Table 1. Characteristics of Patients and Lesions

Characteristic	Value
Median age, *y* (IQR)	69 (59–75)
Gender (male/female)	10/14
Median tumor size, *mm* (IQR)	25 (25–32.5)
Location, n (%)	
Colon	19 (79)
Rectum	5 (21)
Macroscopic type, n (%)	
Protruded, sessile (0-Is, Is+IIa)	11 (46)
Superficial, elevated (0-IIa, IIa+IIc)	12 (50)
Superficial, shallow, depressed (0-IIc)	1 (4)
Invasion depth, n (%)	
LGIN	7 (29)
HGIN	17 (71)
Submucosa	0 (0)

HGIN, high-grade intraepithelial neoplasia; LGIN, low-grade intraepithelial neoplasia.

(4/24), respectively. The en bloc resection rate was similar between operators; that of T.M. was 69% (11/16) and that of T.S. was 63% (5/8) ($P = .585$). The clinical characteristics of the patients receiving en bloc and piecemeal resection are summarized in Table 3. Regarding tumor size, almost all en bloc resected tumors were <30 mm in diameter, whereas most piecemeal EMR cases were >30 mm. No complications such as perforation, bleeding, or other clinical symptoms such as severe abdominal pain or high fever related to CEMR were observed. Histopathologically, 17 patients (71%) had high-grade intraepithelial neoplasia, and 7 (29%) had low-grade intraepithelial neoplasia. On histopathologic evaluation of the cut margin, R0 resection was achieved in 4 cases, whereas 4 were R1 and 16 were Rx. Of all the 16 en bloc resection cases, 4 were evaluated as R0, 4 as R1, and 8 as Rx procedures. No recurrence or residual tumors were noted on follow-up colonoscopy between 6 and 12 months after CEMR.

Discussion

Here we assessed the clinical outcome of CEMR in patients with relatively large neoplasms. The advantages of using this procedure over conventional EMR for large sessile lesions has already been reported by Moss et al.[24] In that study, the rate of en bloc resection (70%) reflected the convenience of its use for imaginary lesions of porcine colon sized 40 × 40 mm. In our study, the en bloc resection rate was unexpectedly low (68%), yet the objective lesions were relatively smaller than those of the study by Moss et al. Thus, the low en bloc resection rate might have been attributable to the lesion configuration. Half of the cases were 0-IIa type lesions or the so-called laterally spreading tumors (nongranular type); these are sometimes difficult to raise by submucosal injection because of the development of submucosal fibrosis, and they have recently been considered as good indicators of the need for ESD. Combining the number of en bloc and 2-piece resections increases the total rate of these procedures to 84%. We believe that few-piece resections might be clinically acceptable because the resected specimen can be retrieved completely, and the lesion is easy to reconstruct from 2 or 3 specimens, allowing the almost complete evaluation of histopathologic features from the reconstructed lesion. Moreover, this procedure was used for lesions diagnosed as noninvasive neoplasms by pit pattern analysis, which is considered the most reliable method with regard to the evaluation of depth. Taken together, our findings suggest that CEMR might be efficient for the resection of large colorectal tumors that are difficult to remove via en bloc resection by conventional EMR.

Achievement of R0 resection with an adequate circumferential horizontal margin is the most desirable result from a curative point of view. However, most colorectal neoplasms are considered to develop via the adenoma-carcinoma sequence, and most lesions arise from the epithelium without chronic inflammation such as ulcerative colitis. Compared with early gastric cancers, the lesion margin can be recognized clearly, and marking during the endoscopic procedure is not required. In our series, the R0 resection rate was only 17% despite the achievement of en bloc resection. We made a marginal incision 2 mm beyond the tumor margin in both CEMR and ESD procedures without marking coagulation. As a consequence, the margin of the lesion might be easily affected by burning. In the case of detection of any burning by histologic analysis in any of the sliced tissue specimens, the horizontal margin was evaluated as "tumor cell (±)." This might explain the occurrence of Rx resection cases despite achievement of en bloc resection. However, we do not consider this issue to be clinically significant. Because the margin of a colorectal neoplasm is very easily detected by indigo-carmine spraying, it can be recognized dur-

Table 2. Summary of Clinical Outcomes

Parameter	Value
Complete CEMR, n (%)	23 (96)
Change to ESD, n (%)	1 (4)
Median CEMR procedure duration, *min* (IQR)	40 (30–63)
En bloc or piecemeal CEMR, n (%)	
En bloc	16 (67)
2-piece	4 (17)
3-piece	2 (1)
4-piece	1 (4)
Complications, n (%)	
Perforation	0 (0)
Delayed bleeding	0 (0)
Resection status	
R0	4 (17)
R1[a]	4 (17)
Rx	16 (66)
Incidence of recurrence, n (%)	0 (0)

[a]All R1 cases were lateral margin (+).

Table 3. Clinical Characteristics Between En Bloc Resection and Piecemeal EMR

	En bloc	Piecemeal EMR
Tumor size, n (%)		
20–30 mm	15 (94)	3 (38)
31–40 mm	1 (6)	5 (62)
Location, n (%)		
Colon	11 (69)	8 (100)
Rectum	5 (31)	0 (0)
Macroscopic type, n (%)		
Protruded, sessile (0-Is, Is+IIa)	8 (50)	3 (38)
Superficial, elevated (0-IIa, IIa+IIc)	7 (44)	5 (62)
Superficial, shallow, depressed (0-IIc)	1 (6)	0 (0)

ing marginal incision. Hence, a vertical margin that was negative for tumor cells and whose depth was limited to the intramucosa and superficial submucosa (<1000 μm) without lymphovascular infiltration by histologic evaluation was considered a curative resection. Nevertheless, no sign of recurrence was seen at the first follow-up colonoscopy in any case, suggesting that the pathologic findings for the vertical margin of the resected specimen are of no clinical significance. Moreover, we previously reported that most residual tumors can be cured with additional endoscopic treatment such as the simple coagulation method or conventional polypectomy, despite the presence of recurrent or residual tumor, provided proper surveillance is conducted after piecemeal EMR.

In addition to its reduced procedure time and decreased risk of perforation compared with ESD, owing to the omission of the submucosal dissection process, our CEMR procedure has several other advantages. First, the addition of a circumferential incision might reduce the risk of residual tumors because residual or recurrent tumors are believed to develop from remnant tumor tissues from the resected margin. Determining the blind side margin and confirming the presence of residual tumor after resection during conventional EMR with relatively large lesions are sometimes difficult because of the influence of ablation. After circumferential incision, however, the snare can be easily placed along the incision, and the tumor margin can be cut reliably. Second, this procedure is achievable with the technical competence of trainees. Third, complete resection of the tumor allows a thorough histologic analysis to be performed. This type of analysis is important for a better understanding of the characteristics of colorectal neoplastic lesions and for identifying good indicators for the CEMR procedure.

Indication for CEMR hitherto relies on lesion size only. In the present study, we performed CEMR for lesions measuring 20–40 mm, and the 8 patients in whom we were unable to achieve either en bloc resection or complete CEMR had lesions >35 mm. This greater reliability with slightly smaller lesions suggests that CEMR is most suitable in lesions measuring 20–30 mm. In their series, Uraoka et al[25] reported that larger tumor size is associated with an increased risk of submucosal invasion, except for the laterally spreading tumor granular uniform type; indeed, precise identification of the deepest penetration area was difficult in 30% of the laterally spreading tumor nongranular type submucosal cancers. Thus, lesions with a high chance of piecemeal resection, particularly laterally spreading tumor nongranular type lesions, should first be considered for ESD.

Notwithstanding the above-mentioned advantages, introduction of the CEMR procedure in the clinic might find some obstacles. First, a complete circumferential incision might hinder dissection into the submucosal layer because of the layer's inability to retain the injected submucosal fluid and the difficulty in maintaining a clear visual field. If the treatment procedure is changed to ESD, the level of technical difficulty might accordingly increase. Considering these limitations, the best strategy appears to be a careful observation of the lesion to determine the optimal treatment method in view of the skills of the individuals involved. Second, the CEMR procedure was performed by 2 endoscopists in a single center. Therefore, its technical acceptability by or safety for the general endoscopist, particularly those who are less experienced, is not guaranteed.

