In the present study, we investigated the relation between real-time images by E-C in vivo and histologic images of colorectal lesions. The E-C system is a novel method of noninvasive imaging that is able to provide real-time microscopic images from colorectal lesions in vivo.

Capsule Summary

What is already known on this topic

- A pit-pattern diagnosis correlates with histology, making it possible to assess early colorectal lesions before endoscopic resection or surgery.
- The E-C system applies contact endoscopy in a novel ultrahigh magnifying endoscope, which enables microscopic observation at the cellular level.

What this study adds to our knowledge

- In a blinded study of 75 lesions detected by colonoscopy, the real-time histologic images obtained by the E-C system closely correlated with histology.
- The E-C system allows viewing of lesions at the cellular level and evaluation of cellular and structural atypia in vivo.

PATIENTS AND METHODS

Patients

The subjects are 113 consecutive patients who underwent a complete colonic examination, from April 2003 to March 2004, performed by a single colonoscopist (K.S.). Written informed consent was obtained from all the patients before the examination. The first conventional colonic examination was performed. Patients without any localized colorectal lesions or with lesions larger than 40 mm in diameter were excluded from the study, thus 60 patients were enrolled for the E-C examination. Of 60 patients, 43 were men and 17 were women, and the mean age was 57.4 ± 8.3 years. All the patients had their lesions treated endoscopically or surgically at the Digestive Disease Center of Showa University Northern Yokohama Hospital. Ethical approval was granted by the ethics review committee of our hospital, and informed consents for colonoscopy and clinical trial were obtained.

Instruments

A colonoscope, CF-Q240ZI (with a magnifying power of ×100 at maximum), CF-Q240AI, or CF-XT240I (Olympus Optical Co, Ltd, Tokyo, Japan) and newly developed endocytoscopes, prototypes I and II (Olympus) were used in the study.

E-C system

An endocytoscope is a soft-catheter–type endoscope, with an outside diameter of 3.4 mm at the distal end and 3.2 mm at the shaft, and with a working length of 250 cm and a total length of 380 cm, which uses a lens system for magnification (Fig. 1A). The prototype I endocytoscope (low-resolution type) has a magnification capability of ×450, the depth of field is 50 μm, the field of view is 300 × 300 μm, and the spatial resolution is 1.7 μm. The prototype II endocytoscope (high-resolution type) has a magnification capability of ×1125; the depth of field is 5 μm, the field of view is 120 × 120 μm, and the spatial resolution is 4.2 μm. Both prototype endocytoscopes were set up with a fixed focus. The E-C system can be passed through the working channel of the colonoscope (Fig. 1B).

Methods

After detection with a conventional colonoscope, the lesion was stained with 1% methylene blue.[15] The excessive stain was washed off to avoid overstaining the cells.

Then, the E-C scope was passed through the working channel of the colonoscope. To obtain real-time images of the lesions at the cellular level in vivo, the tip of the instrument had to be touched to the target colonic glands. After a magnifying endoscopic examination, we observed most of the surface of the lesion by the E-C system if the lesions were 20 mm or less. For those more than 20 mm, the E-C system was used at the important part of the lesions that had been detected by magnifying endoscopy. It takes a few minutes to perform dye staining, and approximately 10 to 20 minutes to observe the surface of the lesion with the E-C system. The prototype I endocytoscope, low-resolution type, was used in all the lesions. However, the prototype II endocytoscope, high-resolution type, was required in cases where such colonic glands were not clearly observed with the prototype I endocytoscope. A pathologist, who was blinded to the conventional colonoscopic views and to the final histologic diagnosis, made a diagnosis of the E-C images by reviewing the digital files of the images. The criteria for the diagnosis is almost the same as for the histologic diagnosis[16] except that the E-C images are views obtained from the surface and are not the vertical section of the lesions. The factors that were considered included (1) pattern of the cellular arrangement; (2) size, shape, and arrangements of colonic glands (pits); (3) size and shape of the cells; (4) size and shape of the nuclei; and (5) nuclear-cytoplasmic ratio. The E-C diagnosis of high-grade adenoma was made according to the following criteria: (1) disorder of polarity, (2) deformity of nuclei, (3) enlargement of nuclei, (4) various shapes of cells, (5) higher cellular density, (6) increased nuclear:cytoplasmic ratio, and (7) irregular colonic glands. In other words, we could evaluate these 7 points of criteria of high-grade adenoma from the E-C images. All the E-C images were reviewed by a single pathologist.

