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CLINICAL PRACTICE UPDATES

AGA Clinical Practice Update on Appropriate and Tailored Polypectomy: Expert Review

Andrew P. Copland,[1] Charles J. Kahi,[2] Cynthia W. Ko,[3] and Gregory G. Ginsberg[4]

[1]Division of Gastroenterology and Hepatology, University of Virginia Health System, Charlottesville, Virginia; [2]Indiana University School of Medicine, Richard L. Roudebush VA Medical Center, Indianapolis, Indiana; [3]Department of Medicine, University of Washington School of Medicine, Seattle, Washington; and [4]Division of Gastroenterology, Department of Medicine, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania

DESCRIPTION: **In this Clinical Practice Update (CPU), we provide guidance on the appropriate use of different polypectomy techniques. We focus on polyps <2 cm in size that are most commonly encountered by the practicing endoscopist, including use of classification systems to characterize polyps and various polypectomy methods. We review characteristics of polyps that require complex polypectomy techniques and provide guidance on which types of polyps require more advanced management by a therapeutic endoscopist or surgeon. This CPU does not provide a detailed review of complex polypectomy techniques, such as endoscopic submucosal dissection, which should only be performed by endoscopists with advanced training.**

METHODS: **This expert review was commissioned and approved by the American Gastroenterological Association (AGA) Institute CPU Committee and the AGA Governing Board to provide timely guidance on a topic of high clinical importance to the AGA membership, and underwent internal peer review by the CPU Committee and external peer review through standard procedures of *Clinical Gastroenterology and Hepatology*. These Best Practice Advice statements were drawn from a review of the published literature and from expert opinion. Because systematic reviews were not performed, these Best Practice Advice statements do not carry formal ratings regarding the quality of evidence or strength of the presented considerations.**

BEST PRACTICE ADVICE 1: **A structured visual assessment using high-definition white light and/or electronic chromoendoscopy and with photodocumentation should be conducted for all polyps found during routine colonoscopy. Closely inspect colorectal polyps for features of submucosally invasive cancer.**

BEST PRACTICE ADVICE 2: **Use cold snare polypectomy for polyps <10 mm in size. Cold forceps polypectomy can alternatively be used for 1- to 3-mm polyps where cold snare polypectomy is technically difficult.**

BEST PRACTICE ADVICE 3: **Do not use hot forceps polypectomy.**

BEST PRACTICE ADVICE 4: **Clinicians should be familiar with various techniques, such as cold and hot snare polypectomy and endoscopic mucosal resection, to ensure effective, safe, and optimal resection of intermediate-size polyps (10–19 mm).**

BEST PRACTICE ADVICE 5: **Consider using lifting agents or underwater endoscopic mucosal resection for removal of sessile polyps 10–19 mm in size.**

BEST PRACTICE ADVICE 6: **Serrated polyps should be resected using cold resection techniques. Submucosal injection may be helpful for polyps >10 mm if margins cannot be well delineated.**

Abbreviations used in this paper: c-EMR, cold endoscopic mucosal resection; CFP, cold forceps polypectomy; CI, confidence interval; CSP, cold snare polypectomy; EMR, endoscopic mucosal resection; ESG, electrosurgical generator; h-EMR, hot endoscopic mucosal resection; HSP, hot snare polypectomy; NICE, Narrow Band Imaging Colorectal Endoscopic classification; RCT, randomized controlled trial; RR, relative risk; SM, submucosal; SMIC, submucosal invasive cancer; SSL, sessile serrated lesion; u-EMR, underwater endoscopic mucosal resection.

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BEST PRACTICE ADVICE 7:	**Use hot snare polypectomy to remove pedunculated lesions >10 mm in size.**
BEST PRACTICE ADVICE 8:	**Do not routinely use clips to close resection sites for polyps <20 mm.**
BEST PRACTICE ADVICE 9:	**Refer patients with polyps to endoscopic referral centers in the context of size ≥20 mm, challenging polypectomy location, or recurrent polyp at a prior polypectomy site.**
BEST PRACTICE ADVICE 10:	**Tattoo lesions that may need future localization at endoscopy or surgery. Tattoos should be placed in a location that will not interfere with subsequent attempts at endoscopic resection.**
BEST PRACTICE ADVICE 11:	**Refer patients with nonpedunculated polyps with clear evidence of submucosally invasive cancer for surgical evaluation.**
BEST PRACTICE ADVICE 12:	**Understand the endoscopy suite's electrosurgical generator settings appropriate for polypectomy or postpolypectomy thermal techniques.**

Keywords: Colorectal Polyp; Polypectomy; Colonoscopy; Complications; Colorectal Neoplasia.

Adequate identification and resection of polyps is needed to maximize the potential of colonoscopy for colorectal cancer prevention. Polypectomy techniques are continually evolving with improvements in the ability to assess polyps for high-risk features and with development of appropriate procedures for complete and safe polyp resection. For example, the Paris,[1] narrow band imaging endoscopic (NICE),[2] Kudo pit pattern,[3] and Japanese Narrow Band Imaging Expert Team[4] classifications enable endoscopists to determine if polyps have high risk of submucosal (SM) invasion and if colonoscopic polypectomy should be attempted or avoided (Table 1, Supplementary Figures 1–4). These advances imply that endoscopists should be able to appropriately assess polyps and to tailor polypectomy techniques.

This clinical practice update provides guidance in characterizing polyps and choosing appropriate polypectomy techniques for polyps 2 cm or less in size, which comprise most polyps encountered by most endoscopists. Although we outline appropriate polypectomy techniques, endoscopists should not attempt polypectomy if they are not appropriately trained or if they lack appropriate equipment or trained staff to complete the polypectomy safely and to manage any potential complications. We also recognize that this field is rapidly evolving with new studies examining the effectiveness and safety of new techniques.

Best Practice Advice 1: A structured visual assessment using high-definition white light and/or electronic chromoendoscopy and with photodocumentation should be conducted for all polyps found during routine colonoscopy. Closely inspect colorectal polyps for features of submucosally invasive cancer (SMIC).