In conclusion, CEMR might represent an effective and uncomplicated procedure for treating relatively large colorectal neoplasms. The technique is clinically simple and has the same short treatment time as conventional EMR. Validation of this procedure awaits additional prospective or multicenter investigation.

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Reprint requests

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Conflicts of interest

The authors disclose no conflicts.

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CASE REPORT

Endoscopic submucosal dissection for large laterally spreading tumors involving the ileocecal valve and terminal ileum

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Abstract

Endoscopic submucosal dissection is a challenging technique that enables *en-bloc* resection for large colorectal tumors, as laterally spreading tumors, particularly difficult, if the ileocecal valve and terminal ileum is involved. Herein, we report on one of 4 cases. The procedures, using a bipolar needle knife (B-Knife) to reduce the perforation risk and carbon dioxide instead of conventional air insufflation for patient comfort, achieved curative resections without any complications.

Key words: Ileocecal valve; Colorectal neoplasms; Laterally spreading tumor; Endoscopic mucosal resection; Endoscopic submucosal dissection; Bipolar current needle knife; B-Knife; IT-Knife

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INTRODUCTION

Laterally spreading tumors (LSTs)[1] are mainly located in the cecum and rectum and endoscopic mucosal resection (EMR) is the therapeutic choice[2,3] because of their lower incidence of submucosal (sm) invasion. Involvement of the ileocecal valve with possible spreading to the terminal ileum, however, complicates the EMR and resulting in piecemeal resection in which persistent recurrence leads to surgery even for adenomas and intramucosal cancers[4]. In addition, the thin wall of the narrow ileum increases the risk of perforation during EMR[5].

Our experience suggests that the well-established endoscopic submucosal dissection (ESD) also produces good results in colorectal cases as in early gastric cancer treatment[6]. Unlike the stomach, colonic ESD presents high risk of complications[7] and increased patient discomfort. These factors motivated us to develop better techniques to achieve successful ESDs such as using a bipolar needle knife (B-Knife® Zeon Medical Co. Tokyo, Japan)[8] to reduce the risk of perforation and carbon dioxide (CO_2) instead of conventional air insufflation for patient comfort[9].

In the present report, we describe our experience and the utility of using ESD on one of 4 complete resections of large LSTs (70 mm in diameter) involving the ileocecal valve and terminal ileum.

CASE REPORT

A 76-year-old woman was referred to our hospital for

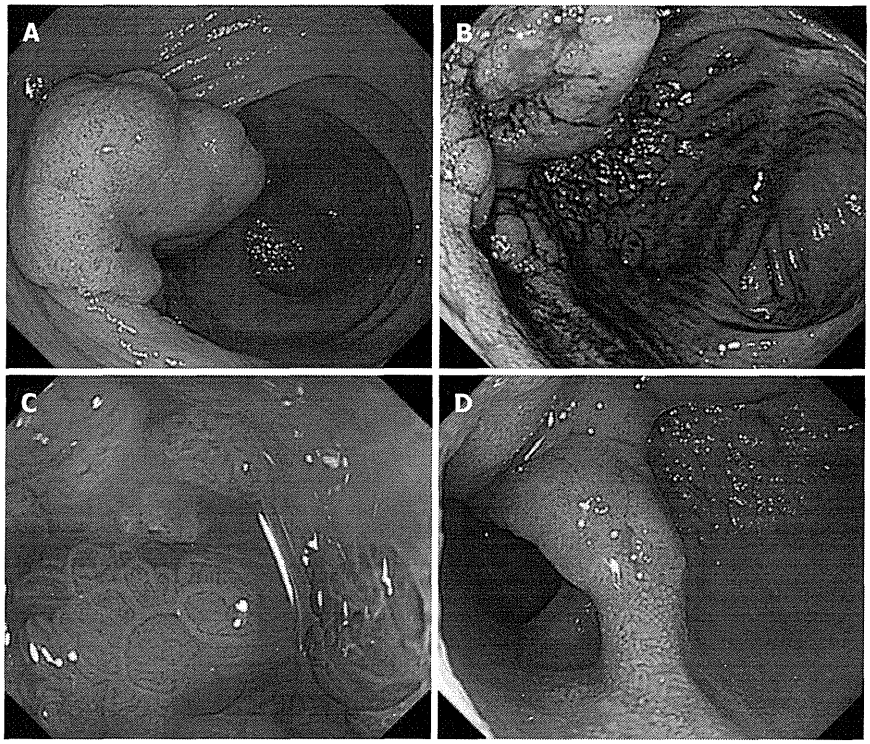

Figure 1 Pre-treatment endoscopic evaluation. A: Close view of the cecum revealed a 70 mm Ⅰs+Ⅱa, LST granular type (LST-G) lesion; B: Clearly delineated margin of the LST-G lesion after 0.4% indigo-carmine dye spraying; C: Magnification view of the Is component of the Ⅰs+Ⅱa (LST-G); D: Spreading confirmation of the tumor through the ileocecal valve to the terminal ileum.

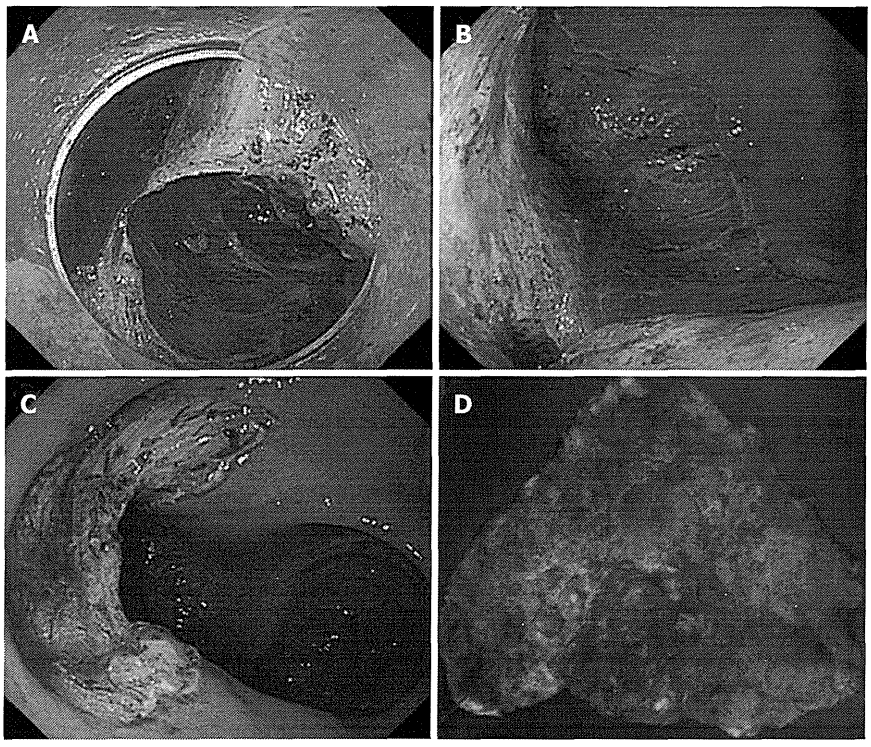

Figure 2 Procedure. A: Endoscopic view through the distal attachment showing dissection with insulation-tip knife; B: Carefully check for bleeding throughout the ileocecal region; C: The ulcer bed of ileum after *en-bloc* endoscopic submucosal dissection; D: Stereomicroscopic view presenting the resected specimen, which pathology reported as a Ⅰs+Ⅱa intramucosal cancer with tumor-free margins of 70 mm in diameter.

cecum. Conventional colonoscopy revealed a broad base, flat tumor. After 0.4% indigo-carmine dye spraying, the margin of the 70 mm-lesion was clearly delineated (Figure 1A and B). High-magnification colonoscopy (PCF-Q240ZI; Olympus Optical Co. Ltd, Tokyo, Japan) disclosed a non-invasive pit pattern[10-12] indicating an intramucosal cancer despite the lesion's large size (Figure 1C). Extension onto the terminal ileum until 1.5 cm from the ileocecal valve was also observed (Figure 1D). After diagnosing a Ⅰs+Ⅱa, LST granular type (LST-G), we performed ESD using B-Knife and insulation-tip knife (IT-Knife) (Olympus Optical Co., Tokyo, Japan) (Figure 2A). During the procedure, we used CO_2 instead of air insufflation to reduce patient's intraoperative abdominal discomfort. This is a safe and effective technique suitable in lengthy colonic endoscopic procedures with the patient under

