

7.7 Polypectomy

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Key Points

- Optical enhancement techniques, such as narrow-band imaging, FICE, or staining with 0.2% indigo carmine, may be used to predict polyp histology.
- Forceps polypectomy is best suited for diminutive polyps. Pedunculated polyps ≤ 5 mm and sessile polyps ≤ 7 mm may be resected with cold snaring.
- Polyps that exhibit the non-lifting sign and polyps that are ulcerated may harbor carcinoma. These polyps should be biopsied to exclude cancer prior to resection.
- Large sessile polyps resected in piecemeal fashion should be followed-up with repeat examination in 2–6 months to exclude residual or recurrent adenoma.
- Management of antithrombotic agents in the peri-endoscopic period depends on the bleeding risk from polypectomy and the thromboembolic risk associated with interruption of medications.
- Colonoscopy should be performed urgently in patients with active post-polypectomy hemorrhage.

Introduction

Colorectal cancer (CRC) is one of the leading causes of cancer death worldwide. The lifetime risk of developing CRC is 6%, with the majority of cancers occurring in people older than 50 years. CRC is believed to arise from adenomas through the adenoma to carcinoma sequence. Interruption of this progression through polypectomy is one of the most effective cancer prevention means in medicine. The National Polyp study showed that colonoscopy with removal of

adenomas decreased the incidence of CRC by 76–90%. More recent studies showed that colonoscopy with polypectomy is associated with a relative reduction in CRC death of 65%. However, colonoscopy is imperfect and incident cancers after clearing colonoscopies continue to occur. Up to one-third of incident cancers are believed to be due to ineffective polypectomy. All endoscopists should therefore be familiar with effective and safe polypectomy techniques.

The aim of this chapter is to discuss techniques of removal of small polyps, large pedunculated polyps, and large sessile polyps. In addition, the chapter discusses the management of antithrombotic agents during the peri-endoscopic period, the treatment of malignant colorectal polyps, and the management of complications of polypectomy.

1. Optical enhancement techniques

Optical enhancement techniques, such as narrow-band imaging (NBI), chromoendoscopy (CE), autofluorescence (AF), Fuji Intelligent Chromo Endoscopy (FICE), and I-Scan, may be used to improve polyp detection and/or predict polyp histology in real time (Fig. 1) (see Ch. 6.2). The discussion of the former use is beyond the scope of this chapter. However, understanding the use of such techniques to predict polyp histology may assist in determining the need for polypectomy.

NBI and CE are the most studied optical enhancing technologies. CE involves spraying of dye, and is cumbersome and time-consuming. NBI has been called digital

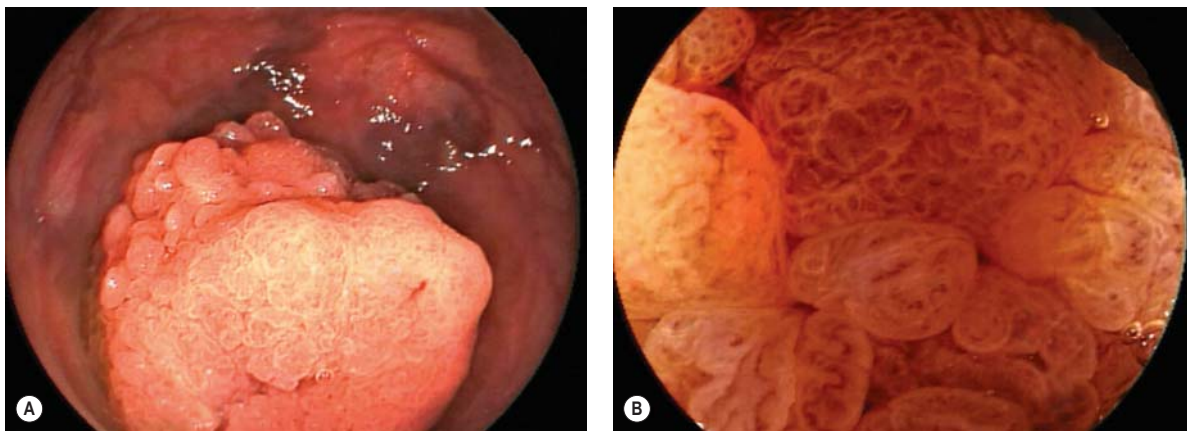


Figure 1 Sessile polyp. (A) This polyp in the transverse colon was identified as a sessile polyp using FICE and optical zoom. (B) Note the tubular pit patterns with no sign of adenocarcinoma.

Table 1 Endoscopic features predictive of polyp histology when viewed by NBI

| Adenomatous polyps | Hyperplastic polyps |
|---------------------------|--|
| Short thick blood vessels | Thin blood vessels crossing polyp surface and not surrounding pits |
| Overall brown color | Bland, featureless appearance |
| Tubular or oval pits | Pattern of black dots surrounded by white |
| Central brown depression | |

chromoendoscopy, does not involve spraying of dye, and is an efficient means of predicting colon polyp histology. Table 1 depicts the endoscopic features that are predictive of adenomatous and hyperplastic histology when viewed by NBI. Experienced endoscopists can correctly predict adenomatous and hyperplastic histology of diminutive polyps (≤ 5 mm) in 90–95% of cases. NBI may, thus, identify small distal hyperplastic polyps that need not be resected (or resected and discarded). All proximal hyperplastic polyps, however, should be resected as they may represent serrated adenomas, which are now recognized as precancerous lesions.

Another potential use of optical enhancement techniques is examination of polypectomy sites to assess the adequacy of polypectomy and the presence of residual or recurrent adenomatous tissue at the index or follow-up colonoscopic examinations, respectively.

2. Equipment

Box 1 Equipment

- Polypectomy snares^a.
- Cold and hot biopsy forceps.
- Tripod grasper forceps.
- Injection needle.
- Endoscopic clips.
- Detachable loops.
- Polyp retrieval 'Roth' nets (Fig. 2).
- Polyp trap (Fig. 2).
- Tattoo (India ink or GI-spot).
- Epinephrine.

^aSnares come in a variety of shapes and sizes. We usually use hexagonal snares, as they can be half opened to remove small polyps, and fully opened to remove large polyps.

