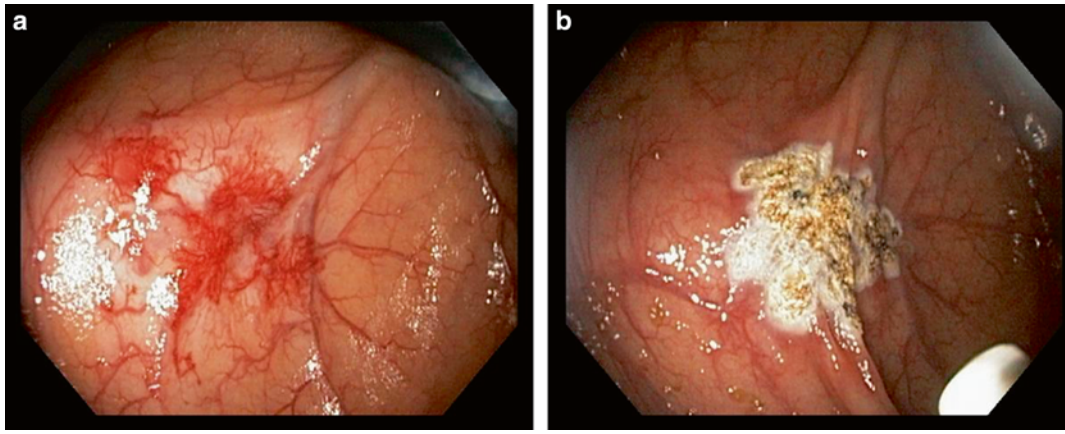

Fig. 15.3 (**a**) Colonic vascular ectasias. (**b**) Ablation with argon plasma coagulation

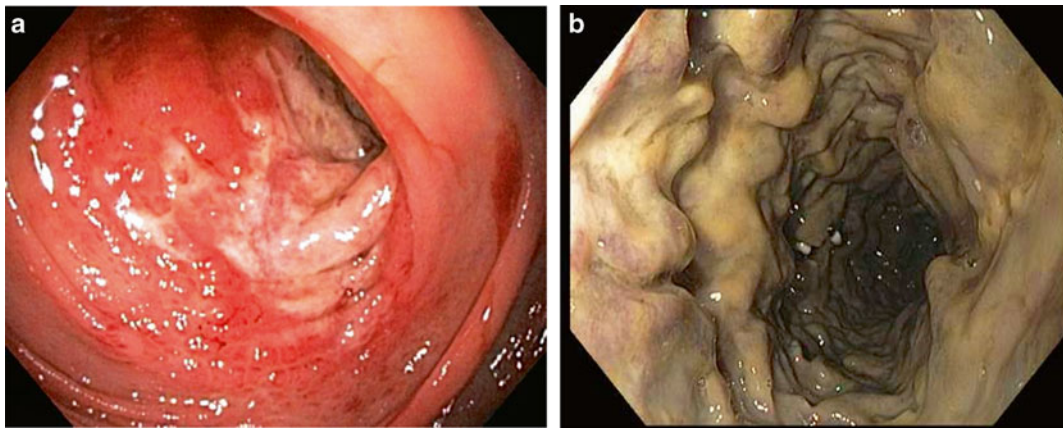

Fig. 15.4 (**a**) Ischemic colitis with ulcerations. (**b**) Severe ischemic colitis with necrotic tissue

suspected ischemic colitis. Care must be taken to minimize endoscopic insufflation and overdistention to prevent worsening ischemic damage. At endoscopy, the ischemic changes usually occur in a segmental distribution and involve the watershed areas (splenic flexure). The endoscopic features vary depending on the degree of injury, ranging from pale mucosa with petechial bleeding to longitudinal ulcers (stripe sign) to cyanotic, necrotic bowel (Fig. 15.4). Endoscopic treatment is usually not indicated or possible in ischemic colitis, except for isolated ulcers with focal active bleeding. Either clip placement or thermal therapy can be performed.