Using a structured assessment of colorectal lesions, including description of polyp morphology, surface appearance, size, and location, allows for clear communication between endoscopists, helps direct best practice resection techniques, and finally helps identify correct surveillance intervals. All polyps should be photodocumented in the procedure report. The American Gastroenterological Association, in cooperation with the American Society for Gastrointestinal Endoscopy and American College of Gastroenterology, recommends the use of minimal standard terminology for polyp morphology, such as the Paris classification.[5] Application of validated optical diagnosis schemas, such as the NICE classification[2] and WASP criteria[6] (Table 1, Supplementary Figures 1–5), can predict histology to inform resection technique, assess need for referral for advanced resection, or identify lesions with suspected SM invasion, which should not be resected endoscopically. In particular, when SM invasion is deep (>1000 μm into the submucosa), surgical resection is recommended. Morphology and surface assessment are less useful for differentiating depth of invasion <1000 μm where en bloc endoscopic mucosal resection (EMR) or endoscopic SM dissection may be appropriate approaches. Key features where caution should be taken are illustrated in Figure 1. Additional endoscopic characteristics, such as a demarcated area with a NICE 2 neoplastic pit pattern, can also identify sessile serrated lesions (SSLs) with dysplasia.[7] Furthermore, best attempts at accurate description of the size and location of colorectal lesions should be made because studies have identified substantial variation in the assessment of polyp size, which results in a meaningful change in colonoscopy surveillance interval for up to 35.2% of follow-up recommendations.[8,9] Polyp size is commonly estimated by comparison with an open snare or forceps, but methods are in development to allow more accurate sizing.[10–12]

Colorectal polyps with no NICE 3 features have been shown to have a >90% negative predictive value for the absence of deep SM invasion, which would make endoscopic resection inappropriate,[13] whereas 42% of polyps with NICE 3 features have at least SM invasion.[14] In addition to surface features, special morphology features are associated with an increased risk of SMIC. For example, nongranular appearance of lateral-spreading tumors (superficial lesions ≥10 mm with

Table 1. Summary of Polyp Classification Systems

Paris classification[1] [a]		
Endoscopic appearance	Paris class	Description
Protruded lesions	Ip	Pedunculated
	Isp	Subpedunculated
	Is	Sessile
Flat elevated	0-IIa	Flat elevated
	0-IIa + c	Flat elevation with central depression
	0-IIa + Is	Flat elevation with raised broad-based nodule
Flat	0-IIb	Flat
	0-IIc[b]	Superficial shallow, depressed
	0-III	Excavated

Narrow band imaging colorectal endoscopic classification (NICE)[2] [a]			
Criteria	Type 1	Type 2	Type 3[b]
Color	Same or lighter than background	Browner relative to background (verify color arises from vessels)	Brown to dark brown relative to background; sometimes patchy whiter areas
Vessels	None, or isolated lacy vessels may be present coursing across the lesion	Brown vessels surrounding white structures	Areas of disrupted or missing vessels
Surface pattern	Dark or white spots of uniform size, or homogeneous absence of pattern	Oval, tubular, or branched white structures surrounded by brown vessels	Amorphous or absent surface pattern
Most likely histology	Hyperplastic polyp or sessile serrated lesion	Adenoma	Deep submucosal invasive cancer

Workgroup serrated polyps and polyposis (WASP) classification[6,a]			
	Features present Brown color Brown vessels Oval or tubular branched surface pattern	2 or more of the following features present Clouded surface Indistinct border Irregular shape Dark spots inside crypts	Histology
Type 1 polyp	None	No	Hyperplastic polyp
		Yes	Sessile serrated lesion
Type 2 polyp	At least 1 present	No	Adenoma
		Yes	Sessile serrated lesion

Kudo pit pattern classification[3,a]	
Endoscopic features	Kudo type
Round pits	I
Stellar or papillary pits	II
Small tubular or roundish pits	III S
Large tubular or roundish pits	III L
Branch-like or gyrus-like pits	IV

Table 1. Continued

Kudo pit pattern classification[3,a]	
Endoscopic features	Kudo type
Irregular arrangements and sizes of pits	VI[b]
Loss or decrease of pits with amorphous structure	VN[b]

Japan Narrow-Band Imaging Expert Team classification[4,a]				
Criteria	Type 1	Type 2A	Type 2B[b]	Type 3[b]
Vessel pattern	Invisible	Regular caliber and distribution	Variable caliber, irregular distribution	Loose vessel areas, interruption of thick vessels
Surface pattern	Regular dark or white spots similar to surrounding mucosa	Regular tubular or branched or papillary	Irregular or obscure	Amorphous areas
Most likely histology	Hyperplastic or sessile serrated polyp	Low-grade intramucosal neoplasia	High-grade intramucosal neoplasia or superficial submucosal invasive cancer	Deep submucosal invasive cancer

[a]Illustrative images available in Supplementary Figures 1–5.
[b]Associated with higher risk of submucosally invasive cancer.

predominantly lateral, not vertical extension; Supplementary Figure 6) has been associated with substantial risk of SMIC in as much as 31.6% of lesions,[15] whereas Paris classification 0-IIC (depression) is associated with a 27%–35.9% risk of invasive cancer,[5] even among <20 mm lesions, which would ordinarily be accessible to routine polypectomy approaches.[5] Similarly, the rate of SMIC among nongranular flat/raised polyps is 4.9%, whereas rates are much higher (31.6%) when depression in the lesion is noted.[15] Endoscopists should be vigilant for risk factors for SMIC while inspecting all colorectal lesions. Although most of these lesions will not harbor SMIC, greater care should be taken to maximize possibility of a safely performed en bloc resection or to consider referral to an advanced endoscopist.

Best Practice Advice 2: Use cold snare polypectomy (CSP) for polyps <10 mm in size. Cold forceps polypectomy (CFP) can alternatively be used for 1- to 3-mm polyps where CSP is technically difficult.

