The suction pseudopolyp technique: a novel method for the removal of small flat nonpolypoid lesions of the colon and rectum

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Background and study aims: Small flat nonpolypoid lesions of the colorectum can be technically difficult to target and completely remove; techniques such as hot biopsy forceps electrocauterization are associated with serositis, delayed bleeding, and perforation. This study aimed to describe a novel technique for the removal of such lesions and demonstrate its safety and efficacy.

Patients and methods: Patients aged 18 – 80 years with flat nonpolypoid lesions (Paris-Japanese classification 0-IIa and 0-IIb, measuring less than 10 mm) identified at colonoscopy were included in this prospective study. The lesions were removed by the suction pseudopolyp technique (SPT): the lesion is aspirated into the suction channel of the colonoscope and continuous suction applied for 5 seconds whilst the colonoscope is gently retracted. On release of the suction, the resulting pseudopolyp containing the lesion and a margin of normal tissue is easily ensnared and resected. The primary outcomes were endoscopic completeness of polyp resection and complication rate.

Results: Over a 12-month period, 1231 polyps were removed during 2656 colonoscopies; 126 polyps (in 101 patients) met inclusion criteria. Complete endoscopic resection was achieved in 100 % of the polyps, without immediate or delayed complication. Of the resected lesions, 57 % had malignant potential (adenomas 47 % and sessile serrated lesions 10 %); a higher proportion of lesions removed from the right colon had malignant potential compared with those from the left colon (75 % vs. 41 %, $P = 0.0066$).

Conclusions: Diminutive flat lesions of the colorectum are predominantly adenomas and sessile serrated lesions. SPT is a safe, effective, and reproducible therapy for removal of these lesions.

Introduction

Small nonpolypoid neoplasms of the colon and rectum (Paris-Japanese classification 0-IIa, nonpolypoid, with superficial elevation < 2.5 mm; and 0-IIb, flat nonpolypoid [1]) have the potential to progress to invasive malignancy. This risk appears to be higher than for polypoidal lesions of the same diameter, and the risk of colorectal cancer exists for all flat nonpolypoid lesions, regardless of their size [2]. Therefore, the detection and resection of such lesions is critical to prevent colorectal carcinoma.

Ensnaring these lesions can be technically challenging because there is minimal or no protruberant tissue for a snare to grip onto and it is therefore difficult to completely and precisely capture the target lesion within the snare. Alternative resection techniques include hot biopsy forceps (HBF) electrocauterization and cold biopsy forceps removal. However, numerous case reports and case series attest to the problems associated with these techniques, which include major bleeding, serositis, and delayed perforation for the thermal modality techniques and residual adenoma in both [3 – 6]. The large variation in method for removing small lesions, many of which are flat, confirms that a clearly superior technique has not yet emerged [7]. An unsatisfactory alternative may be to discount these small flat lesions as being clinically insignificant and not even attempt removal.

In contrast, snare polypectomy is the current therapeutic standard to achieve colonoscopic polypectomy. It is technically effective and associated with few complications [3]. Therefore, whilst snare polypectomy can be a more technically challenging technique for the management of small flat lesions, it appears to be a safer and more complete method than hot or cold biopsy [3]. This concept underlies the present study. Our primary aim was to describe and assess the safety and efficacy of a novel technique for the removal of small flat colorectal lesions (Paris-Japanese