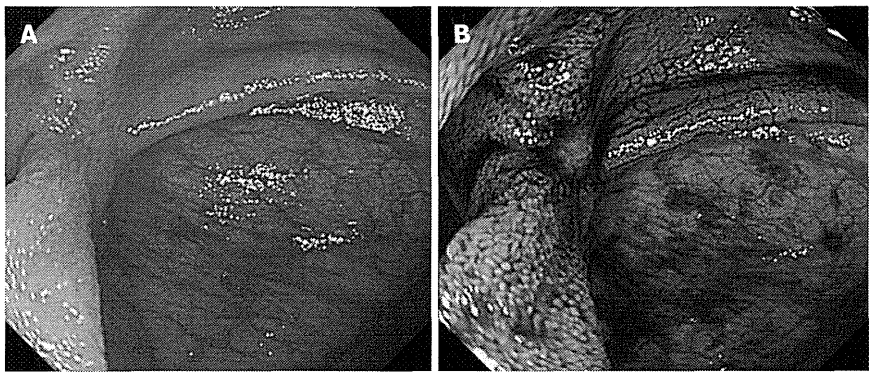

Figure 3 Post-endoscopic submucosal dissection follow-up endoscopic view of the cecum. A: After 6 mo, it shows mildly deformed ileocecal valve due to post-operative scar; B: Following indigo-carmine spraying, no recurrence can be seen.

conscious sedation[13]. Following the injection of glycerol and sodium hyaluronate solution into the sm layer[14,15], a circumferential incision was made using a B-Knife. The thickened sm layer was then dissected (oral to anal) across the ileocecal valve using both the B-Knife and IT-Knife. Finally, hemostasis was carefully checked throughout the ileocecal region (Figure 2B and C). The procedure took 150 min and neither perforation nor delayed bleeding was recognized. Hospitalization lasted four days with no further complications. Histopathology disclosed that the 70 mm resected specimen was an intramucosal cancer with tumor-free margins (Figure 2D). Although some retraction of the ileocecal valve could be observed, follow-up examinations after 6 mo revealed no residual tumor or recurrence (Figure 3A and B).

DISCUSSION

In the present report, en-bloc resection was successfully achieved by ESD using B-Knife and IT-Knife, despite the difficult location involving the ileocecal valve and terminal ileum and the large size of the lesion. IT-Knife, a developed insulation-tipped monopolar electrosurgical knife for removing large gastric lesions en-bloc, is not widely accepted in the colorectum because of its technical difficulty and the risk of complications, such as perforation and bleeding. On the other hand, a bipolar current minimizes the damage to deeper tissues. Thus, the current flow characteristics of the B-Knife reduce the vertical damage and risk of perforation demonstrating its utility for ileocecal ESDs[9,10].

Another important consideration was patient discomfort with air insufflation in long procedures. The supply of air can easily flow into the ileum causing painful distension even in EMRs for cecal lesions. In an earlier study aimed at reducing abdominal discomfort using CO_2 in colorectal ESDs, we demonstrated the advantages and safety of CO_2 compared to conventional air[14]. This factor was evident in the present case. Although a large amount of CO_2 was supplied to the ileum, only a small amount of midazolam (4 mg in both cases) was required for intra-operative sedation.

Considering the indications for colorectal ESD, we M < 40 mm[3]. In these four cases, we decided to perform ESD because of the LST-Gs large size, their location at the ileocecal valve and terminal ileum spreading, the probability of sm infiltration, and an increased likelihood of incomplete resections and recurrence.

Limitations

In our institution, we have performed colorectal ESD using a B-Knife and an IT-Knife in 500 cases. Among of these 500 ESDs, large LST involving the ileocecal valve were only 4 cases, including the presented case. Based on our experience, lesions should be limited at most to 1 or 2 cm into the ileum and not circumferential. If the extension is more than 2 cm or circumferential, ESD would be very difficult and hazardous, so laparoscopy-assisted colectomy should be recommended. The reported case extended 1.5 cm into the ileum, making the most challenging one. Compared with conventional EMR[16], however, the longer procedure time for colorectal ESDs is still a problem. Nevertheless, we are improving our learning curve and using newly developed devices to reduce the length of the procedure and associated complications in order to increase the widespread use of colorectal ESD.

In conclusion, we successfully performed ESD in large LST-G involving the ileocecal valve and terminal ileum using a B-Knife and an IT-Knife with CO_2 insufflation.

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ORIGINAL ARTICLE

How often should we perform surveillance colonoscopy after surgery for colorectal cancer?

Taku Sakamoto · Takahisa Matsuda · Takeshi Nakajima · Yutaka Saito

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Abstract
Purpose Surveillance colonoscopy is undertaken after resection of colorectal cancer to detect and treat local recurrence and metachronous lesions, with the aim of improving survival. This study aimed to clarify the current timing of surveillance colonoscopies and evaluate the rates of local recurrence and metachronous tumors.
Methods We retrospectively analyzed data from 459 patients who underwent surveillance colonoscopy at our institution after curative resection of colorectal cancer. The number and timing of surveillance colonoscopies, incidence of local recurrence and metachronous lesions, pathological findings of lesions, treatment of lesions, and outcomes were recorded.
Results The first surveillance colonoscopy was undertaken at 6–18 months after surgery in 73 % of patients. Local recurrence was detected in three cases (0.7 %), all during the first surveillance colonoscopy, which was performed >1 year after surgery. These three patients all underwent additional surgery and were alive 5 years later. Invasive metachronous cancers were detected in six patients (1.3 %) at 18–57 months after surgery, and advanced adenomas were detected in 30 patients.
Conclusion Considering the low incidence of postoperative lesions and the timing of lesion detection, reducing the number of surveillance colonoscopies after surgery for colorectal cancer may be appropriate.

Keywords Colonoscopy · Colorectal cancer · Local recurrence · Metachronous lesion

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Introduction

Previous studies reported that intense surveillance after curative surgery for colorectal cancer, including colonoscopy, computed tomography, and measurement of serum carcinoembryonic antigen levels, improved overall survival and early detection of local recurrence and distant metastasis [1–7]. The important aims of colonoscopy are detection of local luminal recurrence and metachronous colorectal cancer. Early detection and endoscopic resection of polyps, which may be precursors of invasive lesions, is thought to contribute to improved mortality rates in patients with colorectal cancer. Colonoscopy is therefore considered to play a very important role in achieving curative treatment for colorectal cancer. The American Cancer Society and US Multi-Society Task Force guidelines suggest surveillance colonoscopy at 1, 4, and 9 years after surgery if all synchronous colonic lesions are treated during the preoperative or perioperative periods [8]. However, there are no established guidelines for surveillance colonoscopy in Japan, and the timing of colonoscopies is at the discretion of the attending physician. The aim of this study was to clarify the current timing of surveillance colonoscopies in Japan and evaluate the incidence of local recurrence and metachronous cancer.

Methods

We retrospectively analyzed data from 873 consecutive patients who underwent surgical resection from colorectal cancer at our institution from January 2004 to December 2005. All patients gave written informed consent for clinical examination and treatment. Patients were excluded if they had familial adenomatous polyposis, Lynch syndrome, ulcerative colitis, International Union Against Cancer-TNM stage IV disease at the time of initial treatment, serious

comorbidities (coronary artery disease, neurological disease), or distant metastasis. Of the 671 remaining patients, 459 underwent at least one colonoscopy after surgery at our institution, and the others were followed up in private care. There were no significant differences in clinical background characteristics between patients who underwent colonoscopy at our institution and those who did not (Table 1).

We collected the following information from the medical records: number of surveillance colonoscopies, timing of surveillance colonoscopies, lesions detected during surveillance colonoscopy (local recurrence or metachronous), pathological findings of lesions detected during surveillance colonoscopy, treatment, and outcomes of lesions detected during surveillance colonoscopy. Colonoscopies were classified into six periods according to the time after surgery: 6–18, 19–30, 31–42, 43–54, 55–66, or ≥67 months.

