Colorectal polyp classification and management of complex polyps for surgeon endoscopists

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Accepted Jun. 29, 2023

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Cite as: *Can J Surg* 2023 September 21; 66(5). doi: 10.1503/cjs.011422

Summary

Increasing familiarity with advanced endoscopic excision techniques allows for more colorectal lesions to be removed without major surgery. Endoscopic excision with negative margins is adequate for most polyps and low-risk T1 cancers. The use of modern polyp classification techniques based on size, morphology and pit pattern by an experienced endoscopist allow for an optical diagnosis of these lesions and can predict, with high accuracy, which lesions contain malignant disease and the level of invasion. A surgeon endoscopist must be able to recognize which complex polyps can be resected with advanced polypectomy techniques and which require upfront surgery. We aimed to provide an overview of polyp classification techniques to help surgeons select the correct treatment algorithm for advanced colorectal lesions based on their visual characteristics at index endoscopy.

Widespread screening has increased the detection of early-stage colorectal cancers. Data from the United Kingdom show that nearly 10% of all malignant colon lesions will be found inside polyps.[1] Endoscopic removal is appropriate for most polyps. Early-stage T1 cancers without high-risk features for lymph node metastasis may also be removed endoscopically. However, these lesions should be removed all at once, often by an experienced endoscopist using advanced techniques such as endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD). Colectomy remains the standard of care for more advanced lesions or those with risk factors for lymph node metastasis.[2] Correctly identifying lesions that would benefit most from an advanced endoscopy procedure can be challenging.

Surgeon endoscopists must stay up to date on polyp classification as it can guide the subsequent management of patients with complex colorectal lesions. Patients having surgery for unresectable or high-risk polyps can face risks of complications and increased costs.[3] Modern polyp classification techniques (e.g., Paris, virtual chromoendoscopy and Kudo pit pattern) allow for an optical biopsy, including assessment of lesion location, size, morphology, granularity and surface pit or microvascular surface pattern.[4] The purpose of an optical diagnosis is to differentiate between cancers and premalignant polyps. The former usually require surgery, while the latter can be excised endoscopically (often piecemeal resection is sufficient).[2] Therefore, in cases of uncertainty, a second opinion from an endoscopist who performs advanced endoscopy techniques should be sought before simply proceeding to radical resection. Endoscopic management may be particularly desirable for patients who wish to avoid surgery, such as older patients and those with complex or several comorbidities. Surgeons must select the appropriate intervention for the appropriate patient.

We aimed to provide an overview for surgeon endoscopists for applying techniques to differentiate between malignant and nonmalignant lesions using optical characteristics available at index endoscopy. We also discuss the

management of complex polyps and describe the decision-making process for surgeon endoscopists.

Polyp classification

Polyp morphology

The Paris classification is the most widely validated and accepted system used to describe colorectal polyp morphology in vivo, established by multidisciplinary expert consensus in 2002 (Figure 1).[5] According to this system, lesions are initially divided into polypoid (0-I) or nonpolypoid (0-II and 0-III) subtypes. Polypoid lesions are elevated 2.5 mm or more from the surrounding mucosa — a height conveniently selected as it is the width of closed endoscopic biopsy forceps. Type 0-I is subclassified as 0-Ip (pedunculated), 0-Is (sessile) and 0-Isp (subpedunculated). Type 0-II is subclassified as 0-IIa (superficially elevated), 0-IIb (flat) and 0-IIc (superficial shallow or depressed). Excavated or ulcerated lesions are a third category, designated as type 0-III. In practice, polyps frequently contain a mixture of morphologic characteristics. Accordingly, when documenting such lesions, the dominant characteristic is listed first, followed by the next most common, and so on (e.g., 0-Is + IIc).[5]

The Paris classification allows the standardization of polyp morphology, but more importantly, it can also be used to predict malignant disease. Pedunculated lesions (0-Ip) grow from the underlying mucosa by way of a narrow stalk, thus providing more separation between the neoplastic epithelium and the underlying colonic mucosa. Sessile (0-Is) or flat lesions (0-II) have less distance between abnormal tissue and the normal tissues below and less distance for a neoplastic mass to travel before entering the submucosal plane. Small polypoid lesions (0-I) without concerning features are seldom malignant and can be removed endoscopically. Conversely, lesions with depression (0-IIc) are associated with an increased risk of malignant disease (> 40% risk if 6–10 mm; about 90% risk if > 20 mm). Nearly all nonpedunculated lesions with ulceration (0-III) contain advanced cancer.[5] Therefore, the Paris classification is recommended to help stratify which lesions are more likely to contain advanced pathology and guide treatment strategy.