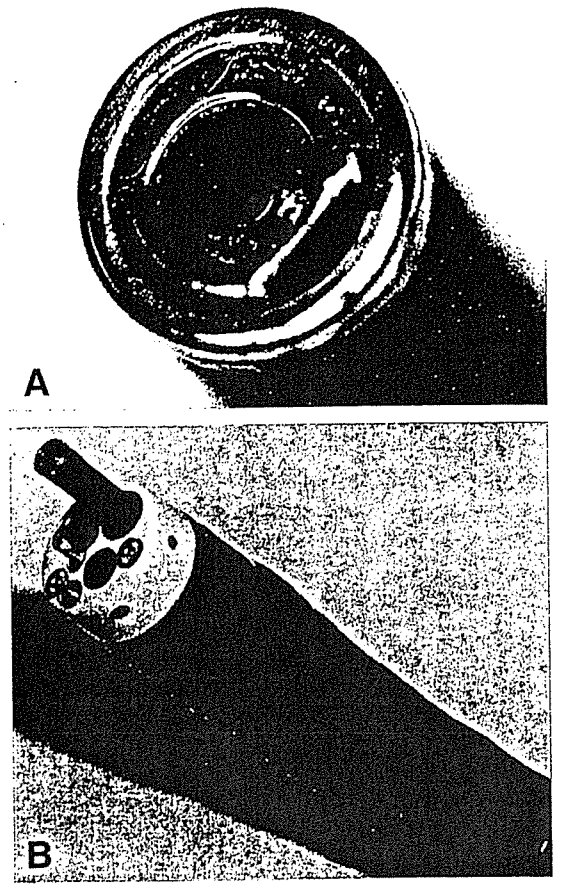

Figure 1. Endocytoscope. **A,** Endocytoscope is a soft-catheter–type endoscope with an outside diameter of 3.4 mm at the distal end. **B,** Endocytoscope can be passed through the working channel of endoscope.

Final histologic diagnosis on the resected specimens was made according to World Health Organization classification,[16] independently by the second pathologist, who was blinded to the conventional colonoscopic and E-C diagnoses. A pit-pattern diagnosis obtained from magnified endoscopic images was made on the basis of Kudo's classification.

After the diagnosis was determined and fixed, the E-C images for each lesion were compared with the H&E-stained slides, not only of the vertical section of specimens but also of the horizontal section of specimens.

Statistical analysis

The statistical analysis was performed by using computer software (SPSS for Windows, version 13.0; SPSS Japan Inc, Tokyo, Japan). The kappa value was used for statistical analysis to assess the differences between histologic and E-C diagnoses. The χ^2 calculation was used for statistical analysis to evaluate the ability of the E-C system for the differential diagnosis. A P value $< .05$ was considered statistically significant.

RESULTS

Seventy-five lesions were detected and endoscopically or surgically resected. In 8 randomly selected cases, the adjacent mucosa of the lesions that looked normal by conventional endoscopy was also subject to analysis as a control when using the E-C system.

Diagnosis of normal colonic mucosa

The criteria for the E-C system for the diagnosis of normal colonic mucosa were as follows: uniform glands were arranged regularly and nuclei along the basement membrane were visualized. As shown in Table 1, the diagnosis of normal colonic mucosa with the E-C system was histologically confirmed in all 8 cases studied. A representative case is shown in Figure 2A and B. The result with the magnifying endoscopy of the same lesion, which showed round pits and also classified as type I in the Kudo's classification, is also shown as a reference in Figure 2C.

Diagnosis of hyperplastic polyps

The criteria of E-C system for the diagnosis of hyperplastic polyps were as follows: serrated glands that were clearly observed and small vacuole that appeared to correspond to foamy change of cytoplasm of hyperplastic epithelia. As shown in Table 1, the diagnosis of hyperplastic polyp with the E-C system was histologically confirmed in all 8 cases studied. A representative case is shown in Figure 3A and B. The result with the magnifying endoscopy of the same lesion, which showed star-like pits and also was classified as type II in Kudo's classification, is also shown as a reference in Figure 3C.