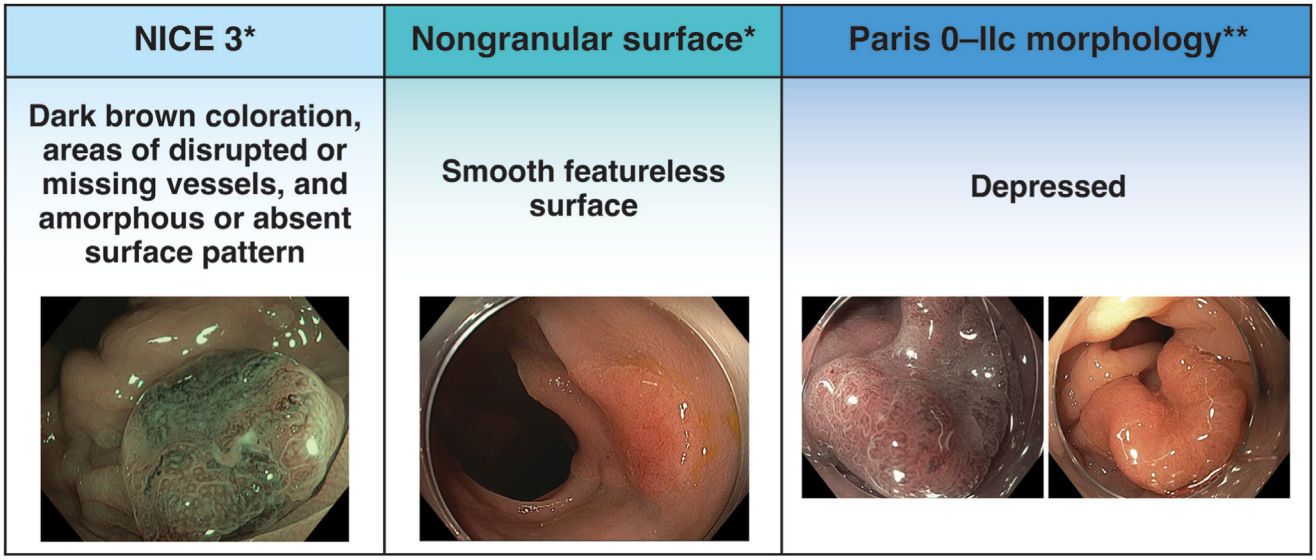

Figure 1. Endoscopic features concerning for submucosally invasive cancer. *Reprinted with permission from Gastroenterology 2020;158:1095–1129 and from **Clin Gastroenterol Hepatol 2022;20:2198–2209.

Most polyps encountered are <10 mm in size, and the risk of high-grade dysplasia or cancer in diminutive (<5 mm) and small (6–9 mm) polyps is quite low.[16] Recent evidence has shown that CSP is safe for removal of diminutive and small polyps with low rates of incomplete polyp removal[17] and risk of complications, leading the US Multi-Society Task Force on Colorectal Cancer to recommend CSP for all polyps <10 mm.[5] For example, in 1 randomized controlled trial (RCT), rates of complete resection of polyps 4–9 mm in size by CSP was 98.2%, with no instances of postpolypectomy bleeding requiring endoscopic intervention.[18] Nevertheless, it can be technically difficult to remove some 1- to 3-mm polyps by CSP. Many endoscopists use CFP for these polyps. In prior literature, CFP was associated with higher incomplete polypectomy rates compared with CSP, with incomplete resection rates of 9.9% versus 4.4%, respectively, for 1- to 5-mm polyps.[19] Because of such data, guidelines have generally recommended against CFP.[5] However, a recent RCT showed that CFP for ≤3-mm polyps using a large capacity forceps had noninferior rates of complete polypectomy (1.7% with both techniques) with shorter polypectomy times compared with CSP.[20] This suggests that CFP could be applied selectively for ≤3 mm polyps. In this setting, large capacity or jumbo forceps should be used over standard forceps,[21–23] and careful inspection of the polypectomy site is needed to ensure complete removal.

Polyps of 6–9 mm can also be safely removed with CSP with improved complete polypectomy rates and safety profiles, and decreased procedure times, compared with hot snare polypectomy (HSP).[18,24–27] Therefore, HSP should no longer be used for polyps <10 mm in size. As previously mentioned, CFP for small polyps is associated with high incomplete polypectomy rates and should be avoided.

The technique of CSP differs from that of HSP (Video 1).[28,29] Ideally, the polyp should be positioned at the 5:00 position. The snare should be opened with the tip against the mucosa proximal to the polyp. The endoscope tip should be deflected downward to apply gentle pressure against the mucosa while the snare is gradually closed. Gentle forward pressure and suction can be applied to avoid slippage of the snare during closure. Once the snare is closed with a 1-to-several millimeter rim of normal tissue, the polyp can be resected by fully closing the snare. Unlike with HSP, the polyp should not be tented upward during resection. Postpolypectomy oozing is common but usually ceases spontaneously. If the polyp is positioned at the 5:00 position and the mucosa is not tented during snare closure, the specimen typically remains in place and can be retrieved by suctioning into a trap. Other techniques to improve polyp retrieval include removing water and debris before polypectomy and pulling the polyp into suction channel during resection.[30]

Multiple different polypectomy snares are available, and guidance on which snare to choose is limited. Dedicated cold snares have a thinner, braided wire and stiffer catheter, and may provide better complete resection rates especially for polyps 8–10 mm in size.[31] Further research is needed to define the optimal snare characteristics for CSP.

Best Practice Advice 3: Do not use hot forceps polypectomy.

Hot forceps polypectomy for diminutive and small polyps is associated with higher incomplete polyp removal rates compared with CSP. It is also associated with higher risks of postpolypectomy hemorrhage, particularly in the right colon with higher risks of deep thermal injury.[32–34] Therefore, the use of hot forceps polypectomy is discouraged.

Best Practice Advice 4: Clinicians should be familiar with various techniques, such as CSP and HSP and EMR, to ensure effective, safe, and optimal resection of intermediate-size polyps (10–19 mm).

Appropriate polypectomy methods are relatively better defined for small and diminutive polyps (<10 mm) and for large polyps (≥20 mm) than they are for intermediate-size polyps (10–19 mm). CSP is the standard of care for small and diminutive polyps, and there is increasing interest in expanding cold resection techniques to intermediate-size nonpedunculated polyps (10–19 mm) because of the improved safety profile compared with electrocautery techniques.[27,35] However, current guidelines have been limited by relatively sparse and low-quality evidence, leading to inconsistent recommendations: the European Society of Gastrointestinal Endoscopy recommends HSP with or without SM injection,[36] whereas the US Multi-Society Task Force on Colorectal Cancer[5] suggests HSP or CSP with or without SM injection. In making the decision whether to use cold or hot resection, as with larger polyps (≥20 mm), a critical first step is ensuring that the lesion does not have overt features of SMIC. Endoscopists should then consider several factors including size within the 10- to 19-mm category, morphology, bulkiness, and histology, and balance the risk of immediate and delayed complications with that of incomplete resection. In general, a larger polyp (on the upper end of the 10- to 19-mm range), with sessile morphology, more bulk, and adenomatous histology is less likely to be effectively removed using cold resection. Such polyps can be difficult or impossible to transect en bloc with a cold snare, and may require piecemeal resection. The proper technique for piecemeal resection of intermediate-sized polyps continues to be clarified.[35,37] Conversely, flat polyps (Paris IIa or IIb) and serrated lesions can be effectively and safely removed with cold resection, and in this setting cold EMR (c-EMR) is preferable.[5] Other techniques, such as underwater EMR (u-EMR), are also being developed with ongoing comparisons with c-EMR.[38] Further studies are needed to define the optimal resection technique for intermediate-sized polyps in routine practice, and the choice of resection technique should be based on obtaining complete resection with adequate margins while minimizing complications.