Neoplastic Lesions

In patients over 50 years of age, a colonic neoplasm is the etiology in about 10 % of cases of rectal bleeding (Fig. 15.5). Although tumor bleeding tends to be low grade and occult, bleeding may occasionally be brisk and overt and occurs due to erosion or ulceration of the lesion. Acutely bleeding distal lesions (left-sided colon and rectum) are more likely to present with bright red blood per rectum, whereas more proximal lesions tend to present with maroon stool, melena, or occult blood.

Standard endoscopic therapies for bleeding neoplasms are of limited benefit. Contact thermal

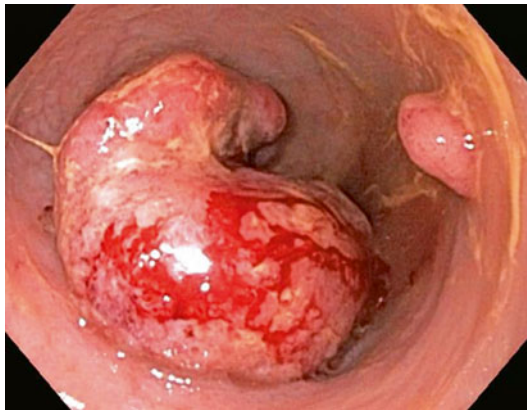

Fig. 15.5 Oozing malignant-appearing rectal mass

therapy, APC, hemostatic spray, or application of fibrin glue may stop bleeding temporarily, but the definitive treatment for most patients with bleeding colonic neoplasms is surgical resection.

Hemorrhoids

Hemorrhoids and other anorectal disorders, such as solitary rectal ulcers (Fig. 15.6) and anal fissures, are an important source of lower GI bleeding. Hemorrhoids are dilated submucosal vessels in the anus, which are considered internal if above the dentate line and external if below. Acute treatment for most patients with bleeding hemorrhoids is not needed since most bleeding episodes are mild in severity and resolve spontaneously. EBL is a reasonable therapeutic option for persistently bleeding internal hemorrhoids (Video 15.7). Surgery is rarely needed for those with persistent or massive bleeding.

Postpolypectomy Bleeding

Postpolypectomy bleeding occurs after 1–6 % of polypectomies and is the leading major adverse event following colonoscopy with polypectomy. Acute hemorrhage occurring at the time of polypectomy accounts for less than 50 % of cases. Therapeutic options include re-snaring the stalk of the polypectomy site (for a pedunculated polyp) to apply pressure, injection with epinephrine, contact or noncontact thermal treatment with bipolar coagulation, coagulation grasping forceps or APC, and clip (Fig. 15.7) or loop (Fig. 15.8) application. Mechanical methods of hemostasis are preferred, when technically feasible, since they do not extend tissue damage and may provide more durable hemostasis (Video 15.2). Delayed postpolypectomy bleeding (Fig. 15.9) usually manifests itself within 7 days, although it can occur up to 30 days following polypectomy when the eschar falls off the site. However, postpolypectomy bleeding is usually self-limited and over 70 % of cases resolve with supportive care only.

Risk factors for postpolypectomy bleeding include removal of large polyps (especially greater than 2 cm in diameter), age over 65 years, cardiovascular or chronic renal disease, platelet dysfunction, and coagulopathy (including the use of antithrombotic medications). The risk of delayed postpolypectomy bleeding may be reduced by prophylactic clip closure of postpolypectomy defects over 2 cm in size [23] and in patients on antithrombotic medications following resection of polyps >1 cm in size. A meta-analysis suggested that use of one or a combination of injection with epinephrine or saline and endoscopic clipping reduces the risk of postpolypectomy bleeding [24].

Radiation Proctitis

Pelvic radiotherapy can cause both acute and chronic radiation proctitis. Acute injury presents within 3 months of radiation therapy with diarrhea, tenesmus, and, rarely, bleeding. Chronic radiation proctitis typically occurs 9–14 months following radiation therapy in up to 20 % of patients, but may occur even years later. Bleeding is a prominent symptom caused by mucosal atrophy and fibrosis, resulting in chronic mucosal ischemia.