Preoperative examination

Full colonoscopy was performed in all patients prior to surgery, either at our institution or the referring institution. Neoplastic lesions, other than the main lesion, measuring >10 mm in diameter were resected endoscopically and examined to confirm that there was no invasive tumor. If it was difficult to perform, full colonoscopy due to poor bowel preparation or severe stenosis, barium enema, or CT colonography was performed instead of full colonoscopy. The timing of the first surveillance colonoscopy in patients who did not undergo full preoperative colonoscopy was decided by the attending physician.

Table 1 Background characteristics of patients

	Surveillance colonoscopy+ (n=459)	Surveillance colonoscopy− (n=212)	P value
Age (years)	62±11	62±12	
Gender (male/female)	268/191	119/93	0.582
Location (%)			0.371
Colon	310 (68)	139 (66)	
Rectum	149 (32)	73 (34)	
Dukes (%)			0.873
A, B	285 (62)	133 (63)	
C	174 (38)	79 (37)	
Full colonoscopy (%)			0.260
Yes	335 (73)	146 (69)	
No	49 (11)	32 (15)	
Unknown	75 (16)	34 (16)	
Observation period (months)	60 (12–85)	–	

Data are presented as the mean ± standard deviation, n (%), or median (range)

Results

Timing of surveillance colonoscopies

Figure 1 shows the timing of colonoscopies. Most patients (73 %) underwent their first surveillance colonoscopy at 6–18 months after surgery, and among these, the most common time period for the second surveillance colonoscopy was 55–66 months after surgery (31 % of all patients). Twenty-one percent of all patients underwent their first surveillance colonoscopy at 6–18 months after surgery and then continued radiographic and carcinoembryonic antigen surveillance without further colonoscopy.

Prevalence of postoperative lesions

Postoperative lesions detected during surveillance colonoscopy included advanced adenomas and invasive cancers, including luminal recurrences. Postoperative lesions were detected in 8.5 % of patients (95 % confidence interval, 6.1–11.4 %). The three cases (0.7 %) of luminal recurrence were all detected during the first surveillance colonoscopy, which was >1 year after surgery. Of these, the initial lesion was located in the rectum in one patient and in the colon in the other two patients. These three patients all underwent additional surgery, and were alive at 5 years after their second operation. Six invasive metachronous lesions (1.3 %) were detected. One metachronous lesion was detected during the first surveillance colonoscopy at 6–18 months after surgery, and the others were detected at 31–66 months after surgery. Curative resection was achieved by endoscopic submucosal dissection or surgery in all cases. Details of the patients with metachronous lesions are shown in Table 2. Thirty advanced adenomas were detected at various follow-up times, all of which were treated by endoscopic mucosal resection. Kaplan–Meier cumulative incidence curves for luminal recurrence, metachronous invasive cancer, and metachronous advanced adenoma are shown in Fig. 2.

Discussion

Our results show that most patients followed up at our institution did not undergo a less intensive surveillance colonoscopy program than the generally recommended guidelines. However, the incidence of postoperative lesions was low. We therefore considered the possibility of prolonging the intervals of surveillance colonoscopies.

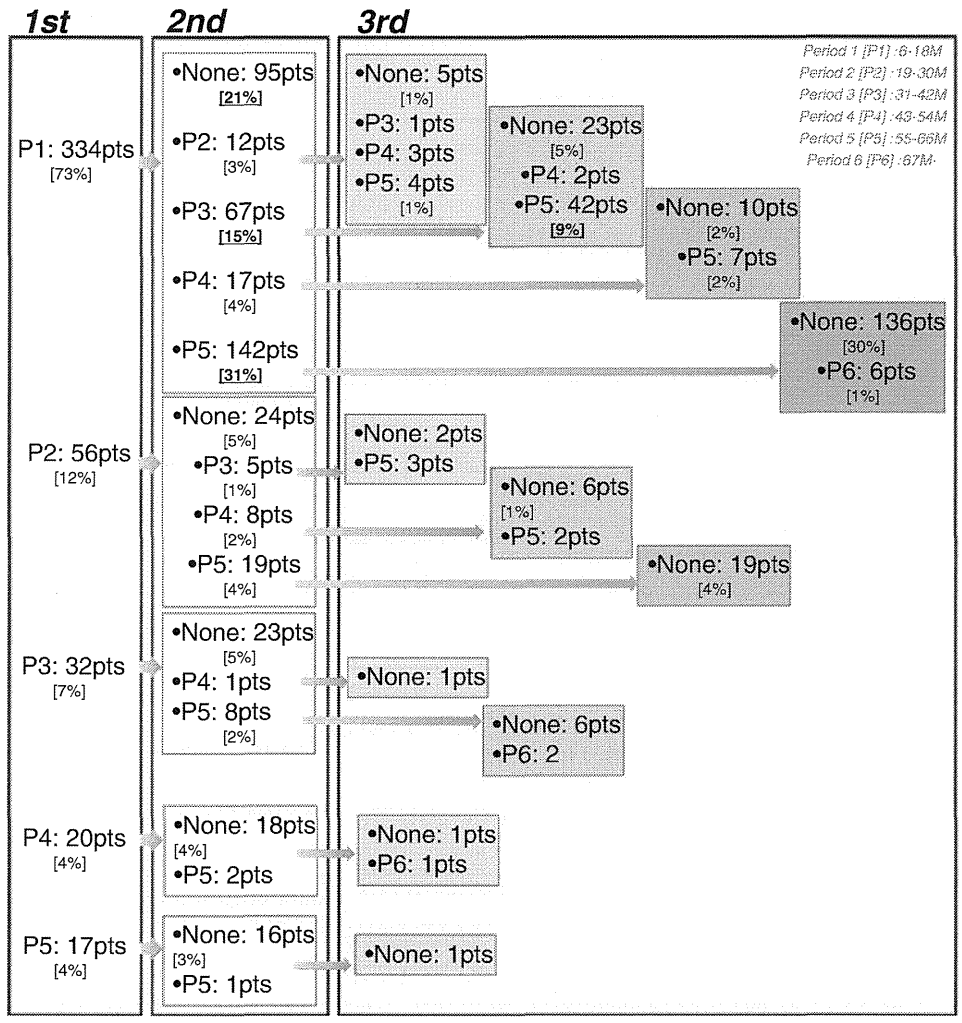

Fig. 1 Details of surveillance colonoscopy intervals

The overall local luminal recurrence rate in this study was <1 %, and recurrent lesions were all detected at >1 year after surgery. The Japanese guidelines for the treatment of colorectal cancer report a local luminal recurrence rate of 0.4 % [9]. These rates are consistent with previously reported rates. Even though the recurrence

Table 2 Clinicopathological characteristics of patients with metachronous invasive cancer

Patient		Primary lesion		Secondary lesion			
Age (years)	Gender	Site	Full CS	Site	Surveillance CS (months)	Clinical diagnosis	Treatment
64	M	S	Yes	C	55	Metachronous	ESD, surgery
70	M	S	No	A	57	Metachronous	ESD
75	F	T	No	A	45	Metachronous	Surgery
67	F	RS	–	Rb	18	Metachronous	Surgery
73	M	T	Yes	–	12	Local recurrence	Surgery
49	M	Rb	Yes	–	13	Local recurrence	Surgery
58	M	D	–	–	12	Local recurrence	Surgery
66	M	S	Yes	A	11, 37	Metachronous	Surgery
72	M	A	Yes	D	29, 41	Metachronous	Surgery