Best Practice Advice 5: Consider using lifting agents or u-EMR for removal of sessile polyps 10–19 mm in size.

SM injection, typically with a contrast agent, such as methylene blue or indigo carmine, is standard practice when performing EMR, particularly for large (≥20 mm) lesions (Video 2).[5] There are several available SM injectant options, and a comparison of their features is beyond the scope of this review. A SM cushion with a contrast dye allows better delineation of lesions with indistinct borders, which is particularly relevant for SSLs. In theory, the contrast agent helps to maintain a correct resection plane and may decrease the risk of deep mural injury. Finally, SM injection may facilitate transection and decrease immediate bleeding via a tamponade effect. However, despite its frequent use, there is little evidence that SM injection is beneficial for polyps ≤19 mm in size.[39,40] u-EMR is an alternative technique for intermediate-sized polyps. This technique incorporates immersion of the entire lumen in water and snare resection without SM injection. In prospective trials, u-EMR has demonstrated equivalent or better complete resection and recurrence rates with similar procedure times and adverse event rates compared with conventional EMR.[38,41,42]

Best Practice Advice 6: Serrated polyps should be resected using cold resection techniques. SM injection may be helpful for polyps >10 mm if margins cannot be well delineated.

A critical factor if cold resection is considered for intermediate-size polyps is rigorous technique, which has been shown to be the single most important determinant of successful complete resection, beyond considerations related to equipment and snare properties.[37] Most studies reporting high rates of complete resection were done by experts, and it is not yet clear how cold resection for intermediate polyps will fare in routine clinical practice. Optimal CSP techniques have been described by experts in numerous reviews.[28,29]

An RCT compared the efficacy of CSP, c-EMR, and conventional hot-EMR (h-EMR) for 763 polyps 6–20 mm in size.[43] Complete resection rates were 81.6%, 94.1%, and 95.5%, respectively; however, the cold snare failures depended on polyp size, with a 53% incomplete resection rate in the 16–20 mm size range. In this study, as expected, immediate bleeding was more frequent in the cold resection arms (9.4% for CSP and 4.4% for c-EMR, compared with 1.4% for h-EMR), whereas delayed bleeding was more common for h-EMR (2.6%, vs 0.8% for CSP and 1.2% for c-EMR). A prospective study found that the incomplete resection rate after CSP of 440 neoplastic polyps was 2.3%, but was not significantly different for polyps 5–9 mm (2%) compared with 10–15 mm (3.5%).[44] A recent noninferiority RCT included 286 polyps 6–15 mm in size, randomized to CSP, c-EMR, HSP, or h-EMR, and reported an overall incomplete resection rate of 2.4%.[40] The 7 incompletely removed polyps were all 10–15 mm in size, and 6 of the 7 were resected using HSP or h-EMR. There were 27 and 35 polyps of 10–15 mm removed using CSP and c-EMR; there were no incomplete resections in the CSP group, and only 1 in the c-EMR group. In addition, there were no serious adverse events in the CSP group, and resection time was significantly shorter (mean, 60 seconds for CSP vs 100–174 seconds for the other 3 groups).

Substantial literature supports the preferential use of cold resection techniques (CSP or c-EMR) for SSLs ≥10 mm, with practically no upper size limit (Video 3).[45–50] The studies are heterogeneous, with different patient populations, study design, polyp histology (SSL alone or SSL with adenomas), and resection techniques. Piecemeal resection was frequently required. However, proper piecemeal technique can still provide complete resection with negative margins.[35] Most studies used SM injection to allow better delineation of lesion borders, and thus ensure a clear resection margin of at least 2 mm. Despite study heterogeneity, there were several consistent observations, including low rates of recurrence (0%–10%), low rates of immediate postpolypectomy bleeding (0%–3%), and no perforations. In 1 large series, c-EMR was as effective as conventional h-EMR for resection of large SSLs, but virtually eliminated the risks of bleeding and deep mural injury, which with h-EMR were 5.1% and 3.4%, respectively.[50] One study even found that CSP without SM injection was feasible and safe for selected SSLs ≥10 mm.[39] Conversely, in another prospective study of 80 adenomas 10–14 mm in size, en bloc c-EMR failed in 14% of cases and had to be converted to electrocautery-assisted resection.[51]

Overall, the available evidence shows that cold resection can be considered for most polyps 10–15 mm, and may be reasonable for all SSLs ≥10 mm in size. HSP, with or without SM injection, should be considered for larger/bulkier adenomas in the 10- to 19-mm range. Ongoing RCTs should help further clarify the most appropriate polypectomy techniques in the intermediate-size range. The optimal surveillance protocols after c-EMR of intermediate-sized polyps remains to be defined, but the choice of surveillance interval should account for the endoscopist's confidence of complete resection.

Best Practice Advice 7: Use HSP to remove pedunculated lesions >10 mm in size.

Pedunculated polyps contain a feeding blood vessel within the lesion stalk, and HSP is recommended to decrease the risk of immediate bleeding. Polyps should be transected low enough on the stalk to allow appropriate resection margin and pathologic evaluation.[52] Although emerging literature suggests that CSP is reasonable for small (<10 mm) pedunculated polyps with a thin stalk, this is not advisable (and often not feasible) for larger lesions.[53] Polyp size ≥10 mm and stalk diameter ≥5 mm are known risk factors for bleeding, and pedunculated polyps with these features should be resected using a hot snare. Prophylactic measures, such as epinephrine injection into the stalk or prophylactic placement of detachable nylon loops or standard clips, are recommended to decrease the rate of immediate and delayed bleeding, particularly for pedunculated polyps with heads ≥20 mm and/or stalks ≥5 mm.[5,54,55]

Best Practice Advice 8: Do not routinely use clips to close resection sites for polyps <20 mm.

Several RCTs and prospective cohort studies support the selective use of clips to prevent postpolypectomy bleeding; however, the benefit of prophylactic clipping seems limited to polyps ≥20 mm located in the proximal colon.[56–59] A multicenter Japanese RCT that included 3365 polyps <20 mm showed no significant difference in postpolypectomy bleeding rates between the clip (1.10%) and the nonclip groups (0.87%).[56] Another recent RCT where about 80% of polyps were in the 10–20 mm size range also reported no benefit for prophylactic clipping among 1050 patients (2.3% vs 2.9%; relative risk [RR], 0.79; 95% confidence interval [CI], 0.37–1.66).[57] A meta-analysis of 9 RCTs comprising nearly 72,000 polyps (of which 22.5% were ≥20 mm) showed no significant difference in rates of bleeding (2.2% with clip vs 3.3% with no clip; RR, 0.69; 95% CI, 0.45–1.08).[58] In a subgroup analysis based on polyp size, clipping was beneficial for polyps ≥20 mm (RR, 0.51; 95% CI, 0.33–0.78), but not for polyps <20 mm (RR, 1.04; 95% CI, 0.60–1.79). In an individual patient data meta-analysis that included nearly 9000 polypectomies, prophylactic clipping reduced delayed bleeding in proximal polyps ≥20 mm by 38% (adjusted odds ratio, 0.62; 95% CI, 0.44–0.88), and the effect was more marked for patients on antithrombotics.[60] Conversely, for polyps <20 mm (n = 5030), there was no benefit for clipping regardless of polyp location or whether the patient was on antithrombotics (adjusted odds ratio, 1.05; 95% CI, 0.76–1.44).