3. Small polyp removal

3.1. General concepts

- Small polyps have a maximum diameter of <10 mm and diminutive polyps have a maximum diameter of ≤ 5 mm.
- Most colon polyps are diminutive (80%) or small (90%).
- The optimal technique for resection of small polyps has not been established.
- The benefit of removal of all diminutive adenomas is not known.
- Most polypectomy complications result from small polyp removal because of their prevalence.

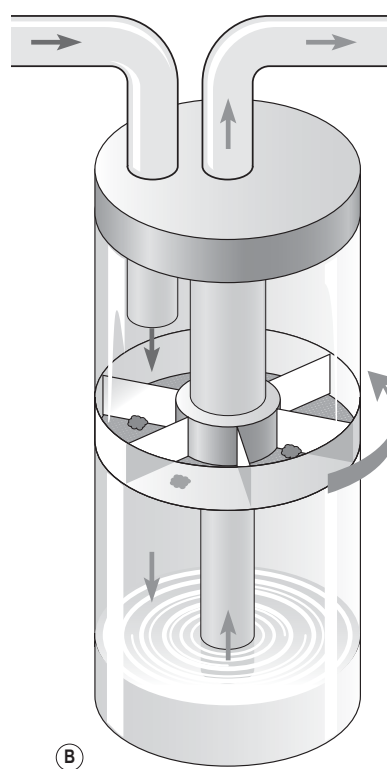
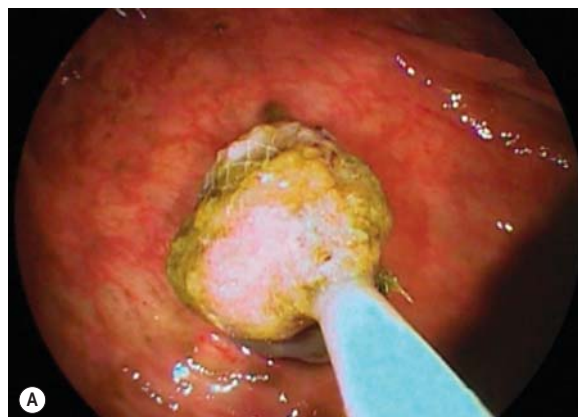


Figure 2 Polyp retrieval devices. (A) Polyp retrieval net (Roth). (B) A polyp trap is useful for small polyps which can be suctioned and then captured in the trap.

- Most polypectomy complications are electrocautery-related.
- Electrocautery is not needed in the resection of many small polyps.

3.2. Cold biopsy forceps

- Cold forceps are appropriate for the resection of smallest polyps (1–3 mm in size).
- Hot forceps are best suited for resection of diminutive flat polyps that are harder to grasp with a snare.

- Resection of larger polyps using a biopsy forceps in piecemeal fashion is inefficient and may result in residual adenomatous tissue.

Clinical Tips

- Polyps >3 mm are usually resected in piecemeal fashion when forceps are used for resection. The endoscopic field may become bloodied, which may obscure the margins of the residual polyp. It is better to use hot biopsy forceps.
- Cold forceps are not associated with increased complication risks and can be used safely in anticoagulated patients and patients on anti-platelet agents.

3.3. Hot biopsy forceps

- The tip of the polyp should be grasped and tented away from the colonic wall to create a pseudo-stalk. Lumen should be first deflated and electrocautery is then applied. Since the electric current density concentrates at the narrowest point, the pseudo-stalk is cauterized.
- Hot forceps are also best suited for resection of diminutive polyps. Resection of larger polyps with hot forceps involves piecemeal resection and risks incomplete polyp removal.
- Hot forceps are associated ~~with residual tissue at the central portion of the polyps, in addition~~ to an increased risk of delayed post-polypectomy bleeding and transmural thermal injury.
- Hot forceps biopsies are associated with a 16–8% risk of residual polyp.
- ~~Hot biopsy forceps may make histopathologic interpretation difficult because of cautery effect.~~

Clinical Tips

- The right colon is particularly susceptible to transmural injury and perforation. Great care must be taken when using hot biopsies in the right colon.
- The American Society for Gastrointestinal Endoscopy (ASGE) recommends that hot forceps should be used only for polyps ≤5 mm.

3.4. Cold snare

- The V of the open snare should be positioned at the point the endoscopist wants the snare to close. This is usually at the junction between the polyp and the adjacent normal tissue (Figs 3, 4). Be careful to check that the colon wall is not caught in the snare before cutting (Fig. 5).
- In general, snaring techniques are more effective than forceps techniques for efficient and complete eradication of polyps.
- Cold snares are effective for resecting sessile polyps up to 7 mm in size and pedunculated polyps up to 5 mm in size.

Clinical Tips

- Hot snaring should be used for resection of larger (>5 mm) pedunculated polyps because their stalk may enclose large blood vessels; electrocautery coagulates blood vessels and helps avoid bleeding complications.
- There is no need to lift or tent the polyp away from the colonic wall when using cold snare technique. Avoiding tenting may help keep the resected polyp in the endoscopic field.

Clinical Tip

- Some authorities recommend resecting 1–2 mm rim of normal tissue around the polyp edge along with polyp to ensure complete resection. This should be avoided when using hot snaring because it increases the size of the cautery burn.