CS colonoscopy, *ESD* endoscopic submucosal dissection

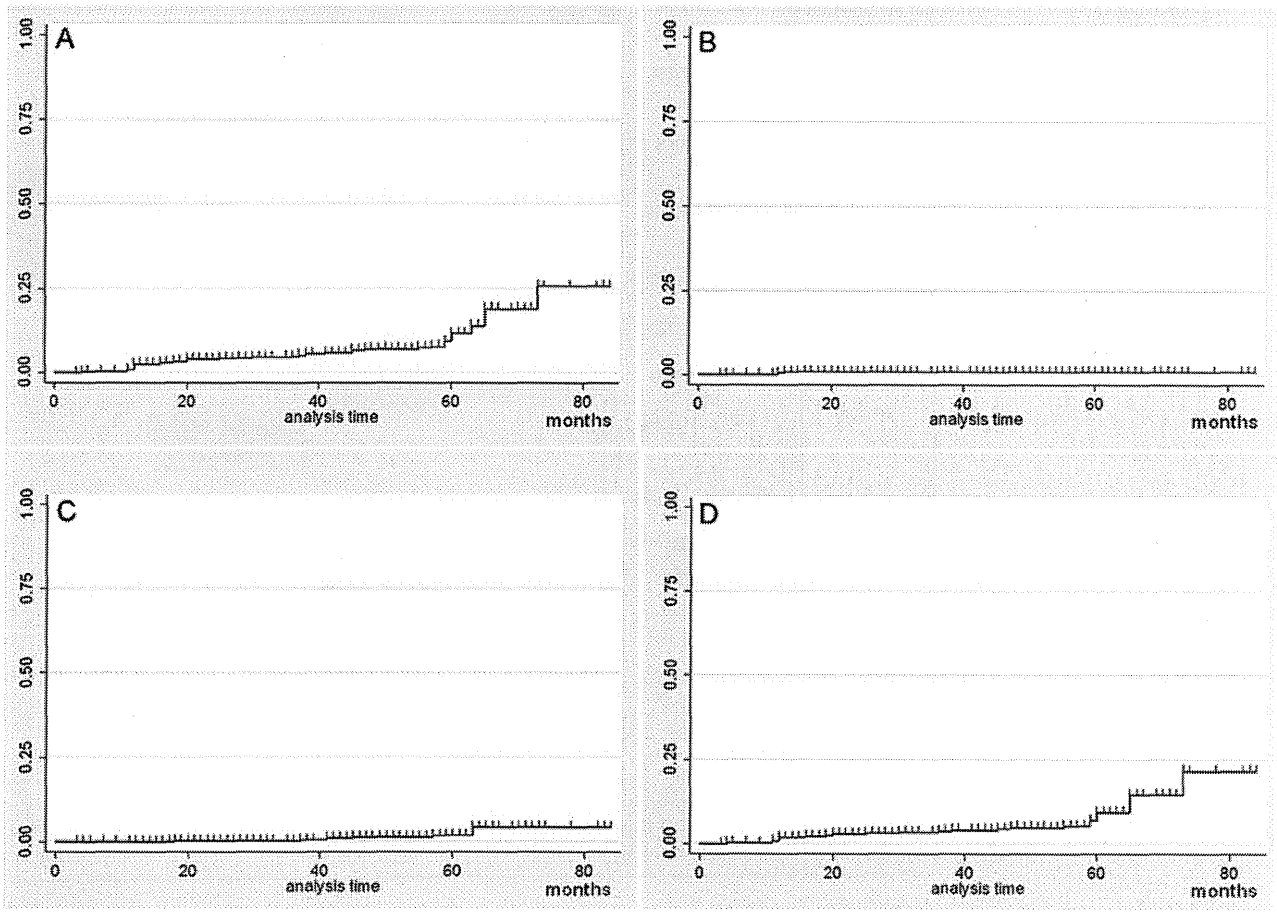

Fig. 2 Kaplan–Meier cumulative incidence curves for postoperative lesions. **a** All postoperative lesions. **b** Local luminal recurrence. **c** Metachronous invasive cancer. **d** advanced adenoma

rate is relatively low, it is important to undertake surveillance for local luminal recurrence at the anastomosis, as such recurrence may affect the patient's prognosis and the invasiveness of ongoing treatment. Surveillance colonoscopy during the first year is therefore considered to be essential.

The metachronous lesion rate (invasive and advanced adenoma) was 8 %, which was more frequent than the rate of local luminal recurrence. Detection of metachronous lesions can therefore be considered to be one of the main purposes of surveillance colonoscopy.

Previous studies have reported an improved survival rate in patients with colorectal cancer who undergo colonoscopic surveillance [10–13]. It is widely accepted that most colorectal cancers arise from an adenoma-carcinoma sequence, and screening colonoscopy is recommended for the early detection and removal of polyps. In this study, surveillance colonoscopy detected advanced adenomas in 5.4 % of patients. Invasive metachronous carcinomas were detected in 1.3 % of patients at 3–5 years after surgery. Two of the six cases of invasive cancer were detected during the second surveillance colonoscopy. One of these two invasive carcinomas was located in the descending colon near the splenic flexure and the other was in the ascending colon. These carcinomas may have been missed during the first surveillance colonoscopy. It has been reported that flat and depressed-type lesions have a relatively high malignant potential [14–18]. These types of lesions are considered difficult to detect by conventional colonoscopy with poor bowel preparation. Moreover, it may be more difficult to detect these lesions in regions of the colon which are curved and have blind areas. If precancerous lesions are detected at the preoperative or first surveillance colonoscopy, they can be treated endoscopically, and a second operation can be avoided. As some metachronous cancers were detected at 4–5 years after surgery, a second surveillance colonoscopy should be planned at 3–4 years after surgery.

Considering the timing of postoperative lesion detection, surveillance colonoscopy during the first 5 years after surgery may be sufficient for the early detection of metachronous lesions. Reducing the number of colonoscopies may

contribute to patient compliance and reduce medical costs. However, quality control of colonoscopies is essential. As discussed above, it is difficult to detect flat and depressed-type lesions with poor bowel preparation, and some lesions may be overlooked. The quality of the preoperative and first surveillance colonoscopies is therefore crucial [19, 20]. If full preoperative colonoscopy is difficult, postoperative colonoscopy should be undertaken within 1 year to detect and resect any lesions that may have been overlooked.

This study has some limitations. First, this was a single-center study, and the quality of colonoscopy and surgery may differ between institutions. A multicenter trial should therefore be conducted to further evaluate the incidence of local recurrence and metachronous lesions. Second, this study was retrospective. Some patients who underwent surgery at our institution were excluded because they were followed up at a different institution due to of their location and age. A prospective study with well-defined inclusion criteria should be undertaken to evaluate the results of colonoscopy after surgery. Third, we were unable to determine the optimal surveillance colonoscopy intervals from the results of this study and were only able to suggest that longer intervals might be appropriate. To evaluate surveillance colonoscopy intervals, the results of the current colonoscopy guidelines should be evaluated by a multicenter retrospective study, and patients who undergo colonoscopy earlier should be compared with those undergoing colonoscopy at the usual times. Fourth, this study could not evaluate the survival rate after surgery. Considering that the aim of postoperative surveillance is to improve the survival rate, this should be further investigated.

In conclusion, we emphasize that reducing the frequency of colonoscopic surveillance may be safe, even in patients who are classified as at high risk for colorectal cancer. We plan to conduct further clinical trials to evaluate this concept.

Conflict of interest The authors have no financial or other conflicts of interest to declare.

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LETTERS, TECHNIQUES AND IMAGES

Impact of endoscopic submucosal dissection knife on risk of perforation with an animal model-monopolar needle knife and with a bipolar needle knife

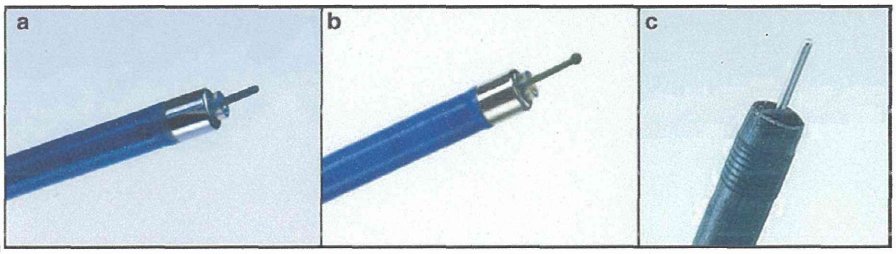

Fig. 1. (a) Bipolar needle knife (B knife). (b) Ball-tip B knife (BB knife). (c) Monopolar needle knife.