Superficial nonpolypoid lesions larger than 10 mm with a lateral growth pattern are collectively referred to as laterally spreading tumours (LSTs; Figure 2). These LSTs are subclassified into the granular (LST-G) or nongranular types (LST-NG) by whether the lesion has a nodular appearance. The LST-G can be further subdivided by whether the nodules are homogeneous in appearance (LST-G-H) or of varying sizes, called nodular mixed (LST-G-NM). Nongranular lesions can be flat-elevated (LST-NG-FE) or pseudo-depressed (LST-NG-PD). The LST classification is essential for surgeons as it can be used to further stratify the lesions' risk for underlying malignant disease. The LST-G-H tumours have the lowest risk at only 0.5%–2%, whereas LST-NG-PD lesions carry the

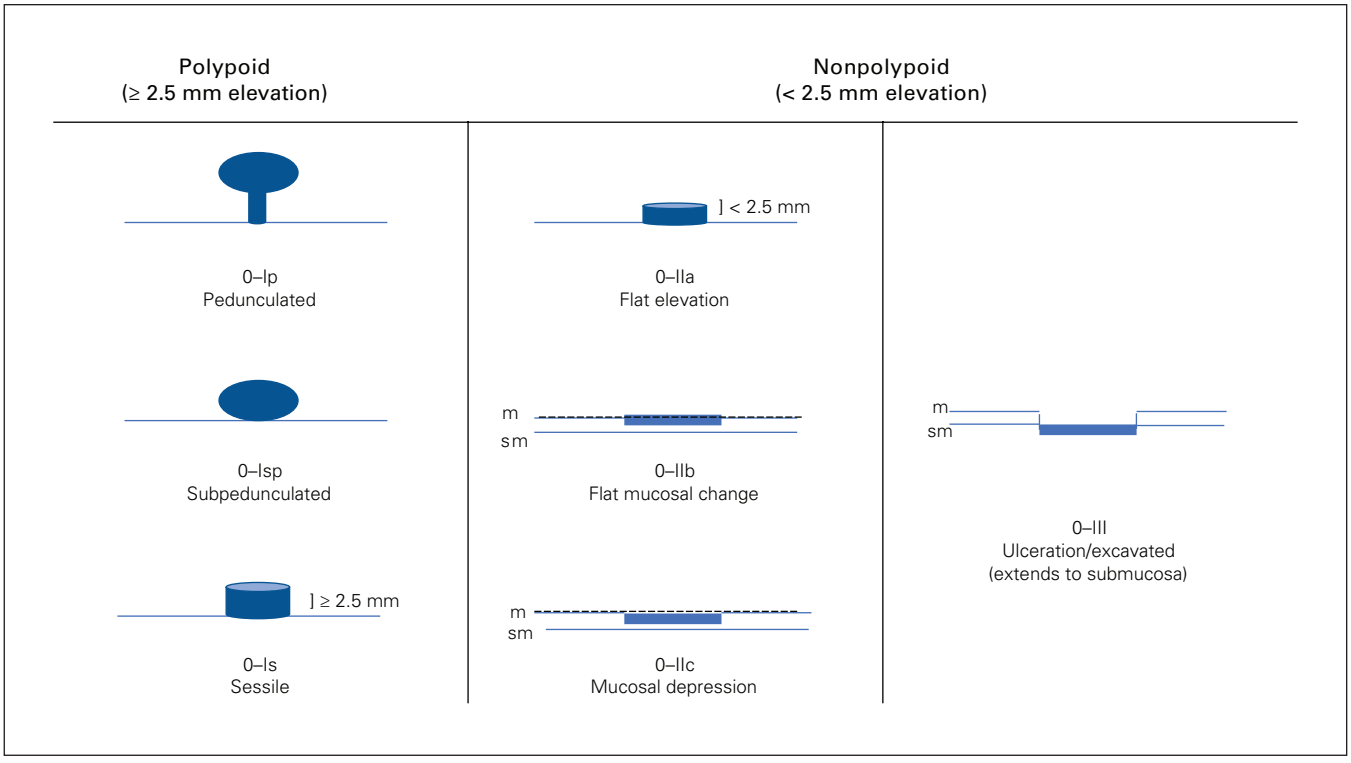


Fig. 1. Schematic representation of the Paris classification of polyp morphology.[5] M = mucosal layer; SM = submucosal layer.

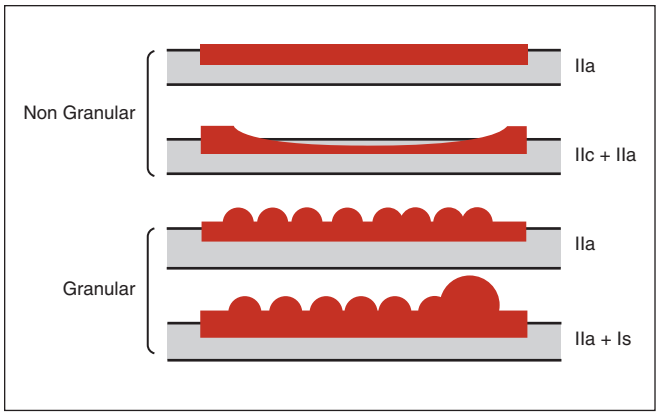


Fig. 2. Lateral spreading tumour classification. Reused from Kudo S ei, Lambert R, Allen JI, et al. Nonpolypoid neoplastic lesions of the colorectal mucosa. *Gastrointest Endosc* 2008;68(4 Suppl):S3–S47,[25] with permission from Elsevier.

highest risk at 31.6%.[6] The intermediate-risk lesions LST-G-NM and LST-NG-FE carry a 10% and 5% risk of malignant disease, respectively.[6] For LST-G-NM lesions, the largest nodule typically carries the highest risk of malignant disease.