REVIEW

Polypectomy and advanced endoscopic resection

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ABSTRACT

Most colorectal cancers evolve from colorectal adenomatous polyps in a pathway known as the adenoma to carcinoma sequence. Early detection and removal of colorectal adenomas can prevent the development of colorectal cancer. The vast majority of these polyps can be resected endoscopically. Advances in endoscopic resection techniques have led to expanded indications for endoscopic polypectomy, whereby giant polyps, scarred lesions and early cancers may be cured. We will outline conventional endoscopic mucosal resection techniques as well as more complex resection methods such as endoscopic submucosal dissection, full thickness resection and the use of combined endoscopic and laparoscopic assisted approaches to resection. We will also explore the role of a virtual multidisciplinary team to aid decision-making when managing large and complex colorectal polyps. This review will provide an update on the endoscopic management of colorectal polyps and highlight exciting new developments in this ever-expanding field.

BACKGROUND

Endoscopic polypectomy was first introduced as a novel technique in the early 1970s.¹ The effectiveness of this technique in preventing the development of colorectal cancer has been demonstrated in the National Polyp Study.² Over the past several decades, there has been an accelerated development in endoscopic resection of colonic polyps. This in turn has led to the expansion of the role of endoscopy in the management of very large polyps and polyps with more invasive pathology, thereby avoiding surgery. This article explores the recent developments in endoscopic resection of polyps and attempts to speculate the trajectory of this exciting field.

Advances in polyp assessment

The success of endoscopic resection of polyps is underpinned by good

assessment. Therefore, the assessment of the nature (benign vs cancer) and the degree of complexity of a polyp is mandatory prior to resection.³ Identifying complex polyps can be achieved using the simple size, morphology, site and access scoring system (table 1). Based on this system, Level 1 and Level 2 polyps are considered less complex, and therefore all independent colonoscopists should be able to resect these polyps as part of a standard colonoscopy. Level 3 polyps are complex and should be resected on a dedicated slot by an expert colonoscopist. Finally, Level 4 polyps are considered to be very complex, and were traditionally managed by surgical means. However, experts in high-volume centres are now able to resect such polyps with good outcomes.⁴

Advances in endoscope resolution and optical enhancement technologies allow endoscopists to make very good assessments of benign and malignant polyps. In a recent meta-analysis by the American Society of Gastroenterology Endoscopy (ASGE) Technology Committee,⁵ the pooled negative predictive value (NPV) of Narrow Band Imaging (NBI) for adenomatous polyp histology was as high as 91%. The same technology was also found to have a high NPV of 92% when used to predict deep submucosal invasive carcinoma in colorectal tumours.⁶ Although most of the data come from NBI, other technologies such as Fuji Intelligent Chromoendoscopy, i-Scan and dye-spray chromoendoscopy show similarly good results in expert hands.⁷

We recommend that all polyps should be carefully assessed for suitability of resection prior to embarking on resection. Diminutive polyps in the rectosigmoid can either be resected or discarded, or left unresected altogether by experts who have proven competence in the use

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Table 1 Site, morphology, site, access scoring system

Factor	Benchmarks	Points
Size	<1 cm	1
	1–1.9 cm	3
	2–2.9 cm	5
	3–3.9 cm	7
	>4 cm	9
Morphology	Pedunculated	1
	Sessile	2
	Flat	3
Site	Left colon	1
	Right colon	2
Access	Easy	1
	Difficult	3

Four polyp levels (with increasing level of complexity) were identified—Level 1 (4–5), Level 2 (6–9), Level 3 (10–12) and Level 4 (>12).

of optical enhancement technologies. On the opposite end of the spectrum, very large or flat polyps should be referred to high-volume centres for endoscopic resection.

Endoscopic mucosal resection

Endoscopic mucosal resection (EMR) is a technique where fluid is injected into the submucosal space, thereby creating a submucosal cushion between the mucosa and the muscularis propria. An electrocautery snare is then deployed to resect the polyp in single or multiple pieces. The development of EMR has transformed the management of colonic polyps, as the outcome is very good. A recent meta-analysis demonstrated that the endoscopic cure rate for polyps measuring >2 cm is as high as 96.3%, perforation rate of 1.5% and rate of progression to surgery of only 8% in these large and complex polyps.⁸

Despite these excellent outcomes, piecemeal resection has inherent deficiencies. Piecemeal EMR does not allow for accurate reporting of completeness of resection unlike en bloc resections. This is particularly important if the polyp contains cancer. Resection of scarred polyps using this technique is particularly challenging due to non-lifting of the polyp. Recurrence rates following piecemeal EMR can be as high as 20%, although a majority of the recurrences can be managed endoscopically.⁹ Nevertheless, we believe that colonic EMR is a very effective technique in expert hands for carefully assessed polyps that do not have any evidence of cancer, and remains the mainstay of treatment for the vast majority of benign colonic polyps.