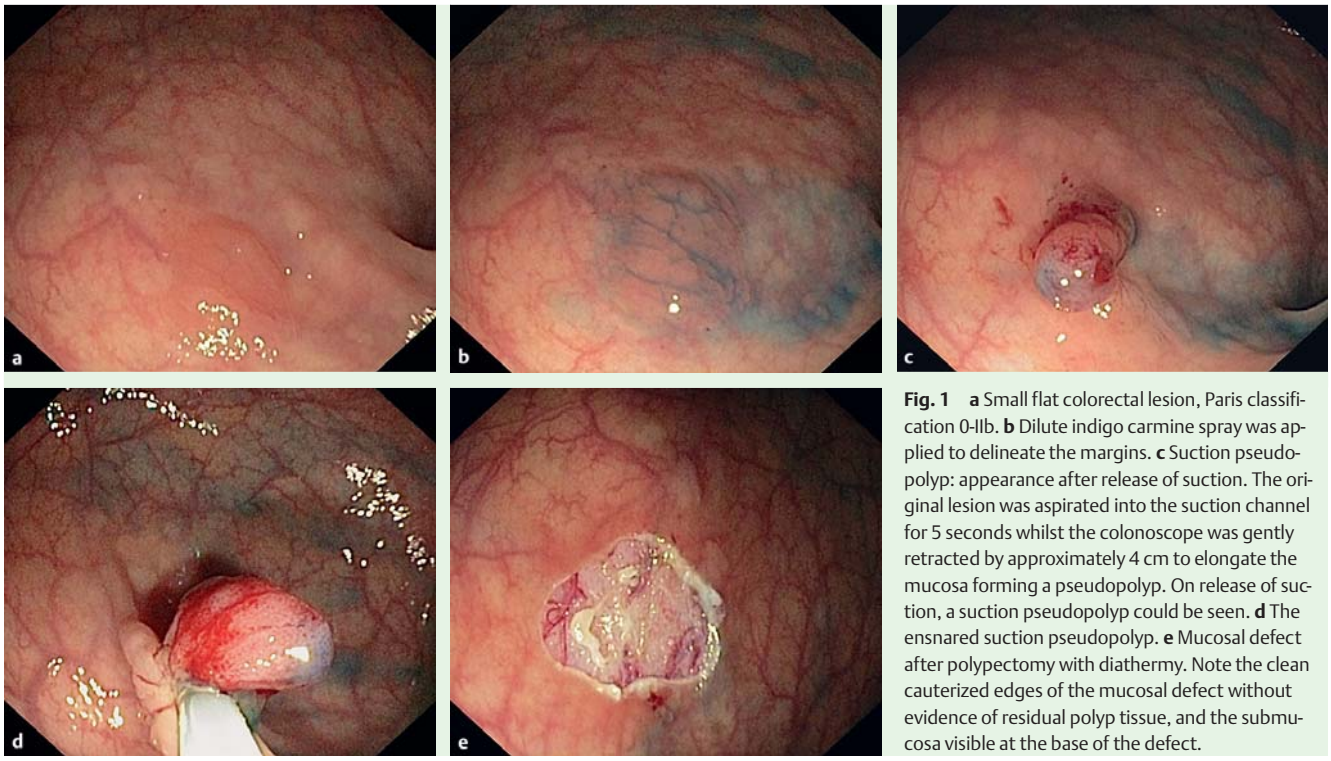

Fig. 1 **a** Small flat colorectal lesion, Paris classification 0-IIb. **b** Dilute indigo carmine spray was applied to delineate the margins. **c** Suction pseudopolyp: appearance after release of suction. The original lesion was aspirated into the suction channel for 5 seconds whilst the colonoscope was gently retracted by approximately 4 cm to elongate the mucosa forming a pseudopolyp. On release of suction, a suction pseudopolyp could be seen. **d** The ensnared suction pseudopolyp. **e** Mucosal defect after polypectomy with diathermy. Note the clean cauterized edges of the mucosal defect without evidence of residual polyp tissue, and the submucosa visible at the base of the defect.

classification 0-IIa and 0-IIb). The secondary aims were to characterize the histology and anatomical distribution of these lesions.

Patients, materials, and methods

The study and its design were approved by the Sydney West Area Health Service Human Research Ethics Committee. The suction pseudopolyp technique (SPT) described below has been one of the standard methods of polypectomy used in our department for more than 5 years, and consent for its use is encompassed in the routine colonoscopy consent process. In the patients who underwent the SPT, an additional consent process to allow use of patient data was undertaken with the patient and their carers just prior to discharge.

Patients aged 18 – 80 years consenting to undergo elective colonoscopy at our institution were eligible for inclusion. Hospital inpatients requiring colonoscopy for acute presentations (including acute lower gastrointestinal bleeding, diarrheal illness), patients with active abdominal pain and those on obligatory antiplatelet therapy (e.g. drug-eluting coronary artery stent) were not eligible for enrolment.