Diagnosis of low-grade adenomas

The criteria of the E-C system for the diagnosis of low-grade adenomas were as follows: tubular glands were homogeneous in size, nuclei were fusiform and regularly arranged along the basement membrane, there was only a slight disorder of polarity, and cellular density was low. As shown in Table 1, the diagnosis of low-grade adenomas with the E-C system was histologically confirmed in 14 of 15 cases studied. A representative case is shown in Figure 4A and B. The result with the magnifying endoscopy of the same lesion, which showed long tubular pits and also classified as type IIIL in Kudo's classification, is also shown as a reference in Figure 4C.

Diagnosis of high-grade adenomas

The criteria of the E-C system for the diagnosis of high-grade adenomas were as follows: nuclei were arranged in the luminal side for the gland; the glands branched out irregularly; disorder of polarity, deformity, and enlargement of nuclei; and various shapes of cells from the viewpoint of cellular atypia were there. As shown in Table 1, the diagnosis of high-grade adenomas with the E-C system was histologically confirmed in 28 of 31 cases studied.

TABLE 1. Accuracy of E-C diagnosis in colorectal lesions

	Histologic diagnosis				
E-C diagnosis	**Normal mucosa**	**Hyperplastic polyp**	**Low-grade dysplasia**	**High-grade dysplasia**	**Invasive cancer**
Normal mucosa	8				
Hyperplastic polyp		8			
Low-grade dysplasia			14	3	
High-grade dysplasia			1	28	1
Invasive cancer					12

Kappa value 0.910.

A representative case is shown in Figure 5A and B. The result with the magnifying endoscopy of the same lesion, which showed that the fine structure of the surface was slightly irregular, is also shown as a reference in Figure 5C.

Diagnosis of invasive cancers

The criteria of the E-C system for the diagnosis of invasive cancers were as follows: there were marked deformities and enlargement of nuclei; colonic gland structure was hardly recognized, because of ulceration and exposure of the desmoplastic reaction at the surface; the nuclei were swollen and round; and vesicular and coarse chromatin were recognizable only by prototype II endocytoscope, high-resolution type. As shown in Table 1, the diagnosis of invasive cancers with the E-C system was histologically confirmed in 12 of 13 cases studied. A representative case is shown in Figure 6A. The result with the magnifying endoscopy of the same lesion, which showed fine structure of the surface, was destroyed and looked nonstructural, and is also shown as a reference in Figure 6B.

A comparison between E-C and histologic diagnoses is shown in Table 1. The overall accuracy was 93.3%. The kappa value between the E-C diagnosis and the histologic diagnosis was 0.910; therefore, the correlation was statistically significant. As for differential diagnosis between neoplastic and non-neoplastic lesions, the P value was $<.01$ (Table 2). Concerning the differential diagnosis between adenoma and invasive cancer, the P value was $<.01$ (Table 3). The differential diagnostic ability of E-C system was statistically confirmed by the χ^2 test.

DISCUSSION

Conventional histology with light microscopy has been based upon a consecutive management of specimens involving formalin fixation, paraffin embedding, thin slicing of the specimen with a microtome, dye staining, and finally mounting the specimen on a glass slide. It usually takes several days to obtain the histologic diagnosis because of involvement of many processes before microscopic examination. In comparison with biopsy, the E-C system provides real-time microscopic images in vivo during endoscopy. Moreover, there is no assurance that you are taking a biopsy specimen from the appropriate parts of the lesion, and the histologic diagnosis made on the biopsy specimens may not be representative of the lesion as a whole. In E-C, however, we are able to observe the entire surface of the lesion. We cannot perform a biopsy in patients with thrombocytopenia or in those who are taking anticoagulant medicine, because it may cause hemorrhage. In contrast, E-C is a safe method of examination even in such risky patients.