Underwater EMR

Underwater EMR (uEMR) was first introduced in 2012 for removing flat colonic polyps.¹⁰ This technique uses water instead of air to distend the colonic lumen and allows for the resection of flat polyps without invasive features. The principle behind this technique is that the muscularis propria maintains its

circular configuration unlike the mucosa or submucosa when the colon is filled with water. In the water-filled lumen, polyps tend to 'float' away from the muscularis propria. Theoretically, this technique lowers the risk of thermal injury to the muscularis propria, as the bowel wall is not as stretched as it would be with air insufflation.

Binmoeller *et al*¹⁰ have demonstrated that this technique has been shown to have a successful resection rate of 100%, a complication rate of 5% and a recurrence rate of 1.9% in a series of 62 polyps. The current conventional EMR technique is well established with good outcomes. uEMR is still in its infancy, and the extra benefit it could offer over conventional EMR would need to be determined by a randomised controlled trial. Until then, this technique remains an experimental one.

Endoscopic submucosal dissection

Endoscopic submucosal dissection (ESD) is a technique pioneered in Japan. It involves a mucosal incision followed by submucosal dissection using specialised endoscopic knives. ESD enables en bloc resection, which leads to more accurate reporting of histological clearance of neoplasia and low recurrence rates of <3%.¹¹ A meta-analysis comparing outcomes of EMR versus ESD found that there were significant differences in en bloc resection (34.9% vs 89.9%), curative resection (36.2% vs 79.6%) and lesion recurrence (12.7% vs 0.7%).¹² However, the same study found that there was a marked difference in procedure time, with the mean operating time for ESD versus EMR being 66.5 vs 29.1 min, and the perforation rates were significantly higher with ESD (4.9% vs 0.9%). Despite the long-term advantages of ESD over EMR, the technique has had poor uptake in the West, as it carries a steep learning curve and high associated complication rates.¹¹ Due to this, the National Institute of Health and Care Excellence has classed colorectal ESD under special arrangements for clinical governance (consent, audit or research). We therefore recommend that this should only be performed under a clinical or research registry.

Part of the challenge in learning ESD is obtaining adequate traction and obtaining optimal orientation. A new technique involving the use of two laparoscopic retractors and an endoscope to carry out the ESD has been developed to treat large rectal polyps. This technique, known as transanal submucosal endoscopic resection, has shown promising preliminary data for low rectal polyps.¹³

We would advocate that ESD is the best technique in the resection of lateral spreading tumours—non-granular type, flat lesions in colitic bowels and any lesion with a high suspicion of T1 cancer. We also believe that as rectal polyps >2 cm carry a high cancer risk, they should be resected via ESD as the benefits outweigh the risks. However, non-rectal

colonic ESD remains high risk and should be restricted to experienced experts.

RECENT DEVELOPMENTS

Knife-assisted resection

The effectiveness of ESD has been established, but the data are mainly from the East. Endoscopists in the West are adept in EMR, but find ESD challenging. With this in mind, knife-assisted resection or hybrid ESD was developed. This technique combines the principles of EMR and ESD.

It involves submucosal injection followed by a circumferential incision of normal mucosa surrounding the lesion. Following this, a degree of circumferential submucosal dissection is carried out to create a groove. This groove facilitates the placement of the snare in the correct resection plane prior to snare excision. This technique allows en bloc excision if the lesion can be dissected sufficiently to shrink the base to <2 cm. However, if the lesion is too big or the endoscopists' skill in submucosal dissection is still being developed, then the lesion will be resected in multiple pieces (figure 1). Initial data show that this technique is feasible, carries a lower recurrence rate than EMR and lower complication rate when compared with ESD.¹⁴ It also demonstrates a learning curve of a 100 procedures to be the threshold number to attain competency in this technique. The same technique has also been shown to be effective in resecting scarred colonic polyps.¹⁵ We believe that this

is the way forward for Western endoscopists, as it a useful technique that facilitates transition from EMR to ESD, and allows for the resection of difficult polyps.