In addition to size and location, polyp histology also seems to be a factor associated with delayed bleeding risk. A post hoc analysis of an RCT of prophylactic clipping after EMR of ≥20-mm polyps showed low bleeding rates for serrated polyps (2.8% vs 5.8% for adenomas), and the risk was not affected by clipping.[61] Although there are no similar direct data for serrated polyps 10–19 mm in size, it is logical to assume that intermediate-size serrated polyps also have low risk of bleeding and do not require clipping.

Although there likely are situations where clipping may be appropriate based on clinical judgment and individual patient characteristics, do not routinely use clips to close resection sites for polyps <20 mm.

Best Practice Advice 9: Refer patients to endoscopic referral centers in the context of size ≥20 mm, challenging polypectomy location, or recurrent polyp at a prior polypectomy site.

Most polyps identified during colonoscopy are <20 mm in size. Most neoplastic colonic polyps <20 mm in size can and should be completely (curatively) resected endoscopically. Colonoscopists should possess the skill sets to identify, characterize, document, and curatively resect most neoplastic colonic polyps <20 mm in size. However, there are several circumstances that may render a colonic polyp <20 mm in size unsuitable for routine polypectomy. Moreover, polyp resection should only be undertaken with the expectation of complete and curative resection. Polypectomy should not be initiated if the endoscopist lacks the time, equipment, or confidence to complete curative resection. This avoids referral after incomplete resection, which is associated with increased risk for adverse events and technical failure.

Some polyps <20 mm in size are not amenable to standard colonoscopic resection techniques.[62] Examples include: pedunculated polyps with long pedicles that cannot be negotiated; polyps in spastic, diverticular-ridden segments; polyps positioned behind folds or at articulations such that the entire lesion cannot be visualized or accessed for resection; polyps that penetrate the appendiceal or diverticular orifices; polyps that extend to the dentate line; and polyps that extend into or beneath the ileocecal valve. Because most of these polyps can be removed by endoscopists skilled in advanced/adjunctive endoscopic resection techniques, these patients should be referred to an advanced endoscopist before considering surgical resection.

All neoplastic colonic polyps and polyps of uncertain neoplastic potential <20 mm in size that are deemed unsuitable for routine colonoscopic resection should be referred to an endoscopist skilled in advanced endoscopic resection techniques before being referred for operative resection.[63] Surgical referral is not indicated unless there are overt signs of cancer. The lesion should undergo thorough photodocumentation (as described previously). Limited cold forceps biopsy tissue sampling should be performed to confirm histology. However, excessive cold biopsy forceps tissue sampling and partial cold or thermal snare resection should be avoided because these maneuvers may promote scarring and fibrosis that makes subsequent attempt at curative resection more difficult. The lesion location should be estimated as to its anatomic location within the colon and be clearly documented in relationship to fixed anatomic structures (eg, appendiceal orifice, ileocecal valve, anal verge) or marked with tattooing (discussed next) for subsequent endoscopic or intraoperative identification.

Best Practice Advice 10: Tattoo lesions that may need future localization at endoscopy or surgery. Tattoos should be placed in a location that will not interfere with subsequent attempts at endoscopic removal.

Colonoscopic tattooing is performed to assist in the localization of a lesion within the colon for subsequent endoscopic or operative address.[64,65] Commercially available inert injection agents are preferred because they are less apt to promote an inflammatory response. The tattoo agent is intended to be injected via a 22- to 25-gauge needle into the SM space. Tattoos should be placed at 2–3 separate locations 3–5 cm distal to the lesion.[5] The orientation of the tattoos in relationship to the lesion should be documented in the procedure report (eg, tattoos were placed in 3 applications, 2 cm distal to the lesion). Care should be taken to create the tattoos ≥2 cm away from the lesion so as to not promote an undermining fibroinflammatory response that may thwart subsequent attempts at colonoscopic resection. Tattoos may not be

necessary if the lesions are in close proximity to clear anatomic landmarks, such as the cecum, ileocecal valve, or rectum,5 or based on the judgment of the endoscopist.

Best Practice Advice 11: Refer patients with nonpedunculated polyps with clear evidence of SMIC for surgical evaluation.

Referral to a qualified surgeon for consideration of operative resection for a colonic polyp <20 mm in size is uncommon but should be considered for the following: overt evidence of deep invasive carcinoma, such as firm, fixed, ulcerated lesion; NICE type 3 (amorphous or absent surface pattern, areas of disrupted or missing vessels); Paris classification type III (excavated); and lesions that extend deeply into the appendix.

Limited cold forceps biopsy tissue sampling of the most suspicious areas should be performed to confirm degree of dysplasia and/or presence of carcinoma. The lesion location should be estimated as to its anatomic location within the colon and be clearly documented in relationship to fixed anatomic structures (eg, appendiceal orifice, ileocecal valve, anal verge) or marked with tattooing for intraoperative identification. If a tattoo is being placed for surgical localization, it should be targeted in line with and on the opposite lumen wall of the lesion.[5]

Best Practice Advice 12: Understand the endoscopy suite's electrosurgical generator (ESG) settings appropriate for polypectomy or postpolypectomy thermal techniques.