There are no standardized recommendations for treatment of bleeding from radiation proctitis. Endoscopic therapy appears superior to medical treatment in reducing severe bleeding, with success rate of nearly 75 % following endoscopic

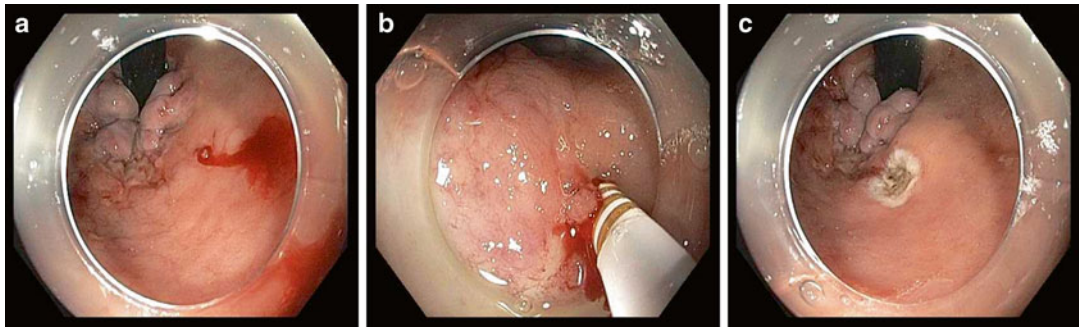

Fig. 15.6 (**a**) Small rectal ulcer with active bleeding. (**b**) Bipolar coagulation of bleeding ulcer. (**c**) Successful hemostasis following thermal therapy

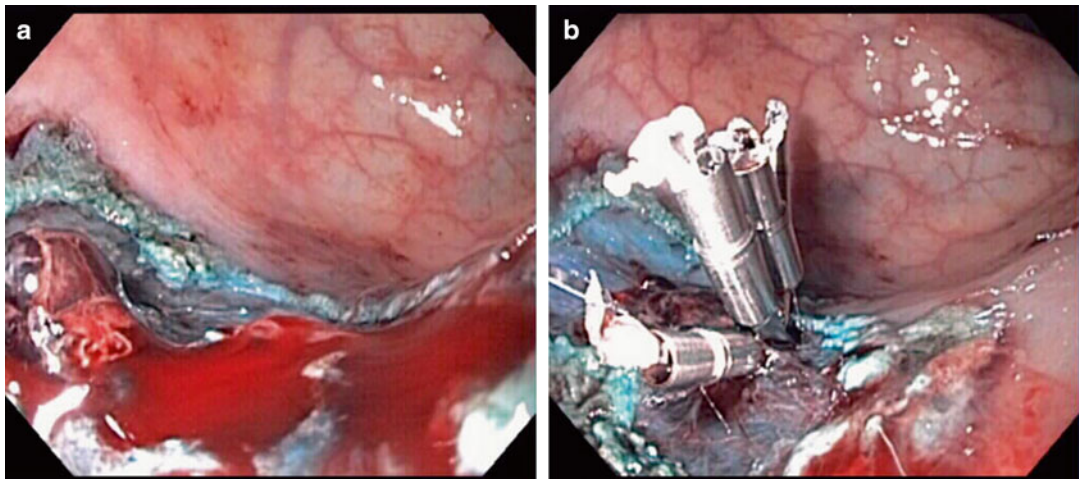

Fig. 15.7 (**a**) Immediate bleeding following endoscopic mucosal resection of a large rectal polyp. (**b**) Hemostasis achieved following clip application