The management of anticoagulation and antiplatelet therapy is standardized for all endoscopic procedures in our department. Warfarin is routinely ceased for four doses prior to elective colonoscopy. Clopidogrel is ceased 7 days prior to colonoscopy, whilst aspirin is not ceased.

Colonoscopies were performed with Olympus CF-Q180A and PCF-Q180A instruments with high-resolution telemonitoring (Olympus Corporation, Tokyo, Japan). If a flat nonpolypoid lesion (Paris-Japanese Classification 0-IIa or 0-IIb) of 10 mm or less was identified then dilute indigo carmine 0.04% (Mayne Pharma, Melbourne, Australia) was sprayed onto the lesion via the working channel of the colonoscope to accurately delineate the margin (**Fig. 1 a, b**). If the lesion was confirmed as potentially neoplastic then it was removed by SPT. A stiff-type small oval snare (15 × 30 mm; Cook Endoscopy, Winston-Salem, North Carolina, USA) was used in all cases. Lesions ≤5 mm were removed by cold guillotine and lesions 6 – 10 mm were removed with diathermy (Erbe Vio 300, endocut Q, effect 3; Erbe, Tübingen, Germany). Small flat polyps in the rectosigmoid that were typical of metaplastic lesions were not included in the study, although they may have been removed.

SPT was primarily performed under direct consultant supervision by third-year gastroenterology trainees or advanced endoscopy fellows, and occasionally by consultants themselves.

The suction pseudopolyp technique (SPT)

The SPT comprises the following steps.

1. Aspirate air to minimize distension. Overdistension places the bowel wall under tension and makes it difficult to ensnare flat lesions.
2. Ensure that the snare is ready to be used, that the diathermy plate is attached (if required), and that the foot pedal is in the correct position.
3. Pass the snare down the working channel of the colonoscope until it is within 15 – 20 cm of the end of the colonoscope. This ensures that the snare can be advanced promptly for use as soon as the pseudopolyp is formed, whilst still allowing sufficient suction to achieve pseudopolyp formation.
4. Align the centre of the lesion with the suction channel; in the Olympus PCF/CF-Q180A colonoscopes; the suction channel lies in the 5-o'clock position.
5. Aspirate the lesion into the suction channel of the colonoscope. Once the polyp has entered the working channel (bearing in mind it is still attached to the mucosa and has not been resected), continuous suction is applied whilst gently pulling the colonoscope backwards for a distance of 2 to 5 cm.
6. On release of the suction the colonic wall springs back to its original position; the flat lesion is now a protruberant "pseu-

dopolyp" containing the lesion and a margin of normal tissue. (▶ **Fig. 1 c**).

7. This can be easily ensnared (▶ **Fig. 1 d**) and removed by standard resection with diathermy (polyps 6 mm or larger; ▶ **Fig. 1 e**) or cold guillotined (for polyps up to 5 mm; ▶ **Fig. 2 a – d**).

Subsequent mucosal defects were then carefully inspected including the use of narrow band imaging (NBI) to identify any residual polyp tissue. SPT procedures were classified as achieving complete resection according to endoscopic criteria if no residual polyp tissue was detected. If residual polyp tissue was present, it was to be removed with biopsy forceps and submitted separately for histological assessment.

Tissue specimens were retrieved, carefully pinned onto corkboard where size permitted, and placed in formalin solution, for histopathological assessment by two specialist gastrointestinal pathologists. The margins of these specimens were inked prior to processing and the specimens sliced and embedded on edge (if size permitted), or embedded whole. Histological examination included measurement of the size of the lesions, histological type, degree of dysplasia (low or high grade) and the presence or absence of invasive carcinoma. When the specimens were not fragmented and size permitted, the histological margins of the resected lesions were evaluated to determine the completeness of resection according to histological criteria.