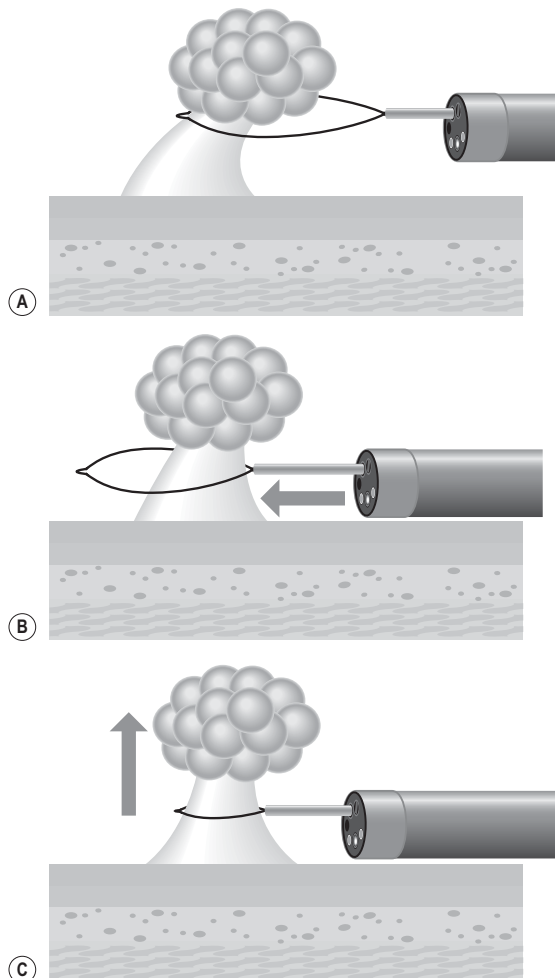


Figure 3 How to place a diathermy snare around the stalk of the polyp. (A) Position the polyp in the 6 o'clock position. Open the snare beyond the polyp and then place it over polyp. (B) Push the snare forward slightly to advance it onto the stalk of the polyp. (C) Once it is around the stalk, close the snare slowly, withdrawing the polyp slightly.

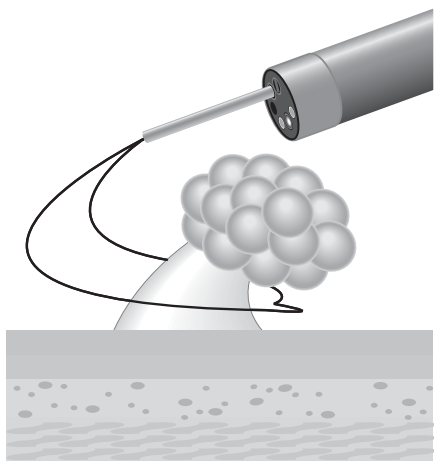


Figure 4 An alternative technique is to place the snare over the front of the polyp and then close the snare behind the polyp. This technique is used when the polyp is difficult to snare using the classic technique.

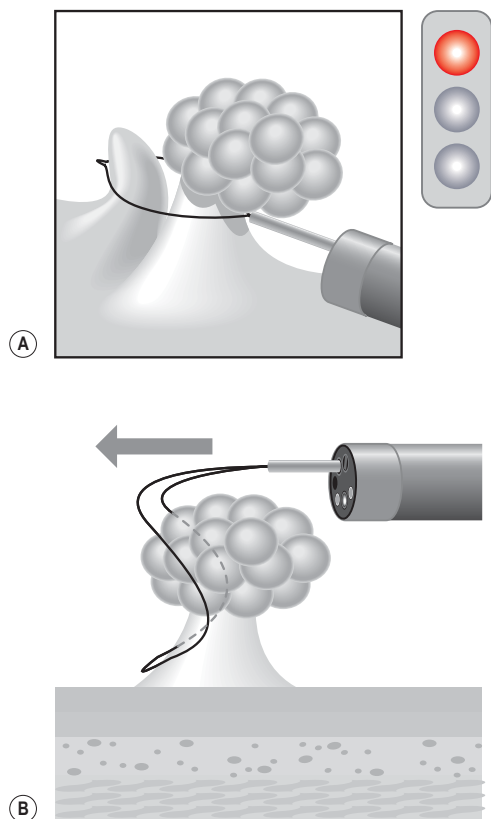


Figure 5 Pitfalls in polypectomy. (A) Be careful to check that the colon wall is not caught in the snare before cutting. (B) This can be avoided by first advancing the snare over the polyp under direct vision before closing.

Table 2 Types of currents used for polypectomies

| Current type | Early bleeding risk | Delayed bleeding risk |
|--------------|---------------------|-----------------------|
| Coagulation | ↓ | ↑ |
| Cutting | ↑ | ↓ |
| Blended | ↑ | ↓ |

The type of current affects the risk of early or late bleeding. Thus coagulation is associated with an increased risk of delayed bleeding, while using a cutting current is associated with a decreased risk of delayed bleeding but an increased risk of early bleeding.

3.5. Hot snare

- Different types of currents may be used for hot snare polypectomies (Table 2). There is currently no consensus for the optimal type of current that should be used. The intensity of the heat delivered per mm of contact depends on the contact area (Fig. 6).
- We usually use endo-cut mode as this setting has a low risk of bleeding while having sufficient cutting current to resect a polyp.
- The ensnared polyp should be lifted away from the colonic wall and the lumen deflated prior to the application of electrocautery to minimize the risk of transmural injury.
- Pedunculated polyps >5 mm are best resected with a hot snare.

4. Large pedunculated polyp removal

- Large pedunculated polyps are most commonly found in the sigmoid colon.

Warning!

Caution needs to be exercised not to mistake a pedunculated mucosal prolapse or a large lipoma for an adenoma. Mucosal prolapse has a normal pit pattern. Lipomas exhibit a positive pillow sign.

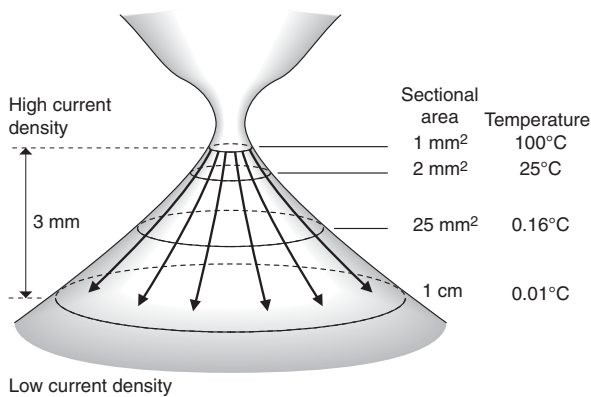


Figure 6 The intensity of the heat delivered per millimeter of contact depends on the contact area.

- A pedunculated polyp of any size should be able to be removed by a single transection. Piecemeal resection of the head may be performed if the polyp cannot be ensnared, until the residual polyp can be encircled with the snare.