Full thickness resection

Lesions involving layers deeper than the submucosa have been out of reach for endoscopists until recently. The first endoscopic full thickness resection (EFTR) device was introduced in 2001, but did not enter clinical practice due to poor wall closure techniques. The advent of over-the-scope clips facilitated the first clinically applicable full thickness resection device (Ovesco Endoscopy, Germany). EFTR has been shown to be feasible and safe in resecting non-lifting polyps due to previous intervention or submucosal invasion of neoplasia, with the technical success rate of 83.3% and R0 rate of 75%.¹⁶ Data comparing this technique with ESD or surgery, however, are still lacking. Despite this, it is a useful tool for a carefully selected group of patients who have T1 or T2 cancers measuring 3 cm or less but are unfit for surgery. It will also have a role in the resection of scarred polyps when ESD is not an available therapeutic option.

FUTURE POTENTIAL

The virtual polyp multidisciplinary team meetings

The advancement of polyp resection techniques and skills means that most benign polyps and select early polyp cancers (Haggitt Classification Level 2 or SM-1

Figure 1 (Clockwise): Chromoendoscopy assessment with indigo carmine demonstrates a large lateral spreading tumour—non-granular type, with a dominant nodule in the sigmoid colon. Mucosal incision made using a 2 mm FlushKnife. The resection base following circumferential multipiece knife-assisted resection. Postresection follow-up assessment shows no evidence of recurrence.

cancer with no lymphovascular invasion and well-differentiated histology) can be cured by endoscopic resection without the need for surgery.

However, data from the English Bowel Cancer Screening Programme suggest a huge variation in the management of large and complex polyps. There was a fivefold variation between screening centres, ranging from 7% to 36%, where surgery was used as the primary therapy for benign polyps.¹⁷ This reflects local expertise and the lack of access to regional expert endoscopists.

One proposed solution is to hold a virtual polyp multidisciplinary team (vMDT) meeting. This involves a virtual link between multiple regional centres with variable expertise in different techniques to discuss difficult cases and identify the best management pathway for complex polyps. If the best therapy cannot be delivered locally, the patient can then be seamlessly referred to the expert centre in the region with the appropriate expertise.

A variation of this model has been piloted between several trusts in the south of England, where it was found that the vMDT altered the management decision of the colorectal MDT by 41.7%.¹⁸ However, a larger study is required to determine if this does indeed lead to improved patient care on a wider scale.

Combined endoscopic–laparoscopic colonic polyp resection

In the last decade, novel combined endoscopic–laparoscopic resection techniques have been used to resect complex polyps while preserving the colon. There are two variations to this technique. The first is the laparoscopic-assisted colonoscopic polypectomy, which involves external manipulation of the polyp for optimal orientation. The second variation is the colonoscopic-assisted laparoscopic resection, which involves endoscopic localisation of the polyp margins and precise laparoscopic stapler positioning. Feasibility data of this novel procedure are promising, but the exact role of this therapeutic option in the era of advanced endoscopic resection techniques remains to be defined.¹⁹

Robotic endotherapy

The use of robotics has been well established in the world of surgery. However, this futuristic technology is still in its infancy in the gastrointestinal endoscopy sphere. Robotic-driven instrumentation aims to enhance the therapeutic capability of the endoscope and enable endoscopists to circumvent the steep learning curve of ESD.²⁰ Robotic endoscopes have robotic arms at the end of the endoscope that are able to provide traction and carry out dissection. Systems such as MASTER (EndoMASTER Pte, Singapore), ISIS-Scope/STRAS system (Karl Storz/IRCAD, Europe), scorpion-shaped endoscopic robot (Kyushu University, Japan), Endomina (Endo Tools Therapeutics, Belgium) and a novel flexible robot

(Imperial College London, UK) are being developed to provide quick, effective and precise dissection that should translate into better patient outcomes.

CONCLUSION

The management of colonic polyps is primarily an endoscopic one. With the development of new techniques and endoscopic technology, the spectrum of endoscopic resection is widening to include complex polyps such as giant and scarred polyps as well as early cancers. Such polyps will be detected more frequently in the era of screening colonoscopy, and therefore a vMDT would be well placed to provide patients' access to expert endoscopists in a structured hub-and-spoke approach. The next decade is an exciting one for the world of advanced endoscopic resection, as the term 'endoscopically unresectable' rapidly becomes redundant.

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