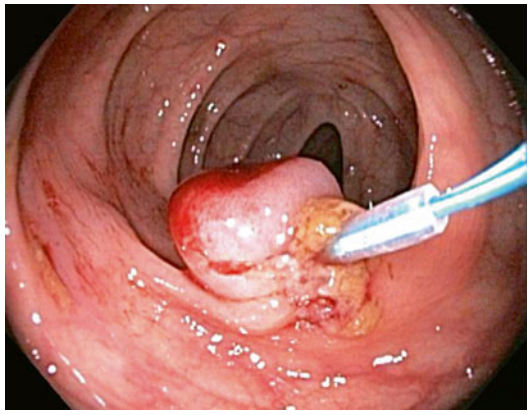

Fig. 15.8 Bleeding postpolypectomy stalk treated with loop placement

treatment compared to 33 % for medical therapy [25]. Heater probe and bipolar coagulation have proven effective in controlling bleeding during a mean of four treatment sessions performed every 4–6 weeks. Due to ease of use, APC is more commonly employed (Video 15.8), with 85–100 % success in reducing or stopping bleeding over a mean of 2–3 treatment sessions every 4–8 weeks (Fig. 15.10). During follow-up of 1–5 years, recurrent bleeding occurred in 0–8 % of patients [26]. The visible telangiectasias are obliterated at each session, although aggressive thermal ablation should be avoided to prevent deep ulcerations, which may not heal readily in the setting of an irradiated field; rectal ulcers from previous

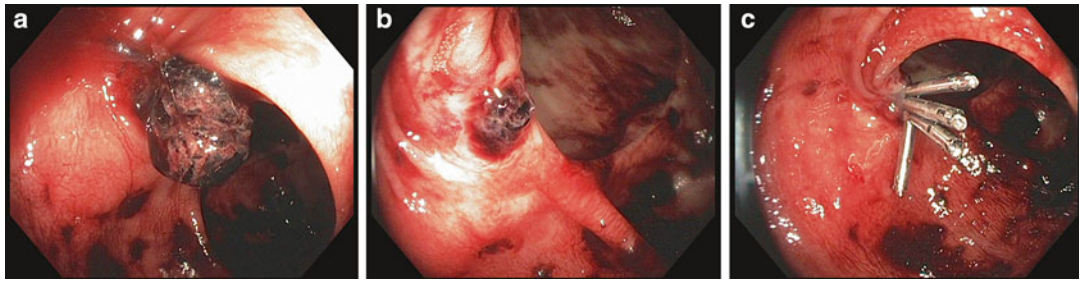

Fig. 15.9 (**a**) Delayed postpolypectomy bleeding with adherent clot. (**b**) Cold snare guillotine of clot, revealing visible vessel. (**c**) Treatment of postpolypectomy bleeding site with clip placement

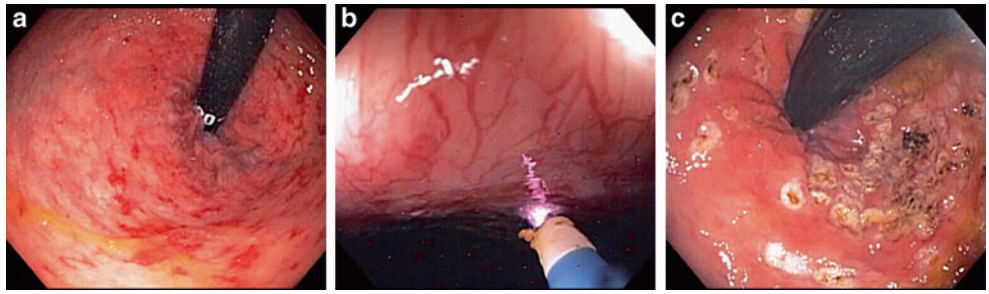

Fig. 15.10 (**a**) Telangiectasias due to radiation proctitis. (**b**) Argon plasma coagulation performed. (**c**) Endoscopic appearance following argon plasma coagulation

treatments should be avoided. Short-term adverse events occur in 7 % of patients and include rectal pain and fever. Rare major adverse events include rectovaginal fistula, anal or rectal stricture, and perforation. A full bowel preparation is required due to reports of colonic gas explosions during APC following enema preparation. A newer endoscopic ablation technique involves radiofrequency ablation, with case reports of successful treatment of radiation proctitis in patients who failed APC [27].

Hyperbaric oxygen is another therapeutic option, which promotes angiogenesis and collagen formation, leading to reepithelialization. A meta-analysis suggests that hyperbaric oxygen therapy is effective in radiation proctitis [28]. However, the treatment regimen is rigorous, requiring that the patient be placed in a hyperbaric chamber at a pressure of 2–2.5 atm with 100 % oxygen for 90 min, 5–7 days per week, for 20–80 sessions [29]. Hyperbaric oxygen therapy may be considered in patients with radiation proctitis who are refractory to standard medical and endoscopic treatments.

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