Clinical Tip

If a pedunculated polyp is resected in piecemeal fashion, then the portion of polyp nearest to the pedicle should be submitted to pathology in a separate jar, because this section will determine the need for further therapy if cancer is found.

- Epinephrine injection of the stalk prior to polyp resection decreases immediate, but not delayed, post-polypectomy bleeding risk. This is particularly important in polyps with a large (>1 cm) stalk that may contain a large artery (Fig. 7).
- Epinephrine injection into the stalk may also result in shrinking of the polyp. For this purpose, injection is best performed during scope insertion so that the delayed effect of shrinkage is appreciated during scope withdrawal.
- Placement of a detachable loop around the pedicle of large pedunculated polyps decreases the risk of immediate and delayed post-polypectomy bleeding (Figs 8–10). This should be avoided in polyps with short stalks, as it may render snare resection more cumbersome and may slip off and result in massive hemorrhage. A detachable loop should be closed gently, as excessive tightening of the loop can transect the polyp stalk.

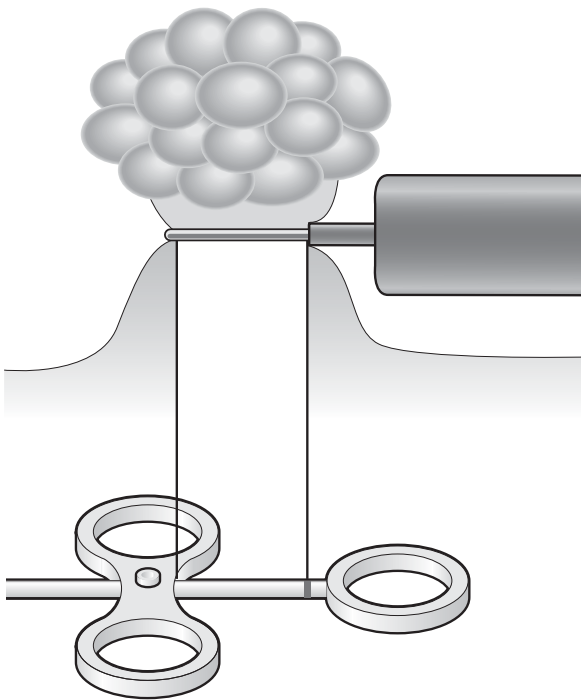


Figure 7 The size of the stalk can be assessed using the handle of the closed loop.

Box 2 Non-lifting sign

- Polyps that do not lift after submucosal saline injection display the non-lifting sign.
 - Such polyps should be biopsied with cold forceps, and resected if biopsies fail to reveal carcinoma.
 - Prior failed attempts at polyp resection with snaring produce a false non-lifting sign due to submucosal fibrosis.
 - The positive predictive value of the non-lifting sign for invasive carcinoma is 83%.
- The snare should be placed over the pedicle such that half or upper third of the pedicle will be resected (Figs 3, 11). This is crucial to ensure R0 resection if cancer is found in the polyp head. In addition, this leaves adequate residual pedicle to grasp and treat if bleeding occurs.
 - Larger snares should be used for giant pedunculated polyps. The colonoscope should be advanced proximal to the polyp, the snare opened widely, and then the polyp ensnared during colonoscope withdrawal.

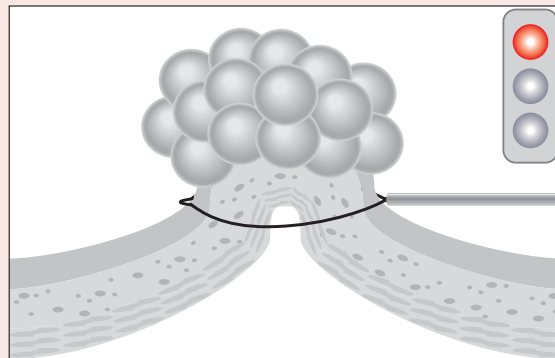
5. Large sessile polyp removal

- Large sessile colon polyps are those ≥ 2 cm in size, and 'giant' polyps refer to those ≥ 3 cm. These lesions have a propensity to harbor or transform to cancer.
- These polyps must be biopsied to exclude the presence of carcinoma. If carcinoma is present, the polyp should be resected surgically.
- Polyps that exhibit the non-lifting sign and polyps that are ulcerated may harbor carcinoma.
- Most large sessile polyps are removed using piecemeal technique (Fig. 12). Submucosal injection, although non-mandatory, facilitates the safe resection of such polyps (Figs 13, 14).
- Initial snaring of the polyp is usually performed using large snares, removing large pieces if possible (Fig. 12). Smaller residual polypoid tissue is then resected using



Warning!

When to use submucosal injection



The muscularis propria is caught in the snare which can cause perforation. Submucosal injection should be performed.