[6] It may be difficult outside of a research setting for endoscopists to stratify LST lesions into all 4 LST categories. A description of the Paris morphology combined with granularity is likely more feasible and confers a substantial amount of information regarding the underlying risk of malignant disease inside a polyp. Generally, nongranular lesions carry a higher risk of underlying malignant disease than granular lesions.

Image-enhanced endoscopy

Virtual chromoendoscopy is a form of endoscopy that uses specialized light-filtering software or optical filtering hardware to allow for direct inspection of the surface pattern of polyps detected at endoscopy. Narrow-Band Imaging International Colorectal Endoscopic (NICE) Classification, developed in 2009,[7] serves as a highly accurate (up to 96.4% specificity for deep invasion) and feasible routine clinical tool to diagnose the histologic class of a polyp.[8] It divides lesions into 3 categories according to their colour, surface vascularity and visual pattern (Figure 3).[7] Type 1 polyps are hyperplastic or sessile serrated lesions, type 2 polyps describe adenomas or superficially submucosal invasive cancer and type 3 are deep submucosal invasive cancers.[7,8] Type 1 and 2 lesions are appropriate for endoscopic excision, whereas type 3 lesions generally require surgery. The NICE Classification is simple to apply and uses narrow band imaging (NBI) software available on most commercial colonoscopes used in Canada. Furthermore, the NICE Classification is recommended by Canadian experts for routine endoscopic polyp documentation.[9] Therefore, it should be an initial tool in any general surgeon endoscopist's armamentarium for characterizing polyps detected at endoscopy.