We believe this report is the first of a kind to evaluate the usefulness of E-C system for colorectal lesions. The E-C system can provide real-time images in vivo, corresponding well to the light microscopic images of the H&E-stained horizontal cross-section of the resected specimens. It is a catheter-type endoscope, which uses a magnifying lens system for magnification.

Chromoendoscopy and magnifying endoscopy are often used now, in addition to conventional endoscopy.[1] Magnifying endoscopy has been established as a clinically useful method, especially for the diagnosis of early colorectal lesions. Our group has reported on the pit-pattern diagnosis when using magnifying endoscopy, describing the correlation between the pit-pattern findings and pathologic diagnoses.[2,3] This pit-pattern diagnosis makes it possible to differentiate between neoplastic and non-neoplastic lesions, and to predict the depth of cancers before endoscopic resection or surgery.[2,3] However, with magnifying endoscopes, we can observe the structural atypia of the lesions but cannot evaluate the cellular atypia.

There were reports on virtual histology of colorectal lesions when using LCM and a probe-type LCM endomicroscope. The images could be obtained by using E-C without dye staining. But it was difficult to obtain clear images from the target in the proximal colon. The probe-type LCM images were not as clear as the images in vivo, which were provided by the E-C system.

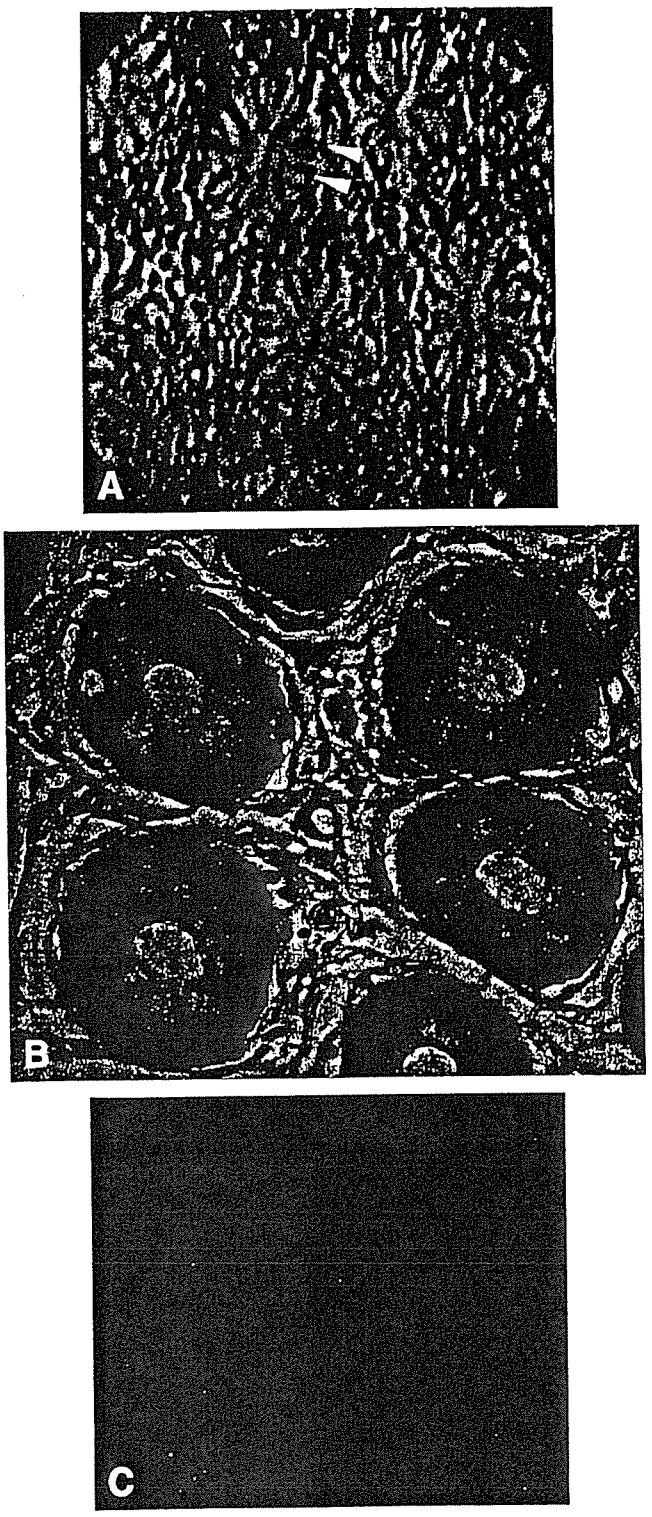

Figure 2. Normal mucosa. **A,** Endocytoscopic image. Nuclei (*yellow arrowhead*) along the basement membrane were visualized (orig. mag. ×450). **B,** Horizontal cross-section of tissue (H&E, orig. mag. ×400). **C,** Magnified endoscopic view after crystal violet dye staining.