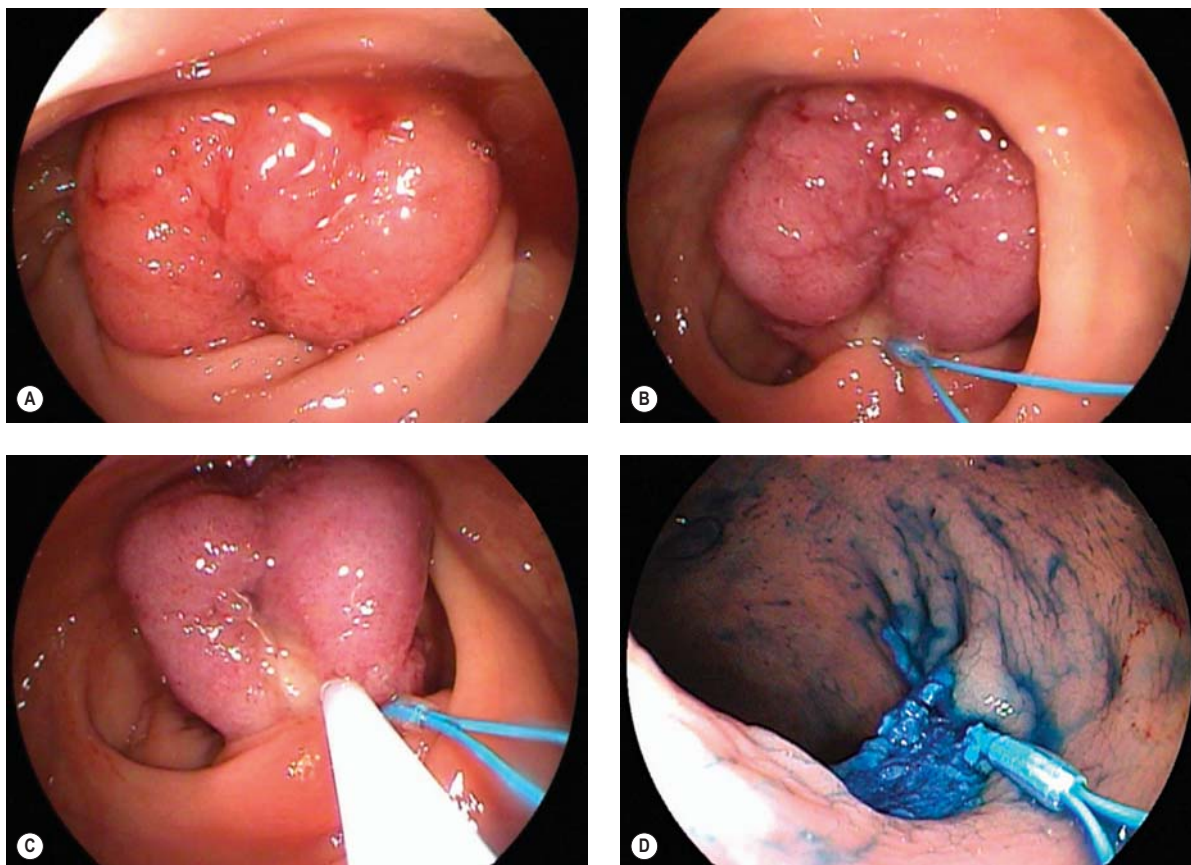


Figure 8 (A–D) Use of a detachable loop in a patient with a large pedunculated polyp.

smaller snares. All remaining flat adenomatous tissue can then be ablated using argon plasma coagulation (see Ch. 7.4) when it is not possible to resect with a snare.

- Spiral snares can be used to grasp residual small areas of very flat adenomatous tissue.
- The use of APC to ablate the edges of the polypectomy site and any visible residual adenomatous tissue has been shown in randomized controlled trials to decrease the incidence of polyp recurrence.
- Large polyps outside the cecum should be tattooed to facilitate endoscopic localization during follow-up examinations. Tattoos should be placed to the right and

left of the polyps. If surgical localization is required, tattoos should be placed in three or four quadrants around the polyp. Transmural injection of the tattoo should be avoided as it may render subsequent surgery more difficult.

- Small pieces of resected tissue can be suctioned through the scope into the retrieval trap (Fig. 2B). A single remaining large piece can be grasped with the snare. Multiple larger pieces can be grasped with a Roth retrieval basket (Fig. 2A). The catheter can be advanced few centimeters beyond the colonoscope tip, which allows colonic examination during withdrawal (Fig. 14E).

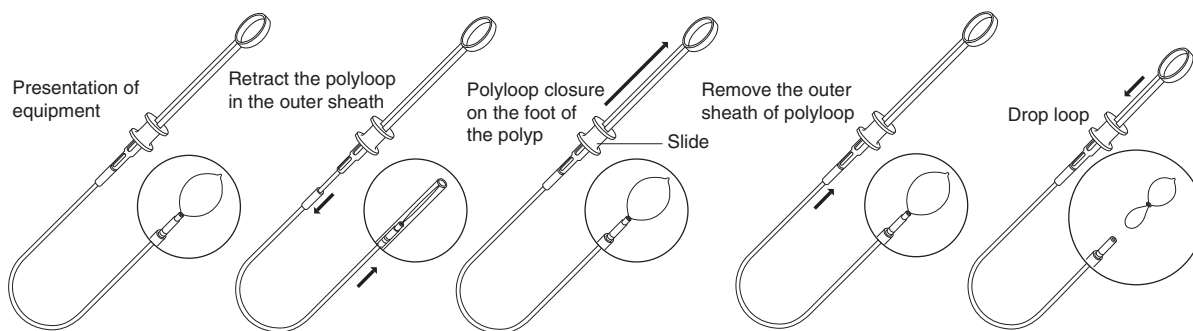


Figure 9 Use of detachable loops.