Recently, the NICE Classification has had some valuable expansions to help further characterize lesions. In 2018, the Japan NBI expert team added a fourth category (Figure 4), subdividing NICE type 2 lesions into a low-grade (type 2A) and high-grade adenomatous or early cancerous lesions (type 2B). Type 2A lesions can be excised endoscopically. Type 2B lesions require a more detailed assessment, such as dye-enhanced Kudo pit pattern, to triage between advanced endoscopic excision and surgery.[10]

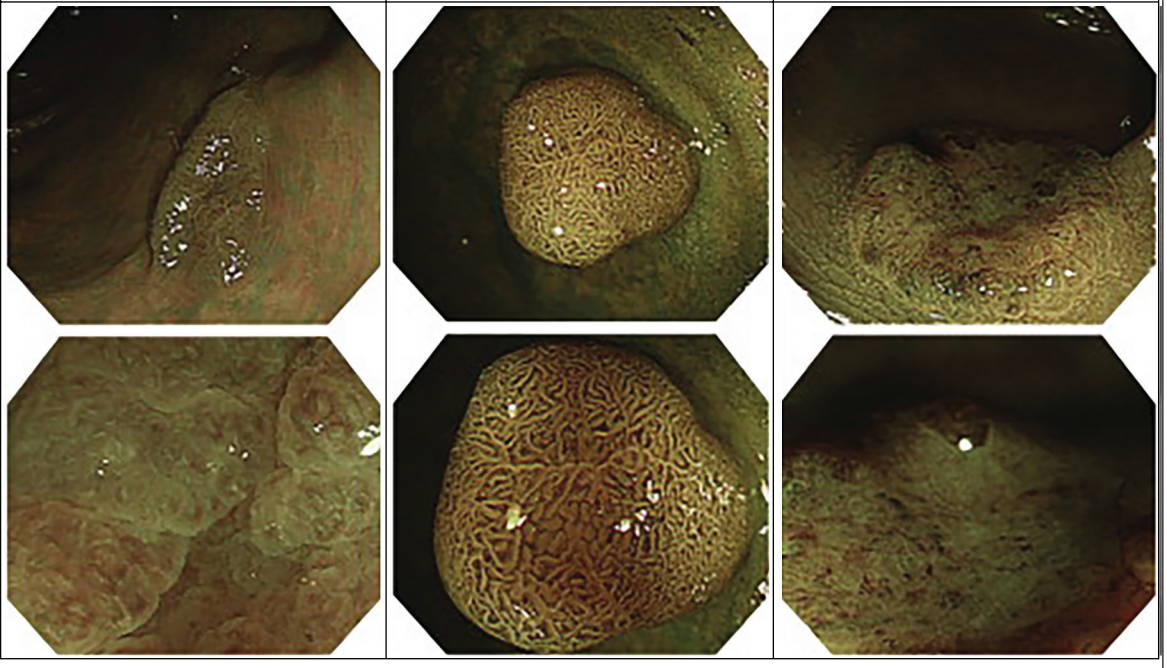
Other groups further identified difficulties in characterizing the malignant potential of sessile serrated lesions using NICE Classification. The Workgroup Serrated Polyps and Polyposis (WASP) criteria added 4 sessile serrated lesion features to NICE (Box 1). The presence of 2 or more WASP criteria in a NICE type 1 or 2 lesion is diagnostic for a sessile serrated lesion. The absence of these features has a negative predictive value of up to 91%.[11]

Pit pattern

Lesion morphology, size and location are useful signs for predicting a lesion's underlying risk of submucosal invasion. However, these criteria are imperfect and are best supplemented with other visual characteristics. The Kudo pit pattern (Figure 5), with the use of dye chromoendoscopy, has been found to be highly accurate for predicting superficial (Type VI) and deep submucosal invasion (Type VN).[12] However, assessing the Kudo pit pattern has limited use owing to dye availability, additional procedural time for their preparation and application and complexity of assessment using these criteria. This classification also relies on a modern generation of endoscopic equipment with high-definition video or 4K processors and monitors for visualization. In a recent Delphi consensus of leading Canadian gastroenterologists and surgeons, Kudo pit pattern was not endorsed as a recommended routine polyp documentation tool.[9]

Other features suggesting cancer

Other polyp features have been described as risk factors for underlying invasive malignant disease. Sclerous wall changes, surface redness, irregular surface, white spots and surface exudate have all been implicated as features suggestive of underlying malignant disease. However, on systematic review, advanced imaging techniques (i.e., surface microvascular evaluation or Kudo pit pattern) were superior to gross morphological evaluation for optical diagnosis of polyps.[13] Spontaneous bleeding of the lesion, or nonlifting sign (if no prior manipulation attempt), have also been associated with malignant disease with deeper invasion.[13]