The occurrence of immediate complications was recorded. Delayed complications were recorded at clinic review at 30 days. Additional data collection regarding the lesion included endoscopic size (assessed visually with reference to an open snare), anatomical site, histological size, and histopathological diagnosis. The chi-squared test was used to analyse the findings.

Results

In the 12 months preceding April 2008, 2656 colonoscopies were performed, with 1231 polyps removed from 1091 patients. Among the polyps, 787 were < 6 mm, 205 were 6 – 10 mm, 98 were 11 – 20 mm, and 141 were > 20 mm.

A total of 126 lesions that were smaller than 10 mm and of Paris-Japanese classification 0-IIa or 0II-b (10.2 % of the total polyp population), in 101 patients, were included prospectively and removed using the SPT during the study period. The indication for colonoscopy was polyp surveillance in 52 patients, screening in 26, previous rectal bleeding in 11, previous abdominal pain in 3, altered bowel habit in 3, anemia and/or iron deficiency in 2, and other indications in 4. The median age was 63 years, and 55 % of the patients were male. Four patients who were taking warfarin and two who were taking clopidogrel ceased this for 4 and 7 days prior to colonoscopy, respectively; 11 patients were taking aspirin and continued this prior to colonoscopy.

All lesions were removed successfully using the SPT. Complete en bloc endoscopic resection was achieved in 100 % of cases (i. e., in no case was residual polyp tissue identified on inspection of the post-polypectomy mucosal defect with NBI or white light endoscopy).

There were no immediate complications of bleeding, perforation or pain as assessed at the time of endoscopy, or prior to same-day discharge. No complications were reported at 30-day follow-up.

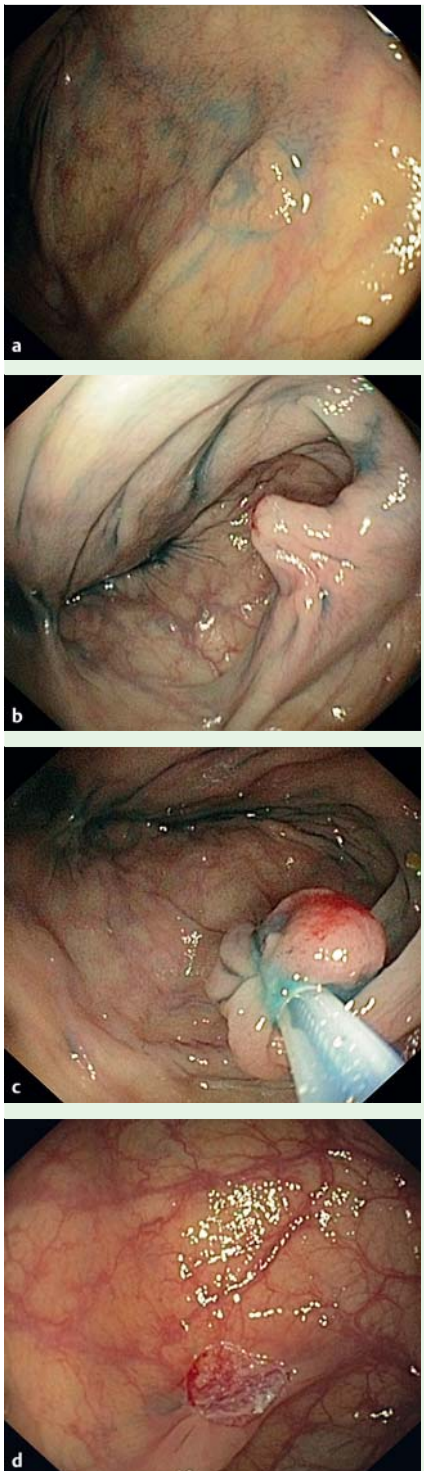

Fig. 2 **a** Paris classification 0-IIa lesion: visualization has been enhanced by application of indigo carmine. **b** Suction pseudopolyp formed. **c** Ensnared suction pseudopolyp. **d** Mucosal defect after cold guillotine of suction pseudopolyp.