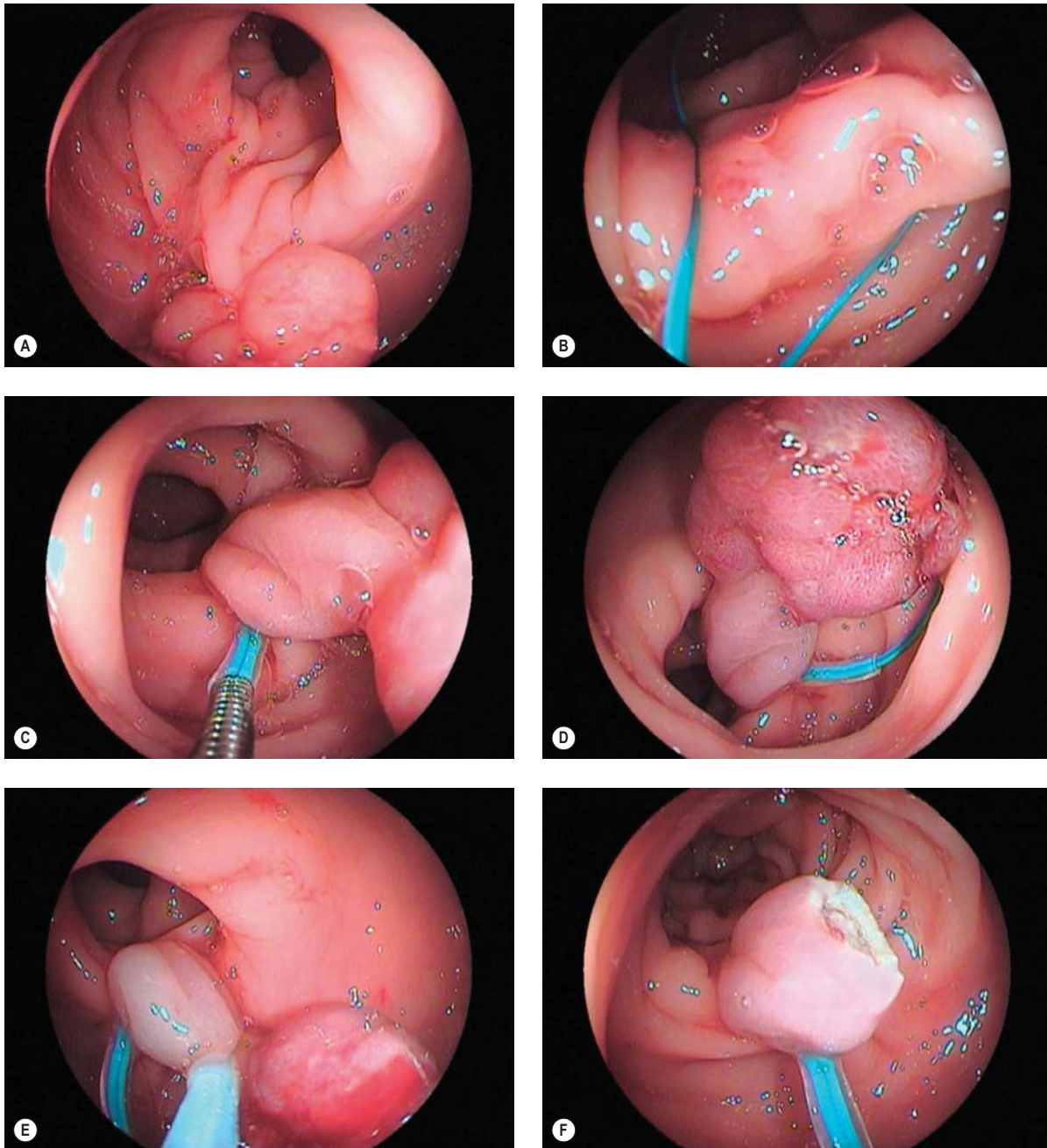


Figure 10 A-F Placement of detachable loop around the pedicle of a large pedunculated polyp.

- Guidelines recommend inspection of the polypectomy site 2–6 months after resection, followed by a second examination 1 year later. The polypectomy scar should be biopsied at follow-up even if macroscopic recurrence is not present. Negative scar biopsy specimen at the first follow-up is predictive of long-term eradication.

6. Special clinical situations

6.1. Malignant polyps

- In general, all malignant colon polyps are best treated surgically.

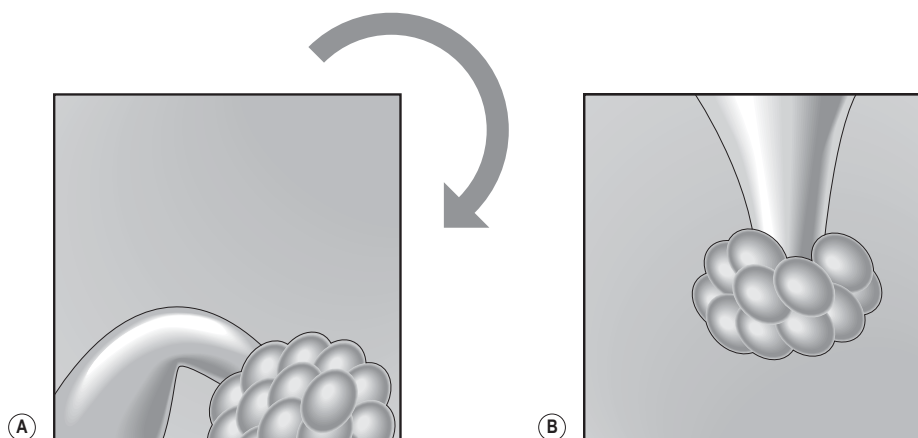


Figure 11 Snaring a large pedunculated polyp. (A) The orientation of the polyp is poor. (B) The patient is repositioned, which improves the orientation of the polyp.

- Some malignant pedunculated polyps with favorable histology can be treated endoscopically.
 - Favorable histology: well-differentiated and moderately-differentiated adenocarcinoma
 - Unfavorable histology: poorly-differentiated adenocarcinoma, mucinous adenocarcinoma, and signet-ring cell carcinoma
 - Carcinoma involving the head of the polyp (above the junction between the adenoma and its stalk), the neck of the polyp (junction between adenoma and its stalk), or the proximal part of the stalk (given that the lower resection margin of the stalk is free of cancer), may be treated with endoscopic resection
 - Carcinoma invading into the submucosa of the bowel wall below the stalk should be surgically resected
 - No surgery is required for cases where the tumor infiltration extends $<1000\ \mu\text{m}$ into submucosal and is well- or moderately-differentiated adenocarcinoma with no lymphatic involvement.

Warning!

Great care must be taken when performing a polypectomy when a clip has been placed. It is important to ensure that the diathermy loop does not touch the clip, as if this occurs, the current will be transmitted through the clip and may cause perforation.

 The diagram shows a diathermy loop (a wire with a red arrow pointing towards it) approaching a clip that is attached to a polyp. A red starburst is shown at the point where the diathermy loop touches the clip, indicating a dangerous situation that could lead to perforation.

7. Complications

7.1. Hemorrhage

- This is the most common complication of polypectomy and can be immediate or delayed. Immediate bleeding is more common with cutting or blended current while

Box 3 Submucosal injection: technique and advantages

- The ideal solution, which will result in substantial bulge and will not dissipate quickly, has not been defined. Most experts in the USA use saline.
- Other solutions used for submucosal injection include hypertonic saline, 50% dextrose sodium hyaluronate, hydroxypropyl methylcellulose (artificial tears), fibrinogen and blood.
- Methylene blue or indigo carmine can be added to the injection solution to delineate the injected mound and to demarcate the edges of the polyp.
- Inclusion of epinephrine in the submucosal injection solution decreases the risk of immediate post-polypectomy bleeding but increases the risk of delayed bleeding.
- Although submucosal injection has been shown to decrease injury to the muscularis propria in an animal model, there is no controlled evidence that it decreases perforation rate in humans.
- The only contraindication for submucosal injection is presence of surface ulceration because of the theoretical risk of tumor seeding if carcinoma is present. Tumor seeding has only been reported in one patient.
- The easiest way to locate the submucosal space is to start injecting before puncturing the mucosal surface. The polyp will lift when the needle enters the submucosal space, which is the only compartment that will accommodate fluid due to the presence of areolar tissue.
- In most cases, injection should begin through the polyp. Injection into the distal (close to the scope) should be avoided, because a large bleb may render the polyp hard to visualize.
- When most of the polyp is hidden from view behind a fold or wrapped around a fold in clamshell fashion, fluid should be injected into the normal mucosa at the proximal (far) edge of the polyp.