NBI International Colorectal Endoscopic (NICE) Classification*			
	Type 1	**Type 2**	**Type 3**
Color	Same or slightly lighter than background	Browner relative to background (verify colour arises from vessels)	Brown to dark brown relative to background; sometimes patchy whiter areas
Vessels	None, or isolated lacy vessels 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 structure surrounded by brown vessels**	Amorphous or absent surface pattern
Most likely pathology	**Hyperplastic**	**Adenoma*** **	**Deep submucosal invasive cancer**
Examples			

*Can be applied using colonoscopes with or without optical (zoom) magnification
**These structures (regular or irregular) may represent the pits and the epithelium of the crypt opening
***Type 2 consists of Vienna classification types 3, 4 and superficial 5 (all adenomas with either low or high grade dysplasia, or with superficial submucosal carcinoma). The presence of high grade dysplasia or superficial submucosal carcinoma may be suggested by an irregular vessel or surface pattern, and is often associated with atypical morphology (e.g., depressed area).

Fig. 3. The Narrow-Band Imaging International Colorectal Endoscopic (NICE) Classification. Reused from Hayashi N, Tanaka S, Hewett DG, et al. Endoscopic prediction of deep submucosal invasive carcinoma: validation of the narrow-band imaging international colorectal endoscopic (NICE) classification. *Gastrointest Endosc* 2013;78(4):625–32,[7] with permission from Elsevier. NBI = narrow-band imaging.

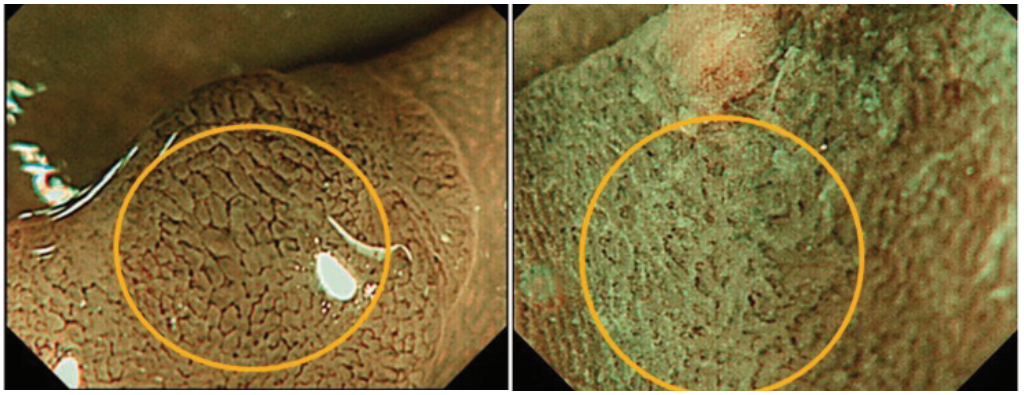
Box 1. The Workgroup Serrated Polyps and Polyposis (WASP) criteria[12]

- Clouded surface
- Indistinctive border
- Irregular shape
- Dark spots inside crypts

The presence of ≥ 2 features suggests sessile serrated adenoma or polyp diagnosis in narrow-band imaging international colorectal endoscopic classification type 1 and type 2 lesions.

Polyp location

Polyp location is crucial to guiding management. Specifically, differentiating colonic compared with rectal lesions is critical owing to the increased risk of invasive disease in the latter.[14] For lesions destined for surgery, accurate endoscopic localization guides subsequent surgical planning.[9] Other important lesion locations include the ileocecal valve, the appendiceal orifice and near the



Type 2A	Type 2B
Low grade neoplasm	High grade neoplasm or cancer with superficial submucosal invasion
Regular caliber vessels with a regular distribution (meshed or spiral pattern)	Irregular vessel distribution
Regular surface pattern (tubular/branched/papillary)	Irregular or obscure surface pattern