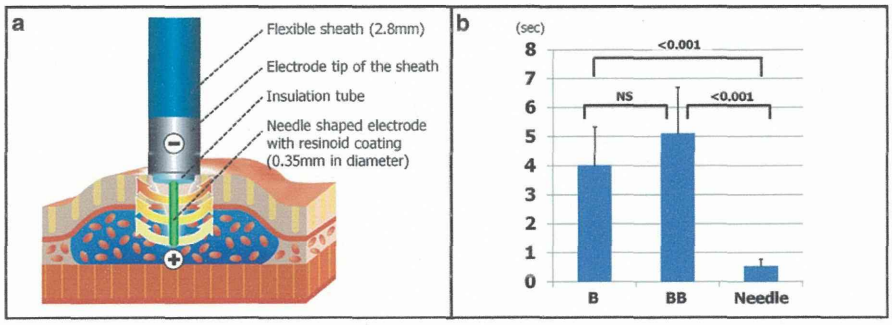

Fig. 2. (a) Schematic view showing flow route of high-frequency electric current from knife to sheath tip. (b) Results of bipolar needle knife (B knife), ball-tip B knife (BB knife) and monopolar needle knife showing time to perforation (s) on a resected porcine esophagus. NS, not significant.

The bipolar needle knife (B knife; XEMEX Co, Tokyo, Japan) was developed to reduce the risk of perforation during endoscopic submucosal dissection compared to monopolar instruments (Fig. 1a).[1] It was designed so high-frequency electricity flows from the knife to the sheath tip, reducing the amount of current sent to the muscle layer (Fig. 2a).[2] Subsequently, the ball-tip B knife (BB knife; XEMEX) was designed with a ball-shaped needle end, to further reduce the risk of perforation (Fig 1b). The objective of this animal experiment was to confirm and compare the actual risk of perforation with these different knives.

A resected porcine esophagus was cut open along the long axis to expose the lumen, which was fixed to a tray with stable tension. The end of each endoscopic submucosal dissection knife attached to a stick was designed to perpendicularly contact the mucosa. A 200 g fixed weight attached to the stick created a constant pressure for each application. A 40 W forced coagulation current (ICC200; ERBE, Tübingen, Germany) was applied with a needle knife (Olympus Optical Co., Ltd, Tokyo, Japan) (Fig. 1c), B knife and BB knife, and perforation time was measured. This procedure was repeated 10 times for each knife.

The time to perforation (mean ± SD) with the needle knife, B knife and BB knife was 0.5 ± 0.2, 4.0 ± 1.3 and 5.1 ± 1.6 s, respectively (needle *vs* B, $P < 0.001$; B *vs* BB, not significant; needle *vs* BB, $P < 0.001$) (Fig. 2b). The B and BB knives had significantly longer times to perforation than the needle knife.

Bipolar instruments are considered safer because of their perceived reduced risk of perforation, particularly the BB knife with its ball-tipped design. Our study reaffirmed that bipolar knives are better for performing endoscopic submucosal dissection of the esophagus and colorectum, which have thinner walls than the stomach.

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Knowledge of, attitudes toward, and barriers to participation of colorectal cancer screening tests in the Asia-Pacific region: a multicenter study

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Background: The rapid increase in the incidence of colorectal cancer (CRC) in the Asia-Pacific region in the past decade has resulted in recommendations to implement mass CRC screening programs. However, the knowledge of screening and population screening behaviors between countries is largely lacking.

Objective: This multicenter, international study investigated the association of screening test participation with knowledge of, attitudes toward, and barriers to CRC and screening tests in different cultural and sociopolitical contexts.

Methods: Person-to-person interviews by using a standardized survey instrument were conducted with subjects from 14 Asia-Pacific countries/regions to assess the prevailing screening participation rates, knowledge of and attitudes toward and barriers to CRC and screening tests, intent to participate, and cues to action. Independent predictors of the primary endpoint, screening participation was determined from subanalyses performed for high-, medium-, and low-participation countries.

Results: A total of 7915 subjects (49% male, 37.8% aged 50 years and older) were recruited. Of the respondents aged 50 years and older, 809 (27%) had undergone previous CRC testing; the Philippines (69%), Australia (48%), and Japan (38%) had the highest participation rates, whereas India (1.5%), Malaysia (3%), Indonesia (3%), Pakistan (7.5%), and Brunei (13.7%) had the lowest rates. Physician recommendation and knowledge of screening tests were significant predictors of CRC test uptake. In countries with low-test participation, lower perceived access barriers and higher perceived severity were independent predictors of participation. Respondents from low-participation countries had the least knowledge of symptoms, risk factors, and tests and reported the lowest physician recommendation rates. "Intent to undergo screening" and "perceived need for screening" was positively correlated in most countries; however, this was offset by financial and access barriers.

Limitations: Ethnic heterogeneity may exist in each country that was not addressed. In addition, the participation tests and physician recommendation recalls were self-reported.

Conclusions: In the Asia-Pacific region, considerable differences were evident in the participation of CRC tests, physician recommendations, and knowledge of, attitudes toward, and barriers to CRC screening. Physician recommendation was the uniform predictor of screening behavior in all countries. Before implementing mass screening programs, improving awareness of CRC and promoting the physicians' role are necessary to increase the screening participation rates. (Gastrointest Endosc 2012;76:126-35.)

Abbreviations: CRC, colorectal cancer; FOBT, fecal occult blood test.

DISCLOSURE: *The authors disclosed no financial relationships relevant to this publication.*

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The past decades have seen a rapid increase in the incidence of colorectal cancer (CRC) in usually low-risk Asia-Pacific populations, with industrialized countries and regions such as Japan, China, Hong Kong, Taiwan, Korea, and Singapore reaching incidence rates comparable to those of Western nations.[1-3] This increase in incidence has been largely attributed to environmental factors including the adoption of the Western lifestyle.[1]

Population screening with fecal occult blood test (FOBT) significantly reduces CRC mortality.[4,5] Despite this, the participation rates of at-risk populations in Western and Asian countries remain low.[6-9] CRC screening is a challenging process and requires all of its components to function correctly for it to be successful. Barriers to successful CRC screening include lack of patient awareness, attitudes and acceptance, physicians' knowledge, attitudes and recommendations, multiple screening modalities with their intrinsic benefits, limitations and risks, logistic and financial considerations, timely diagnosis, and appropriate follow-up. Successful screening also requires moderate patient effort, sustained participation, and specialized health care providers with skills in colonoscopy.[10]

The Asia-Pacific Working Group in Colorectal Cancer was established in 2004 to study the epidemiology of CRC and the appropriateness and feasibility of implementing population-based CRC screening programs in the Asia-Pacific region. It recently reported consensus guidelines on screening and recommended FOBT, flexible sigmoidoscopy, and colonoscopy as suitable screening modalities in Asia, with FOBT as the preferred test in resource-limited countries.[11] Subsequent studies revealed comparable incidences of advanced CRC in Asian and Western nations, supporting the benefits of screening.[12,13] However, screening behavior in the Asia-Pacific region remains largely unknown. This comparative study involved 14 Asia-Pacific countries and used a validated structured survey based on the Health Belief Model.[14] The study investigates the prevailing participation of CRC tests, knowledge of and attitudes toward CRC and screening tests, and barriers to screening and examines possible interventional strategies to facilitate screening participation in different cultural and sociopolitical contexts. Interventional measures, including culturally and linguistically appropriate educational programs may be developed to improve the overall uptake rates of CRC tests in the Asia-Pacific region.

Take-home Message

- Considerable deficiencies existed in colorectal cancer (CRC) knowledge, attitudes, and physician recommendations, leading to poor uptake of CRC tests in the Asia-Pacific region.
- Improving awareness of CRC through mass education and increasing physicians' promotion of CRC screening are strongly recommended.

METHODS

Subjects

This multicenter, international study involved 14 countries/regions in the Asia-Pacific area: Hong Kong, Australia, Brunei, China, India, Indonesia, Japan, Korea, Malaysia, Pakistan, Philippines, Singapore, Taiwan, and Thailand. Over a 4-month period in 2007, trained researchers performed person-to-person interviews in native languages with patients and visitors of ages 30 to 65 years who were randomly recruited from outpatient clinics at the investigators' respective hospitals. To reduce selection bias, patients attending gastroenterology or related clinics (eg, inflammatory bowel disease and hepatology clinics) were excluded from the study. Participation was voluntary, and informed consent was obtained from all participants. Ethics approval was obtained from the individual centers for the collection and reporting of these data.