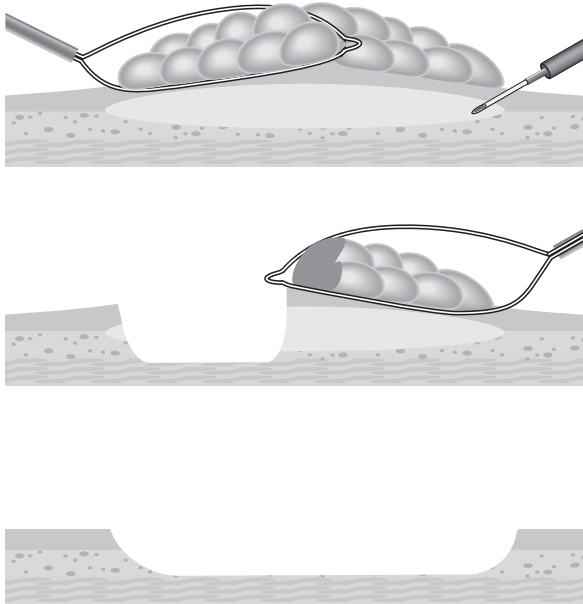


Figure 12 Piecemeal resection of a sessile polyp. Submucosal injection is performed to raise the polyp. The polyp is then removed piece by piece until fully resected.

delayed bleeding is more common with coagulation current. Delayed bleeding can occur up to 1 month after polypectomy.

- The overall risk is about 1–2% for snare polypectomy.
- Risk factors for bleeding include coagulopathy, large polyp size, and proximal polyp location.
- Immediate hemorrhage can be treated with epinephrine injection, bipolar electrocautery, and/or clip placement (Fig. 15, Table 3).
- Approximately 70% of patients with delayed hemorrhage stop bleeding spontaneously, as evidenced by decreasing frequency or cessation of stooling, and can be managed conservatively.
- Colonoscopy should be performed urgently in patients with active hemorrhage. Since the location (s) of polypectomy site(s) are known a priori, colonoscopy

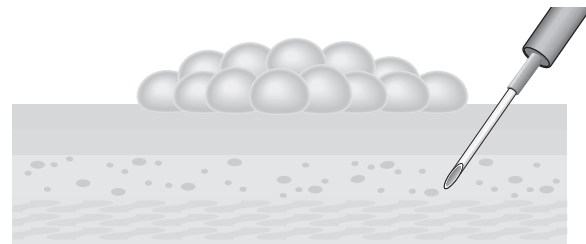
Table 3 Treatment of immediate post-polypectomy bleeding

| Methods | Comments |
|--|--|
| Grasp the stalk with the snare | Hold for stalk for few minutes Do not transect the remaining stalk |
| Inject the stalk with epinephrine | Therapeutic effect is by vasoconstriction and tamponade |
| Apply coaptive coagulation with bipolar electrocautery | Bleeding vessel is tamponaded and sealed by a protein coagulum |
| Place detachable snare around stalk | This method may be cumbersome and impractical in the case of vigorous bleeding |
| Place hemoclips over the bleeding vessel | Efficient method for treating post-polypectomy hemorrhage |

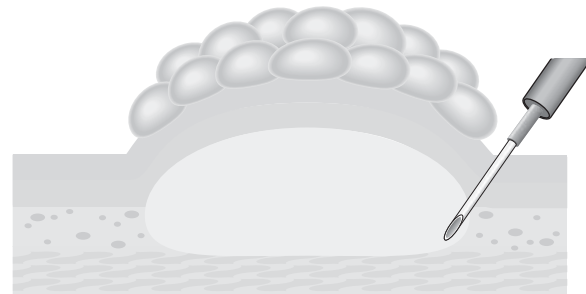
may be performed without bowel purging. Bleeding is best treated with epinephrine injection and clip placement, since thermal therapy can potentially extend tissue injury.

7.2. Post-polypectomy syndrome and perforation

- Post-polypectomy syndrome, also known as transmural burn syndrome, results from transmural burn due to electrocautery but without free perforation. Patients present with abdominal pain (often with rebound



(A)



(B)



(C)

Figure 13 How to perform submucosal injection. (A) Injection should begin through the polyp. Injection into the distal (close to the scope) should be avoided, because a large bleb may render the polyp hard to visualize. When most of the polyp is hidden from view behind a fold or wrapped around a fold in clamshell fashion, fluid should be injected into the normal mucosa at the proximal (far) edge of the polyp. (B) Continue injection until the polyp has been raised. This indicates that there is no invasion of the muscularis propria. (C) Submucosal injection of a polyp.