Fig. 4. The Japan NBI Expert Team (JNET) classification subdivision of NICE type 2 polyps. Reused from Kobayashi S, Yamada M, Takamaru H, et al. Diagnostic yield of the Japan NBI Expert Team (JNET) classification for endoscopic diagnosis of superficial colorectal neoplasms in a large-scale clinical practice database. *United European Gastroenterol J* 2019;7:914–23,[10] with permission from John Wiley & Sons Inc. NBI = narrow-band imaging; NICE = Narrow-Band Imaging International Colorectal Endoscopic Classification.

dentate line. Traditionally, these lesions have warranted surgical excision owing to technical difficulty, even if they were at an otherwise low risk for deep invasion. However, case series in skilled referral centres suggest that these polyps can be resected completely with a success rate of more than 90% using advanced endoscopy techniques.[15]

Polyp size

Previously, the size of the polyp was deemed the most important factor in assessing malignant potential. However, it is increasingly recognized that polyp size alone is a poor predictor of submucosal invasion (especially for sessile polyps), especially in comparison with other visual polyp characteristics.[13] Regardless, it is important to note lesion diameter, as size is independently associated with recurrence risk and malignant disease.[16] Measurement of a polyp against an open snare of known dimensions is recommended.

Risk of malignant disease and lymph node metastasis

Increasing familiarity with EMR and ESD has rendered many early-stage T1 lesions endoscopically resectable. While many techniques can accurately differentiate between cancers and noncancers, 1 factor that ultimately determines whether a patient needs a colectomy is the risk of lymph node metastasis.[8] The classical risk factors for lymph node metastasis are well known to surgeons. High-risk features include high-grade carcinomas, positive margins, lymphovascular invasion and tumour budding.[2,8,17,18] Depth of submucosal invasion on histopathology classified by way of Haggitt classification (primarily useful for pedunculated polyps)[19] and Kikuchi classification (divides the submucosa into thirds),[20] also inform surgeons regarding the risk of lymph node metastasis. Although a recent meta-analysis calls into question the importance of the depth of submucosal invasion as an independent risk factor for metastasis.[21] Ideally, predicting if a complex polyp has deep underlying malignant disease and possible lymph node metastasis during the index endoscopy, before histopathology is available, would allow planning for appropriate management from the outset. Predicting which colorectal lesions will lead to lymph node metastasis is still impossible; however, identifying lesions at high risk based on optical features is an active area of research. Some have combined NICE, Paris and LST classification systems to predict the presence of underlying high-risk histopathology.[8] Kudo pit pattern assessment also attempts to estimate the underlying risk of lymph node metastasis by predicting submucosal invasion (e.g., VI and VN lesions).[22]

What to do with a complex polyp?

Given the number and complexity of classification systems available, it can be daunting to characterize complex polyps adequately and determine the

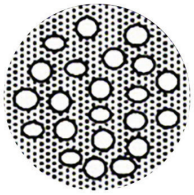
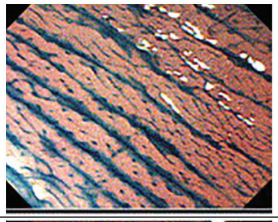
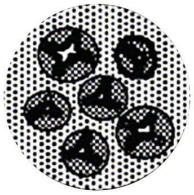
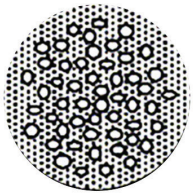
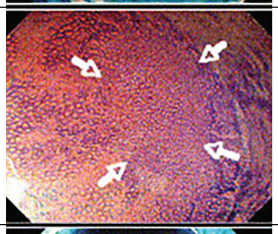
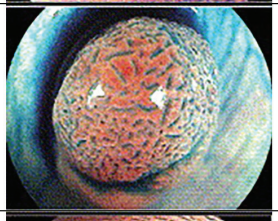
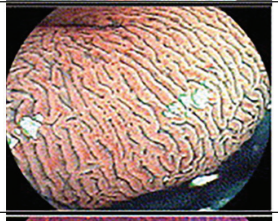
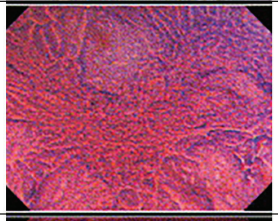
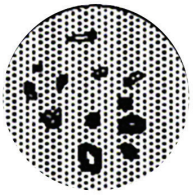
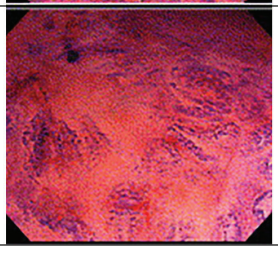
Type	Schematic	Endoscopic	Description	Suggested pathology	Ideal treatment
I			Rounds pits	Non-neoplastic	Endoscopic or none
II			Stellar or papillary pits	Non-neoplastic	Endoscopic or none
III_S			Small tubular or round pits that are smaller than the normal pit	Neoplastic	Endoscopic
III_L			Tubular or roundish pits that are larger than the normal pits	Neoplastic	Endoscopic
IV			Branch-like or gyrus like pits	Neoplastic	Endoscopic
V_I			Irregularly arranged pits with type III_S, III_L, IV type pit patterns	Neoplastic (invasive)	Endoscopic or surgical
V_N			Non-structural pits	Neoplastic (massive submucosal invasive)	Surgical