Questionnaire

A simplified version of questionnaire items used in a telephone survey by Hong Kong researchers in 2006 was used as measurement instruments, and the details of the questionnaire are described elsewhere.[14] In multilingual countries, the questionnaire was translated into the native languages and back-translated to ensure accuracy. The study questionnaire included measurements of key elements that were essential components of the Health Belief Model, including (1) knowledge of the CRC symptoms and risk factors, (2) knowledge of the types of CRC screening tests, (3) perceived risk of CRC, (4) risk factors for CRC, (5) previous CRC test participation and clinical indications, (6) perceived benefits of screening, (7) intent to undergo CRC screening, (8) major barriers to CRC screening, (9) perceived severity of CRC, (10) access to health care, (11) cues to action, and (12) sociodemographic information including sex, age, education, marital status, employment status, and personal and household income. To assess respondents' knowledge of CRC symptoms, risk factors, and screening tests, respondents were asked "what are the symptoms of bowel cancer" and "what are the risks of bowel cancer" and whether they had heard of each screening test (FOBT, colonoscopy, flexible sigmoidoscopy, and virtual colonoscopy). A standardized lay description of each test was presented to ensure correct comprehension and representation. Interviewers scored correct answers on a list undisclosed to the respondents.

The assessment of perception of CRC severity and the negative consequences of screening tests consisted of 9 questions and used a 5-point Likert scale. Respondents indicated the extent to which they agreed or disagreed with each item. Each response category ranged from

TABLE 1. Demographic characteristics

Characteristic	Total (N = 7915)	Australia (n = 500)	Brunei (n = 502)	China (n = 1078)	Philippines (n = 343)	Hong Kong (n = 502)	India (n = 340)
Sex, %							
Male	51.7	42.4	58.6	50.0*	53.6	45.2	87.4
Female	48.3	57.6	41.4	50	46.4	54.8	12.6
Age, ≥50 y, %	37.8	62.2	32.1	25.5	27.1	57.6	19.1
Education level, %							
Primary or no schooling	18.0	4.4	12.7	13.2	15.7	32.7	44.4
Secondary	39.0	72.2	57.6	46.8	21.9	53.4	21.2
Tertiary	43.0	23.4	29.7	40.0	62.4	13.9	34.4
Monthly household income, US$, %							
≤1000	48.0	38.4	47.1	87.8	90.7	21.0	88.9
1000-5000	40.9	48.2	45.7	10.8	8.3	66.8	2.0
≥5000	11.1	13.4	7.2	1.4	1.0	12.2	9.1
Network member had colorectal cancer, %	25.1	41.8	33.7	19.7	39.1	28.7	6.2
Health insurance, yes, %	44.5	29.4	5.8	42.4	23.9	23.5	9.7

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*n = 648 available for analysis of sex.
†n = 27 available for analysis of monthly household income.

strongly agree, agree, unsure, disagree, and strongly disagree and was scored from 0 to 4. Scores were summed; higher scores indicated greater negative perception. Similarly, for perceived financial barrier, time constraints, and access barrier to testing, respondents were also asked the extent to which they agreed with these items, which were scored from 0 to 4.

To evaluate perceived susceptibility, respondents were asked whether they had any CRC risk factors. Each reported risk scored 1 point, and the total was classified as perceived risk score. A question examining the need for regular screening in an asymptomatic person aged 50 years and older was posed to determine whether respondents appreciated the rationale for screening. The responses "great need," "some need," "not sure," "little need," and "no need" were scored from 4 to 0 and categorized as the perceived testing need score.

To assess health behaviors, respondents were asked whether they had undergone previous CRC tests and if so, the type and indications for them. The indication was classified as symptomatic or asymptomatic. Intention to undergo screening was assessed with the question "Will you have a bowel cancer screening test?" The responses were "definitely yes," "yes," "no," and "definitely not." To evaluate cues to action, respondents were asked whether they had received physician recommendations to have tests, whether they recalled reading or hearing CRC information in the media, and whether they were familiar with patients with CRC.

Statistical analysis

Associations between categorical variables and outcomes were assessed by using the χ^2 test. Continuous variables were compared by using nonparametric methods. The Australian cohort was considered the reference country with which comparisons of categorical and continuous variables for each country were made. This was because CRC screening has been an accepted test in this country, where there was a high level of knowledge and acceptance.[15,16] The Kruskal-Wallis test was first used to compare 14 countries simultaneously followed by the Mann-Whitney *U* test for pairwise comparisons. Results are shown with Bonferroni adjustment for multiple comparisons. Because Kruskal-Wallis tests revealed a significant effect for all factors ($P < .001$), post hoc tests by using the Mann-Whitney *U* test with Bonferroni correction were conducted. To assess for independent predictors of CRC test uptake, a 4-level hierarchical logistic regression to variable selection was used. The first level included sociodemographic variables, the second level included knowledge factors, the third level included perception factors, and the fourth level included cues to action. At

TABLE 1. *(Continued)*

Indonesia (n = 611)	Japan (n = 388)	Korea (n = 767)	Malaysia (n = 501)	Pakistan (n = 490)	Singapore (n = 906)	Taiwan (n = 535)	Thailand (n = 452)
53.2	56.3	43.7	49.3	64.3	54.9	43.0	36.7
46.8	43.7	56.3	50.7	35.7	45.1	57.0	63.3
33.2	80.7	52.0	19.8	19.0	48.1	16.8	35.8
33.1	2.3	8.7	11.6	31.2	17.0	7.9	19.9
31.1	84.1	45.9	37.9	21.2	40.2	14.0	17.3
35.8	13.6	45.4	50.5	47.6	42.8	78.1	62.8
37.9	0.0	14.3	72.2	96.6	21.4	16.6	49.9
53.3	51.9	70.9	26.5	2.6	44.7	73.7	44.2
8.8	48.1†	14.8	1.3	0.8	33.0	9.7	5.9
17.2	9.0	33.8	15.2	19.4	22.6	25.4	27.7
57.1	47.6	73.3	61.7	26.9	50.3	64.5	70.8

each level, all variables were included, and those with a P value $\leq .1$ were retained and adjusted for the next level by using backward stepwise regression. In the final model, the variables were considered significant if $P < .05$ after adjusting for variables at the same level and higher. SPSS for Windows, version 17 (SPSS Inc, Chicago, Ill) was used to analyze the data.

RESULTS

Demography

During the study period, 8755 eligible subjects were invited to participate in the survey, and 7915 (90.4%) completed the survey (49% male subjects, 435 subjects [40%] missing sex data from China cohort; 37.8% of subjects were 50 years and older). The demographic characteristics are depicted in Table 1. At the time of the study, Japan, Korea, and Taiwan had population-based screening programs using FOBT.

Knowledge of CRC symptoms, risk factors, and screening tests

Considerable differences were evident in the knowledge of CRC symptoms, risk factors, and tests according to country of residence (Table 2). The most commonly recalled CRC symptoms were blood in the stool (45.1%), abdominal pain (30.5%), and diarrhea or constipation (27.8%), whereas 30% were unable to recall any symptom. The most frequently identified risk factors were consuming too much fried food (27.3%), inadequate consumption of fruits and vegetables (25.1%), and family history of CRC (23.8%), whereas 29% were unaware of any risk factor. Only 15% of all respondents and 16% of those older than 50 years of age recognized age as a risk factor. The median knowledge scores for symptom, risk factor, and tests were very low in India, Brunei, Malaysia, and Singapore; more than half of the respondents from these countries could not recall a symptom or risk factor. In contrast, respondents from the Philippines and Japan had the highest knowledge scores, with more than 90% recalling at least 1 CRC symptom and risk factor. Respondents from Thailand and Pakistan had high levels of knowledge of symptoms and risk factors, but not of tests.

Perception of CRC and screening tests

Overall, 18.4% reported having risk factors for CRC. The perception scores of respondents from each country were compared with Australia and depicted in Table 3. Respondents from Korea, China, and Taiwan had the lowest median perceived risk scores. Those from Brunei, Korea, and Taiwan had the highest perceived cancer severity scores, whereas Malaysian and Japanese respondents had lowest perceived cancer severity scores. Japan had the lowest perceived negative health consequences of testing. Respondents from Malaysia and Pakistan had the lowest scores for perceived need for testing when asymptomatic and the highest time constraints and access barriers.