The ESG is an important tool in conducting safe resection of some colorectal lesions and management of periprocedural bleeding. A firm understanding of the principles of electrocautery and settings for particular ESG is critical to safe execution. For polyps <20 mm, snare electrocautery is usually used to facilitate transection of pedunculated polyp stalks and to help ensure en bloc resection where too large an area of tissue is grasped to complete cold resection. It should be emphasized that the use of electrocautery is a risk factor for postpolypectomy bleeding and mural injury and that current recommendations increasingly recommend CSP, particularly for <20 mm nonpedunculated colorectal polyps, as described previously. Insufficient data exist to make a specific recommendation for electrocautery settings, and the choice of settings relies on the endoscopist's preference and experience. Blended currents and coagulating currents are the most commonly used,[66] and pure cutting currents are discouraged because of the rapidity of transection and increased likelihood of immediate bleeding requiring further intervention.[67] Data on pathologic specimens have suggested that conventional ESG blended currents may result in better margin evaluability (75.7% vs 60.3%; $P = .046$) compared with microprocessor-controlled blended currents, although the clinical relevance of this among low-risk polyps is unclear.[68] A recent RCT of pure coagulating and microprocessor-controlled blended current settings among ≥20 mm nonpedunculated polyps demonstrated similar adverse event rates and resection rates with the exception of an increase in immediate bleeding requiring further intervention in the blended current group.[69] Regardless of the settings chosen, it is important to understand the usual therapeutic settings for the endoscopy suite's specific ESG. To help ensure consistency and avoid errors, saved and clearly labeled programs should be consistent across the ESGs in an endoscopy suite.

Conclusions

The understanding of appropriate polypectomy techniques continues to evolve, and polypectomy techniques have advanced so that most polyps are able to be removed. Endoscopists should be familiar with classification schemes that can predict polyp histology and be able to recognize features suggestive of SMIC. Correct assessment of the size, morphology, and potential high-risk features of polyps allows endoscopists to choose polypectomy techniques that maximize complete resection while reducing complications. Endoscopists should also recognize when patients should be referred to advanced endoscopy or surgical centers for appropriate management. Referral to surgery should be reserved only for lesions with overt signs of SMIC or in difficult anatomic locations, whereas many complex polyps can be managed by endoscopists proficient in advanced resection techniques. Ongoing research will allow further tailoring of polypectomy techniques to improve patient outcomes.

Supplementary Material

Note: To access the supplementary material accompanying this article, visit the online version of *Clinical Gastroenterology and Hepatology* at www.cghjournal.org, and at http://doi.org/10.1016/j.cgh.2023.10.012.

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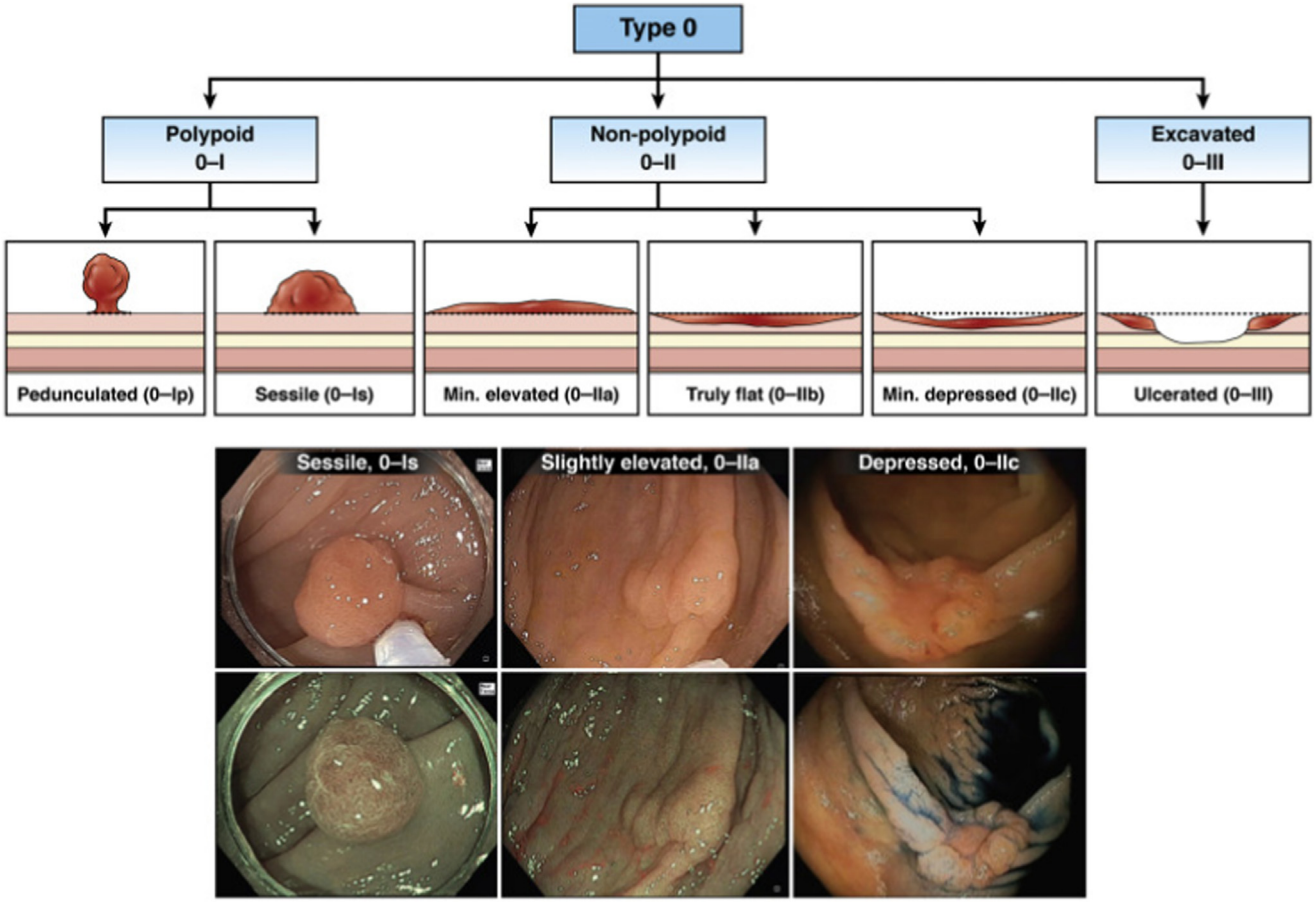
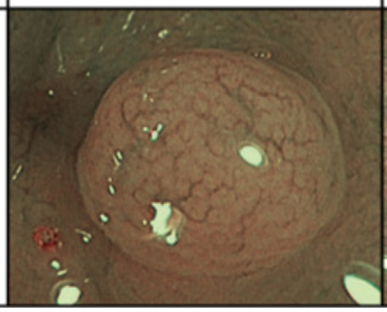
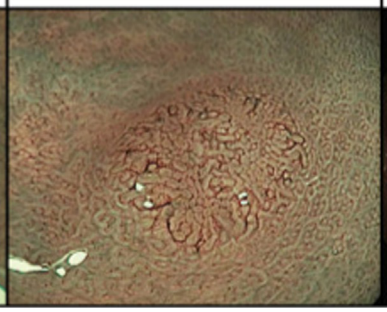
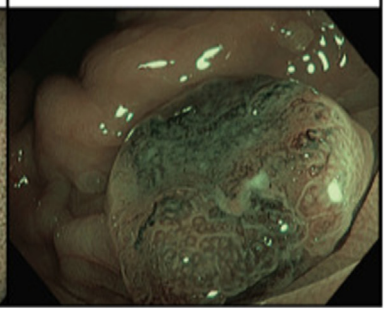
Correspondence
Address correspondence to: Cynthia W. Ko, MD, Division of Gastroenterology, Box 356424, University of Washington, Seattle, Washington 98195. e-mail: cwko@uw.edu.