Fig. 5. Kudo colonic pit pattern classification. Reused from Tanaka S, Kaltenbach T, Chayama K, et al. High-magnification colonoscopy (with videos). *Gastrointest Endosc* 2006;64:604–13,[22] with permission from Elsevier.

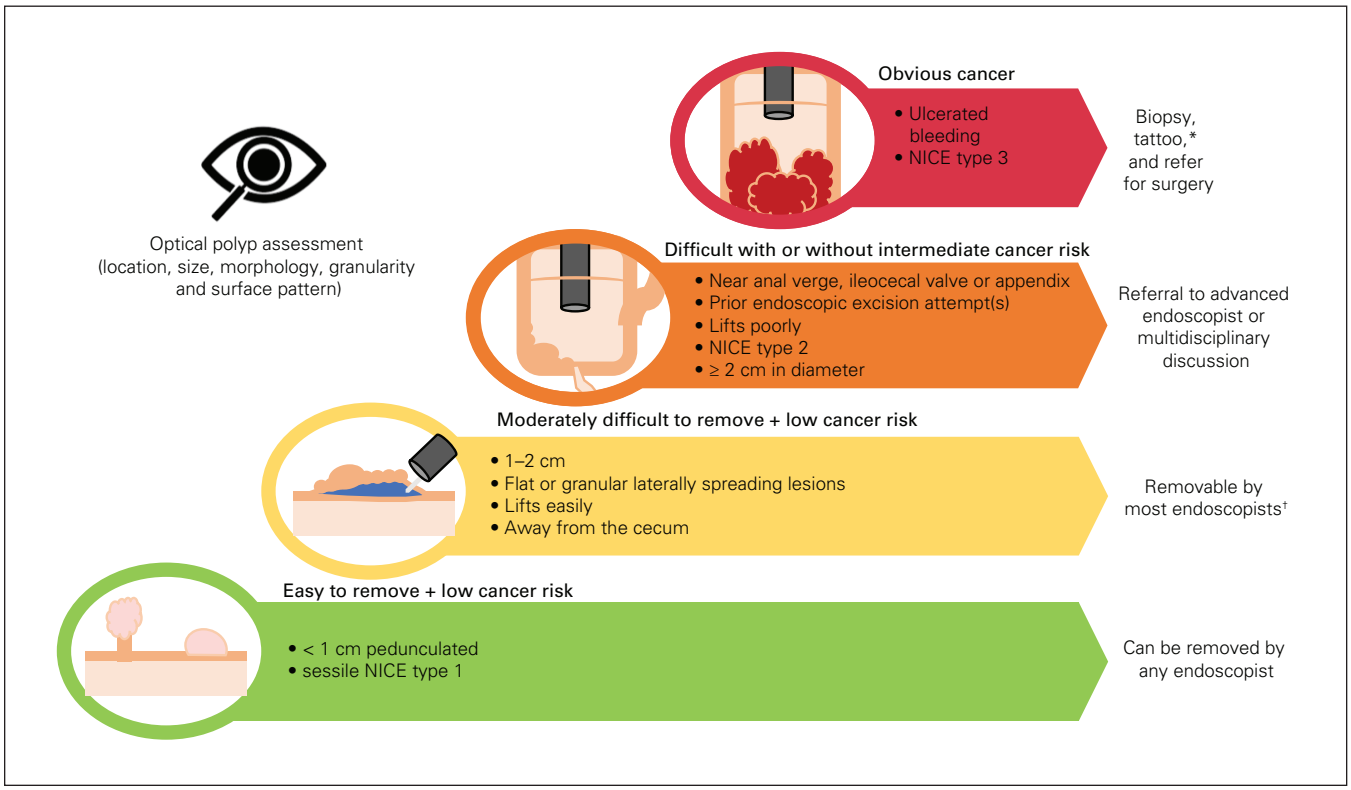


Fig. 6. Decision aid for when a polyp is discovered at endoscopy. *These lesions should be tattooed just distal, ensuring that tattoo material does not touch the lesion. †If the endoscopist cannot confidently and completely remove the polyp, they should not attempt and refer. As always, treatment should be individualized accounting for patient factors and the skill set of the surgeon endoscopist.

appropriate treatment approach. Therefore, we provide the following algorithm as general guidance to help the surgeon endoscopist with decision-making and provide the optimal treatment strategies to their patients after initial polyp identification (Figure 6). Most patients who have polyps without obvious malignant features should be offered endoscopic excision.[2] These include lesions smaller than 1 cm without friability, induration, ulceration or tethering underlying tissues. Conversely, patients with obvious malignant disease or polyps with high risk for deep invasion should be offered surgery. These include lesions larger than 2 cm that are Paris 0-III or NICE type 3 lesions. A more individualized approach is needed when a combination of concerning and reassuring features are simultaneously present. When in doubt, an endoscopist should take high-quality photographs showing the features required to characterize the polyp according to the criteria described previously (including NBI chromoendoscopy, if available). A tattoo should be placed appropriately, distal to the lesion and far enough away (2–3 cm) to allow the tattoo not to touch the polyp and induce mucosal or submucosal fibrosis. The recommended tattoo placement technique is different for lesions that are endoscopically resectable (1 spot) than for those destined for surgery (3 circumferential quadrants).[9] Endoscopists should also comment on polyp relation to any relevant anatomic markers, such as the cecum, appendiceal orifice, ileocecal valve or rectal folds, which may affect endoscopic resectability and approach.