TABLE 2. Knowledge of CRC and screening tests

Factor	Australia	Brunei	China	Philippines	Hong Kong	India	Indonesia	Japan	Korea	Malaysia	Pakistan	Singapore	Taiwan	Thailand
Did not know any symptom, %	31.2	45.6*	22.6*	2.0*	14.5*	61.5*	41.1†	0.3*	41.1*	50.1*	15.9*	54.4*	12.0*	3.1*
Did not know any risk factor, %	34.8	40.6	17.5*	1.2*	13.1*	71.5*	21.1*	7.2*	51.5*	58.3*	20.4*	54.0*	8.4*	1.3*
Did not know any CRC test, %	12.8	52.4*	35.8*	12.2	22.3*	87.1*	58.3*	2.4†	9.6	80.0*	58.4*	39.3*	18.9†	53.3*
Median symptom knowledge score, 0-9	2.0	1.0‡	2.0‡	4.0‡	2.0	0.00‡	1.0‡	2.0‡	1.0‡	0.0‡	3.0‡	0.00‡	3.0‡	3.0‡
Median risk factor knowledge score, 0-9	1.0	0.00‡	2.0‡	4.0‡	1.0‡	0.00‡	0.00	4.0‡	0.00‡	0.00‡	2.0‡	0.00‡	2.0‡	3.0‡
Median test knowledge score, 0-5	2.0	0.00‡	1.0‡	2.0‡	1.0‡	0.00‡	0.00‡	2.0‡	1.0§	0.00‡	0.00‡	1.0‡	2.0§	0.00‡

CRC, Colorectal cancer.
*$P < .001$ compared with Australia with χ^2 2 × 2 test ($df = 1$).
†$P < .05$ compared with Australia with χ^2 2 × 2 test ($df = 1$).
‡$P < .001$ compared with Australia with Mann-Whitney *U* test.
§$P < .05$ compared with Australia with Mann-Whitney *U* test.

TABLE 3. Perception and attitudes toward CRC and screening

Median (scores range)	Australia	Brunei	China	Philippines	Hong Kong	India	Indonesia	Japan	Korea	Malaysia	Pakistan	Singapore	Taiwan	Thailand
Median perceived risk score, 0-2	1.0	1.0*	0.00*	1.0*	0.00†	1.0*	0.00	1.0	0.00*	1.0	0.00	1.0	0.00	2.0*
Median perceived cancer severity score, 0-20‡	13.0	17.0*	13.0	15.0*	14.0	15.0*	14.0†	9.0*	15.0*	7.0*	14.0	14.0*	15.0*	14.0*
Median perceived testing need score, 0-4§	3.0	3.0*	3.0*	3.0	4.0*	2.0*	3.0*	3.0*	3.0	1.0*	1.0*	3.0	3.0*	4.0*
Median score of perceived negative health consequence of testing, 0-16‡	6.0	8.0*	9.0*	12.0*	7.0*	10.0*	8.0*	4.0	9.0*	9.0*	12.0*	6.0	10.0*	8.0*
Median score of perceived financial burden of testing, 0-4‡	2.0	3.0*	2.0	3.0*	3.0*	1.0*	3.0*	1.0*	2.0*	2.0*	3.0*	2.0*	1.0*	2.0†
Median score of perceived time constraint of test, 0-4‡	1.0	1.0*	2.0*	3.0*	1.0	1.0*	1.0*	3.0*	1.0*	3.0*	3.0*	1.0*	2.0*	1.0*
Median score of perceived access barrier to testing, 0-4‡	1.0	1.0*	2.0*	3.0*	3.0*	3.0*	3.0*	1.0	1.0*	3.0*	3.0*	1.0*	1.0*	2.0*

CRC, Colorectal cancer.
*$P < .001$ compared with Australia by using Mann-Whitney *U* test.
†$P < .05$ compared with Australia by using Mann-Whitney *U* test.
‡Higher values = greater negative perception.
§Higher values = greater perceived need.

Participation in investigations for CRC

A total of 1422 (18%) of respondents had undergone previous CRC testing (FOBT, 30.4%; colonoscopy, 61.8%; flexible sigmoidoscopy, 7.7%; CT colonography, 3.2%; and other, 17%). Of these respondents, 384 (27%) were symptomatic at the time of testing, which included rectal bleeding (35%), change in bowel habits (25%), abdominal pain or distention (20%), and anemia and weight loss (4%). Of

the asymptomatic respondents (n = 1038), 33% had undergone FOBT, 53% colonoscopy, and 9.7% flexible sigmoidoscopy. Only 31% of respondents reported undergoing testing on a regular basis.

Respondents aged 50 years and older (n = 2990)

Knowledge of CRC symptoms, risk factors, and screening tests. Respondents aged 50 years and older from Hong Kong, Indonesia, Korea, and Taiwan had poorer knowledge of symptoms and risk factors, and, to a lesser extent, screening tests compared with younger respondents (Table 4). There were no significant differences comparing both age groups in the other countries.

Participation in CRC screenings. Of the respondents aged 50 years and older, 809 (27%) had undergone previous CRC screenings, and these varied by country (Table 5). Aside from Japan and the Philippines, all other countries had significantly lower participation rates compared with Australia. Of the respondents who had undergone previous CRC testing, 549 (67.9%) were asymptomatic at the time (FOBT, 38.3%; colonoscopy, 60.1%), and this varied by country (Table 5).

Intention to undergo screening. Most respondents (70.5%) responded positively to undergo future CRC tests (responded "definitely yes" and "yes"), comparable to Australia; however, respondents from India and Malaysia had significantly more negative responses (Table 5).

Physician recommendation for CRC tests. Only 20.4% received physician recommendations to undergo CRC testing. Significantly lower rates were reported by respondents from Malaysia (1%), India (1.5%), and Brunei (3.7%) compared with the Philippines (53.8%), Australia, and Japan (both 41%) (Table 5). Despite having population-screening programs, only 12.3% and 18.9% of respondents from Korea and Taiwan, respectively, had received physician recommendations.

Predictors of uptake in investigations for CRC. To assess for predictors of uptake in CRC tests, countries were categorized into 3 groups according to their participation rates: countries with low participation (<10% participation: Brunei, India, Indonesia, Malaysia, and Pakistan), medium participation (10%-30%: China, Hong Kong, Korea, Singapore, Taiwan, and Thailand), and high participation (>30% participation: Australia, Japan, and the Philippines). Using sequential multivariate modeling with logistic regression, independent predictors of each group are depicted in Table 6. Physician recommendation and knowledge of CRC tests were the most important predictors of screening participation in all groups. In countries with low participation, lower perceived access barriers (total score of financial burden of testing, time constraints, and access to tests), and higher perceived severity were independent predictors of participation. In countries with medium participation rate, having health insurance, lower

TABLE 4. Knowledge of CRC and screening tests in 2 age groups

	Age <50 y, %	Age ≥50 y, %	*P* value
Did not know any symptom			
Hong Kong	9.4	18.3	.005
Indonesia	37.5	48.3	.01
Korea	30.4	50.9	<.001
Taiwan	9.0	26.7	<.001
Did not know any risk factor			
Hong Kong	7.5	17.3	.001
Indonesia	18.9	25.6	.05
Korea	41.3	60.9	<.001
Taiwan	4.3	28.9	<.001
Did not know any CRC test			
Hong Kong	15.5	27.3	.002
Indonesia	59.1	56.7	.57
Korea	10.9	8.5	.27
Taiwan	18.7	20.0	.76
Median symptom knowledge score			
Hong Kong	2	2	.01
Indonesia	1	0	.06
Korea	1	0	<.001
Taiwan	3	1.5	<.001
Median risk factor knowledge score			
Hong Kong	1	1	<.001
Indonesia	0	0	.79
Korea	1	0	<.001
Taiwan	3	1	<.001
Median test knowledge score			
Hong Kong	1	1	.01
Indonesia	0	0	.67
Korea	1	1	.36
Taiwan	2	2	.60

CRC, Colorectal cancer.