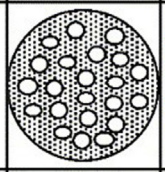
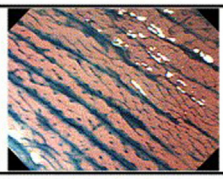
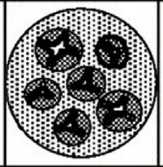
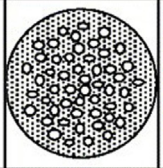
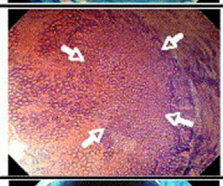
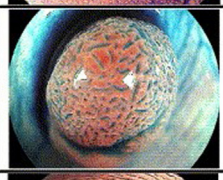
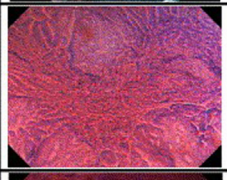
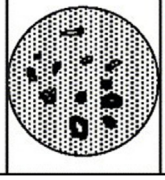
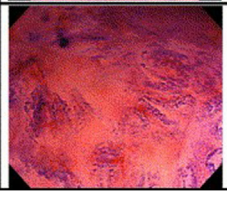
Conflicts of interest
The authors disclose the following: Andrew P. Copland is a member of the American College of Gastroenterology and the American Society for Gastrointestinal Endoscopy. Charles J. Kahi is a member of the American College of Gastroenterology and the American Society for Gastrointestinal Endoscopy. Cynthia W. Ko is a member of American College of Gastroenterology. Gregory G. Ginsberg has a financial relationship with commercial interests with Olympus Inc, Boston Scientific Corp, GIE Medical, and Cook Medical; received personal income/renumeration from Olympus Inc; and is a member of the American Society for Gastrointestinal Endoscopy, American College of Gastroenterology, and European Society of Gastrointestinal Endoscopy who all have guidelines pertaining to the topic.



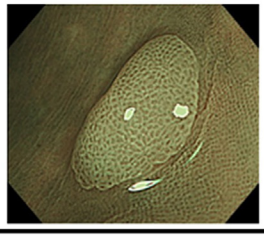
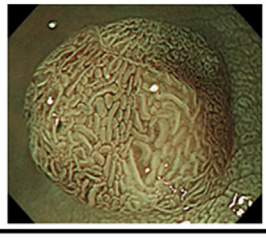
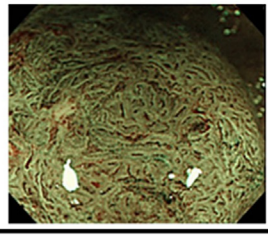
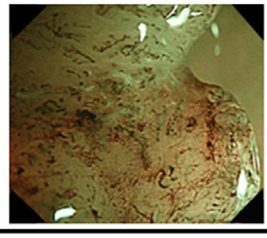
Supplementary Figure 1. Paris classification of colorectal polyps. Reprinted with permission from Kaltenbach T, et al. Endoscopic removal of colorectal lesions – recommendations by the US Multi-Society Task Force on Colorectal Cancer. Gastroenterology 2020;158:1095–1129.

	Type 1	Type 2	Type 3
Color	Same or lighter than background	Browner relative to background (verify color arises from vessels)	Brown to dark brown relative to background; sometimes patchy whiter areas
Vessels	None, or isolated lacy vessels may be present coursing across the lesion	Brown vessels surrounding white structures**	Has area(s) of disrupted or missing vessels
Surface pattern	Dark or white spots of uniform size, or homogeneous absence of pattern	Oval, tubular, or branched white structures** surrounded by brown vessels	Amorphous or absent surface pattern
Most likely pathology	Hyperplastic and sessile serrated lesions***	Adenoma****	Deep submucosal invasive cancer
			

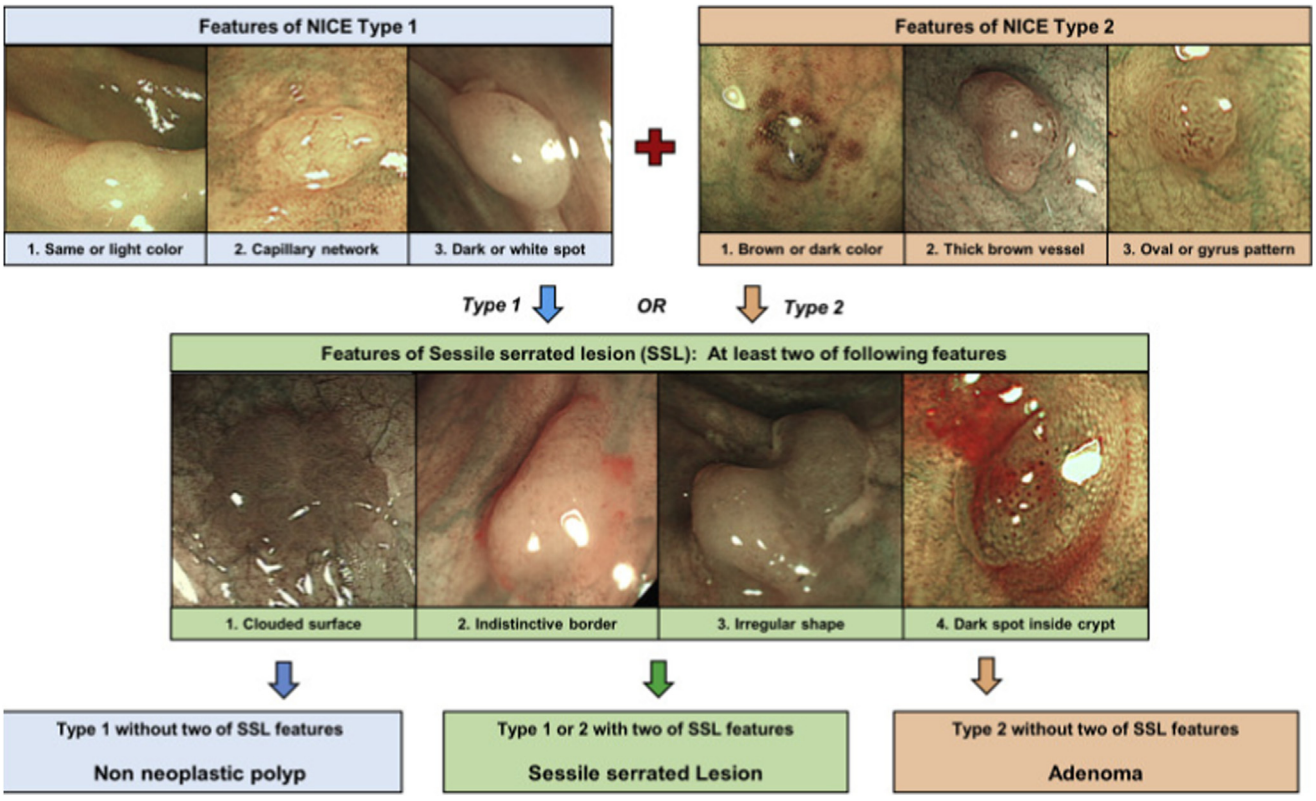
Supplementary Figure 2. Narrow Band Imaging Colorectal Endoscopic (NICE) classification of polyps. Reprinted with permission from Kaltenbach T, et al. Endoscopic removal of colorectal lesions – recommendations by the US Multi-Society Task Force on Colorectal Cancer. Gastroenterology 2020;158:1095–1129.