The decision of whether to biopsy is contentious. Recent reports show that tissue biopsy of lesions that are endoscopically resectable can induce scarring and fibrosis, complicating subsequent endoscopic removal attempts. Endoscopic excision of advanced lesions with a failed attempt at removal is associated with increased risks of perforation and bleeding.[23] In general, lesions that are highly suspicious for deeply invasive cancer should be biopsied, and candidates for endoscopic excision should be referred to an advanced endoscopist without biopsy. Endoscopists should not attempt to partially remove a polyp if they do not have the skills to remove it entirely. Such attempts will complicate subsequent excision, rendering the patient more likely to require surgery, even if surgery was not otherwise indicated.[23] Furthermore, even injection of some submucosal agents may cause tissue fibrosis, impairing subsequent optical diagnosis.[24] The patient should be referred to a local advanced endoscopy expert, colorectal surgeon or multidisciplinary colorectal polyp board (including gastroenterology, therapeutic endoscopy, pathology, general surgery or diagnostic imaging specialists).

Conclusion

As experience with advanced endoscopy techniques increases, more patients with colorectal lesions are candidates for endoscopic treatment. Only surgeons provide definitive management for patients with more advanced cancers. However, surgeons must also be able to differentiate between patients who require colectomy and those who may be offered a less invasive option. Classification of colorectal polyps is an important skill for surgeon endoscopists that must be used to risk stratify patients and help guide treatment decisions.

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Competing interests: J.G. Coneys received consulting fees from Vantage Endoscopy and Abbvie. No other competing interests were declared.

Contributors: J.G. Coneys, E. Hyun, G.G.R.J. Johnson and J. Park designed the study. G.G.R.J. Johnson and E. Hyun acquired the data, which R. Helewa and D.C. Moffatt analyzed. G.G.R.J. Johnson wrote the article, which J.G. Coneys, R. Helewa, E. Hyun, D.C. Moffatt and J. Park reviewed. All authors approved the final version to be published.

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