Lesion size and anatomical distribution

Lesion size was assessed visually at the time of endoscopy with reference to an open snare. The median size of the lesions as assessed at endoscopy was 6 mm. Of the 126 lesions, 59 (47 %) were located in the right colon. Regarding size, 53 % of the lesions in the right colon and 76 % of the lesions in the left colon measured < 6 mm. As there is poor interobserver agreement for discrimination between 0-IIa and 0-IIb for small lesions, and as they are often considered together in morphological and histological risk assessments, these subgroups were assessed together.

Histopathology

Of the 126 lesions, 125 (99.2%) were retrieved for histology. Overall, 57% of the lesions retrieved had malignant potential, with 47% being adenomas (of which 97% were tubular and 3% tubulovillous adenomas) and 10% being sessile serrated lesions; none of these lesions harbored high grade dysplasia or invasive carcinoma. Another 36% of the lesions were hyperplastic polyps and in 7% of cases no polyp tissue was identified in the histological sample (**Table 1**).

Regarding location, 75% of the lesions in the right colon had malignant potential, compared with 41% of the lesions in the left colon ($P = 0.0066$). Regarding size, there was no difference between the proportion of lesions with malignant potential amongst those measuring ≤5 mm compared with those measuring 6–10 mm (52% vs. 48%; not significant).

In 78 of the 125 retrieved specimens, evaluation of the histological margins of the resection was attempted. Despite en bloc resection the other specimens were either fragmented (by forces generated when the resected polyp passed through the colonoscope suction channel at retrieval) or too small to permit an attempt at orientation during embedding. Of the 78 specimens, 24 (30%) showed complete resection in the plane of section examined, 13 (17%) lesions involved the margin of resection, and in 41 (53%) the margins could not be histologically assessed. The lesions in which margins could not be assessed were small and, because of their diminutive size, had imperfect orientation at the time of embedding; hence the margins were not clearly identifiable in the sections. Small specimens also frequently showed crush and diathermy effects at the periphery. Thus complete excision could not be proven histologically in the majority of specimens.

Table 1 Characteristics of 126 small nonpolypoid colorectal lesions (Paris-Japanese classification 0-IIa or 0-IIb, less than 10 mm in size) resected from 101 patients.

Size, median (range), mm	6 (1–10)
Anatomical distribution (126 lesions), n (%)	
Right colon	59 (47)
Left colon	67 (53)
Histology (125 lesions)	
Lesions with malignant potential*, n (%)	
(71/125, 57% of total small nonpolypoid)	
Adenoma	59 (47%)
Tubular	57 (97%)
Villous	0 (0%)
Tubulovillous are subsets of adenoma	2 (3%)
Sessile serrated	12 (10%)
Lesions without malignant potential (non-neoplastic)	
(54/125, 43% of total small nonpolypoid)	
Hyperplastic	45 (36%)
Other: normal mucosa, focal colitis	9 (7%)

* Note: no carcinomas were detected in this series.

Discussion

We have described a novel, safe, simple, and reproducible technique for the removal of small flat and superficially elevated nonpolypoid lesions of the colorectum. The importance and clinical significance of such "diminutive" colorectal nonpolypoid lesions is evident in this series which demonstrates that over 10% of the lesions identified at colonoscopy during the study period were 10 mm or less and with a Paris-Japanese classification of 0-IIa or 0-IIb, and that 57% of such lesions had malignant potential, being adenomas or sessile serrated lesions. That the majority of these small flat lesions have the potential to develop to malignancy must be acknowledged, and future guidelines for colonoscopy screening and prevention of colorectal carcinoma must emphasize that these lesions, including the smallest ones of less than 5 mm, must be removed in order to minimize the risk of malignancy. Furthermore, given that 65%–90% of polyps detected at colonoscopy measure less than 10 mm [8,9], that most complications occur in polypectomies of polyps less than 10 mm in size [10], and that in this study over 10% were of flat morphology, techniques that address the definitive and efficient removal of these lesions are critically important in improving the overall clinical impact of colonoscopic polypectomy.