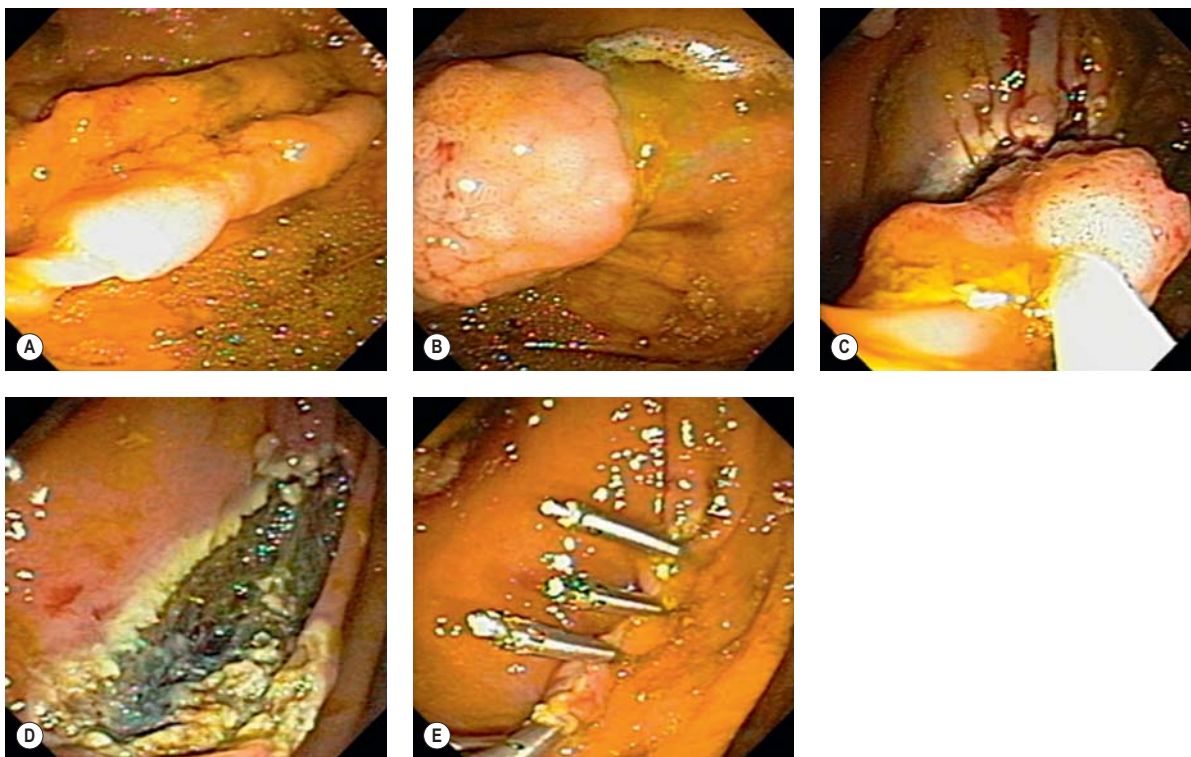


Figure 14 Piecemeal resection of a 35 mm sessile cecal polyp. (A) Large sessile cecal polyp; (B) after submucosal injection; (C) during piecemeal resection; (D) after resection and treatment with APC and (E) after polypectomy site closure with clips.

tenderness), fever, and leukocytosis. Abdominal imaging may reveal air in the bowel wall but not free air in the abdomen, as seen with free perforations.

- Abdominal computed tomography (CT) should be obtained in patients with high suspicion for perforation even if abdominal radiographs are non-revealing.
- Management of post-polypectomy syndrome includes nil per os, antibiotics, and surgical consultation. In properly managed patients, the risk of evolution to frank perforation is low.

- Endoscopic clipping may be useful in closing small perforations that are recognized immediately.

Most patients with colon perforations are treated surgically, although successful conservative management has been reported.

Patients with polyps require surveillance colonoscopy. Guidelines can be found in Table 4.

Table 4 Guidelines for surveillance of small adenomas

| | Surveillance period |
|--|---------------------------------------|
| Patients with 1 or 2 small adenomas | 5 years after initial polypectomy |
| Patients with 3–10 small adenomas | 3 years after initial polypectomy |
| Patients with >10 small adenomas | <3 years after initial polypectomy |
| Patients with any adenoma with villous features or with high-grade dysplasia | 3 years after initial polypectomy |
| Patients with adenomas that are removed piecemeal | 2–6 months to verify complete removal |

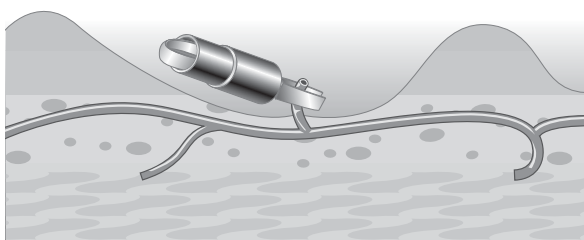


Figure 15 Clip placement. A clip has been placed across a bleeding vessel following polypectomy.

Further reading

- Anderson MA, Ben-Menachem T, Gan SI, et al: Management of antithrombotic agents for endoscopic procedures, *Gastrointest Endosc* 70:1060–1070, 2009.
- Fatima H, Rex DK: Minimizing endoscopic complications: colonoscopic polypectomy, *Gastrointest Endosc Clin N Am* 17:145–156, viii, 2007.
- Haggitt RC, Glotzbach RE, Soffer EE, et al: Prognostic factors in colorectal carcinomas arising in adenomas: implications for lesions removed by endoscopic polypectomy, *Gastroenterology* 89:328–336, 1985.
- Herrera S, Bordas JM, Llach J, et al: The beneficial effects of argon plasma coagulation in the management of different types of gastric vascular ectasia lesions in patients admitted for GI hemorrhage, *Gastrointest Endosc* 68:440–446, 2008.
- Khashab M, Eid E, Rusche M, et al: Incidence and predictors of 'late' recurrences after endoscopic piecemeal resection of large sessile adenomas, *Gastrointest Endosc* 70:344–349, 2009.
- Levin TR, Zhao W, Conell C, et al: Complications of colonoscopy in an integrated health care delivery system, *Ann Intern Med* 145:880–886, 2006.
- Norton ID, Wang L, Levine SA, et al: Efficacy of colonic submucosal saline solution injection for the reduction of iatrogenic thermal injury, *Gastrointest Endosc* 56:95–99, 2002.
- Rex DK: Narrow-band imaging without optical magnification for histologic analysis of colorectal polyps, *Gastroenterology* 136:1174–1181, 2009.
- Uno Y, Munakata A: The non-lifting sign of invasive colon cancer, *Gastrointest Endosc* 40:485–489, 1994.
- Winawer SJ, Zauber AG, Ho MN, et al: Prevention of colorectal cancer by colonoscopic polypectomy. The National Polyp Study Workgroup, *N Engl J Med* 329:1977–1981, 1993.