Type	Schematic	Endoscopic	Description
I			Round pits.
II			Stellar or papillary pits.
III_S			Small tubular or round pits that are smaller than the normal pit
III_L			Tubular or roundish pits that are larger than the normal pits.
IV			Branch-like or gyrus-like pits.
V_I			Irregularly arranged pits with type IIIs, III_L, IV type pit patterns.
V_N			Non-structural pits.

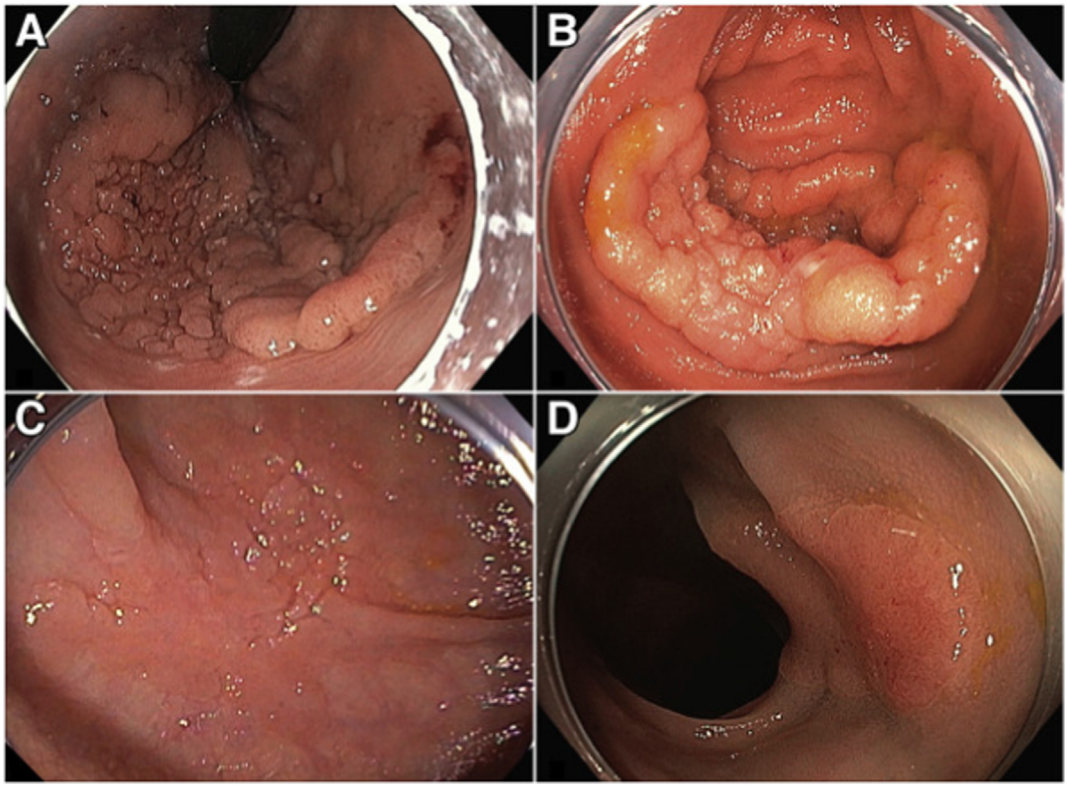
Supplementary Figure 3. Kudo classification of colonic pit patterns. Adapted and reprinted with permission from Tanaka S, et al. High-magnification colonoscopy (with videos). Gastrointest Endosc 2006;64:604–613.

	Type 1	Type 2A	Type 2B	Type 3
Vessel pattern	· Invisible *1	· Regular caliber · Regular distribution (meshed/spiral pattern) *2	· Variable caliber · Irregular distribution	· Loose vessel areas · Interruption of thick vessels
Surface pattern	· Regular dark or white spots · Similar to surrounding normal mucosa	· Regular (tubular/branched/papillary)	· Irregular or obscure	· Amorphous areas
Most likely histology	Hyperplastic polyp/ Sessile serrated polyp	Low grade intramucosal neoplasia	High grade intramucosal neoplasia/ Shallow submucosal invasive cancer *3	Deep submucosal invasive cancer
Endoscopic image				

Supplementary Figure 4. Japanese Narrow Band Imaging Expert Team (JNET) endoscopic classification of colorectal polyps. Reprinted with permission from Sano Y, et al. Narrow-band imaging (NBI) magnifying endoscopic classification of colorectal tumors proposed by the Japan NBI Expert Team. Dig Endosc 2016;28:526–533.



Supplementary Figure 5. Workgroup on Serrated Polyps and Polyposis (WASP) diagnostic criteria for colorectal polyps. Reprinted with permission from Bae JH, et al. Improved real-time optical diagnosis of colorectal polyps following a comprehensive training program. Clin Gastroenterol Hepatol 2019;17:2479–2488.



Supplementary Figure 6. Morphology of lateral spreading tumors. (*A* and *B*) The granular (LST-G) subtype, which has a nodular surface. (*C* and *D*) The nongranular (LST-NG) subtype, which has a smooth surface. Reprinted with permission from Kaltenbach T, et al. Endoscopic removal of colorectal lesions – recommendations by the US Multi-Society Task Force on Colorectal Cancer. Gastroenterology 2020;158:1095–1129.