The reported prevalence of nonpolypoid colorectal neoplasia (not limited to those measuring ≤10 mm) ranges from 8.4% to 40.9% [2,11–13]. The Paris endoscopic classification of superficial neoplastic lesions of the esophagus, stomach, and colon was devised (and recently updated) in part so that a uniform classification system might minimize this variability [1,14]. Variability in prevalence may also be due to the differing endoscopic detection techniques used at colonoscopy (e.g. chromoendoscopy vs. white light endoscopy). Notwithstanding this variability, it must be emphasized that nonpolypoid colorectal neoplasms are common, as both reported internationally [2] and confirmed by the present study.

The Paris-Japanese classification also assigns a clinically associated risk of submucosal invasion and risk of lymph node metastasis to each lesion subtype [1,14]. Up to 4% of Paris classification 0-IIa and 0-IIb lesions demonstrated submucosal invasion in a pathology series of 3680 lesions, while lesions 1–10 mm size have a prevalence of submucosal invasion of up to 0.2% as reported in an endoscopic series with pathology confirmation in 19560 cases [14]. Whilst the risks appear low, this confirms the possibility for small nonpolypoid lesions to have malignant potential and supports the need for meticulous colonoscopy to find these lesions, and for development of techniques for their safe and complete removal.

It is likely that the prevalence of sessile serrated lesions has formerly been underestimated: a prevalence as low as 1.9% has been reported [15]. We have shown that the prevalence is higher (10%) amongst flat lesions measuring ≤10 mm, this finding being consistent with one other previous report [16]. This further emphasizes the importance of identifying and removing these lesions.

There is currently no consensus on the optimal technique for removing small flat lesions [9]. Cold snare excision for small polyps was first described by Tappero et al. [17]. Whilst over 85% of endoscopists use snare polypectomy for medium-sized lesions measuring 7–9 mm, hot and cold biopsy techniques have been used preferentially for lesions measuring 1–6 mm [7]. The lack of consensus on the management of such lesions and the absence of a clearly superior technique indicate that this is a field requiring further study. Additionally, there are numerous reports as to the limited efficacy and poor safety profiles of the commonly used techniques of hot and cold biopsy. Hot biopsy forceps electrocauterization has been reported as having an overall complication rate of up to 16% [4] and transmural injury occurs with a frequency of up to 44% in animal models [6]. Major bleeding is described in 0.41%, perforation in 0.52%, and 87% of these per-

forations occur in the right colon [4]. Although the majority of this data is not recent, there is no published contemporary experience to refute these statistics and, anecdotally, despite improvements in electrosurgical generators in recent years, the hot biopsy technique continues to be associated with a notable incidence of complications. These complication rates are in clear contrast to those of snare polypectomy, with reported rates of 0% to 0.26% for perforation and 0.9% for hemorrhage in large series where polyps of all sizes were removed [18, 19].

In our experience the suction pseudopolyp technique (SPT) removes flat lesions without risk of transmural injury or entrapment of the underlying muscle layer. This technique works particularly well in the colon because the mucosa is very loosely attached to the underlying muscularis propria [20], a feature that is not shared by the esophagus or stomach. The SPT utilizes the advantageous anatomical structure of the colorectum in order to gently pull and stretch the colonic mucosa with suction, effectively lifting the mucosal layer from the muscularis propria and thus forming a protuberance, which can be snared easily in comparison with a flat lesion. The advantage of suction in this setting over other lifting techniques such as submucosal injection is that suction produces longitudinal elongation of the area of mucosa as it is suctioned into the working channel of the colonoscope, as opposed to injection that elevates both the lesion and the surrounding mucosa as the solution disperses beneath the intended target. The SPT is simple to use and is also faster than injection techniques which require additional solutions and apparatus and device exchange via the working channel of the endoscope.

Incomplete lesion resection is an important problem with the current most commonly practiced techniques. Both hot and cold biopsy methods are associated with a significant risk of residual adenomatous tissue in the order of 17% – 52% [4, 5, 21 – 23]. Studies suggest that more than 25% of colonic cancers developing after colonoscopy may result from ineffective polypectomy, confirming the importance of a reliable means of complete excision [24, 25]. In our study, in spite of apparent 100% en bloc resection of the lesions and careful pinning of retrieved specimens, histological assessment for clear lateral and deep margins (the proposed gold standard) could not be reliably made because of the small size of the lesions. The reasons included difficulties in orientating small fragments of tissue so that the lateral and deep margins were visible on the sections, the presence of diathermy and crush artifacts, and the fragmentation of small tissue specimens [20]. Others have shown that small size makes polyps susceptible to cytologically injurious forces during polypectomy and specimen retrieval [26]. Decreasing polyp size is linearly associated with the inability to make an accurate diagnosis, particularly at specimen margins, owing to tissue injury, and this includes polyps that are excised without thermal electrocautery [26].

Completeness of resection in small adenomas is usually assessed at the time of endoscopic removal and involves endoscopic, not histological criteria [24, 27]. This approach is problematic given the limitations of the currently most widely practiced polypectomy techniques. The histological proof of complete excision for small sessile lesions is inherently difficult and is an area where study has been limited. Studies in the existing literature have relied upon biopsy of the polypectomy site to establish whether excision was complete [5, 23]. A potential limitation of the present study is the absence of this feature. However, in the present study, careful endoscopic assessment of the mucosal defect and the margin with both NBI and white light endoscopy did not detect residual adenomatous tissue for any lesion. Although margins were histologically involved in 13 cases in our series (10%), we believe that the SPT minimizes this risk more than any other technique, as the SPT involves excision of a margin of normal tissue which can be visualized above the snare and below the lesion after capture of the pseudopolyp.

Current guidelines do not include (or define) “histological evidence of complete excision” in their determination of risk or recommendation for future screening [28 – 34]. The incorporation of such a definition in future guidelines, taking into consideration the inherent challenges associated with histological assessment of diminutive lesions, would be a step towards defining and ensuring quality colonoscopy.

Normal tissue was retrieved in seven cases; it is likely in these cases that a normal fold of mucosa with an “irregular” appearance or mucosa overlying lymphoid follicles was mistaken for a Paris 0-IIa or 0-IIb lesion and hence removed [20]. It is unlikely that “lesions” were not correctly targeted and removed as each resection was followed by careful inspection with both white light and NBI of the post-chromoscopy mucosal defect and associated area of uninvolved mucosa.

We encourage further study of this novel technique in order to reaffirm its safety and utility. Complete pathological confirmation of total resection by SPT may be confirmed in future studies by histological evaluation of small cup biopsies of the edge and base of the mucosal defect. Comparisons of this technique with standard, jumbo and hot biopsy forceps are of clinical interest; in addition to assessing completeness of resection and safety, such comparisons should consider time efficiency and the costs of equipment associated with each modality. Whilst a prospective randomized controlled trial comparing the hot biopsy forceps (HBF) method and the SPT would provide the strongest evidence for the superiority of one technique over another, this might be considered both unethical (given the documented complication rate associated with HBF) and logistically challenging; such a trial would require large numbers and multicenter collaboration. If one assumes a zero incidence of complications in the SPT arm and an incidence of bleeding and perforation of 0.41% and 0.52% (in keeping with published data), respectively, in the HBF group then randomization with at least 3820 patients would be needed to achieve statistical significance at the 0.05 level and 80% power. Based on our experience, less than 4% of patients at any one institution would be eligible for inclusion and more than 95 000 colonoscopies would have to be undertaken. Animal studies in a suitable model, where the depth of mural injury and excisional efficacy are compared for the various techniques, will likely be the means by which these important questions can be answered. Such a study is underway in our department.

In conclusion, small flat nonpolypoid lesions of the colon and rectum are a common occurrence, accounting for over 10% of lesions identified at colonoscopy in this series. Such lesions identified in the right colon are predominantly lesions with malignant potential, but so are a substantial proportion of small flat left colonic lesions. It is crucial that these lesions are identified and removed in order to reduce the future risk of colorectal carcinoma. The SPT is a safe, effective, and reproducible therapy for the removal of such lesions.

Competing interests: None

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