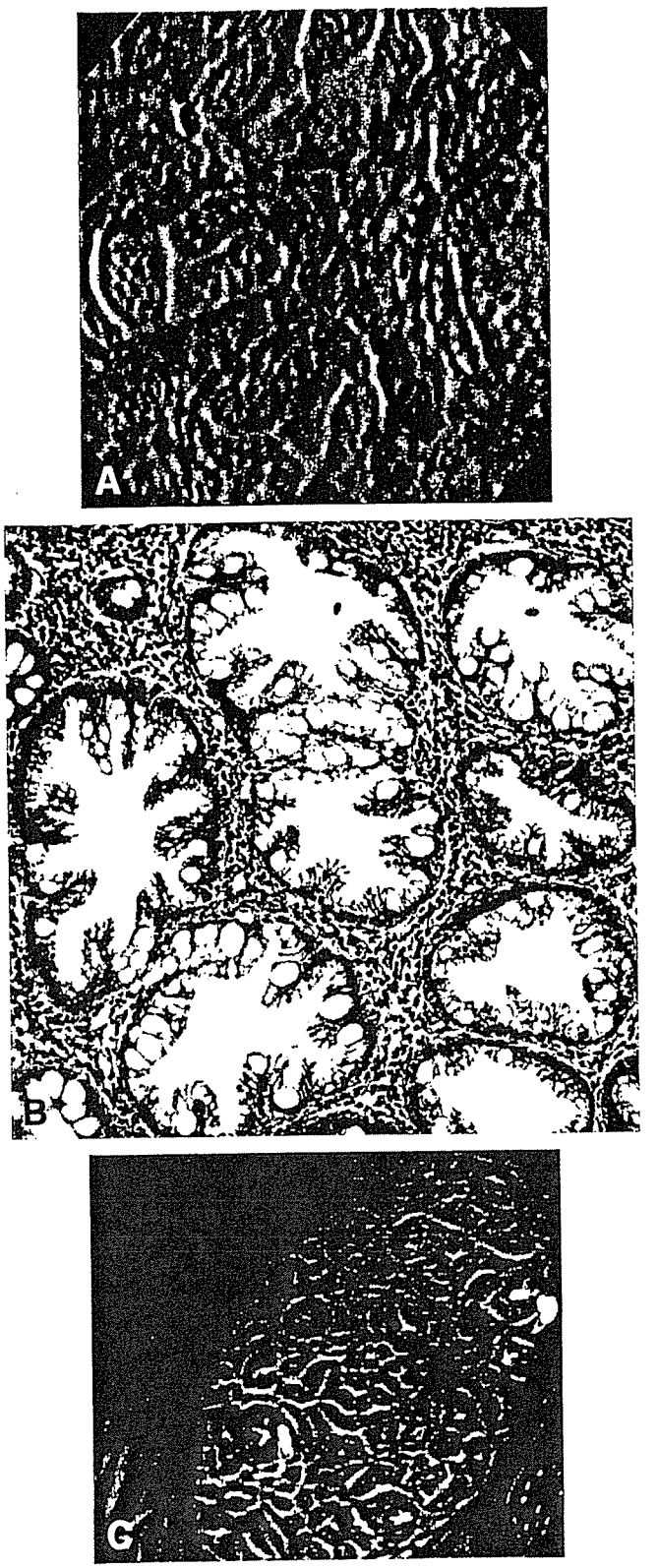

Figure 3. Hyperplastic polyp. **A,** Endocytoscopic image (orig. mag. ×450). **B,** Image (H&E, orig. mag. ×400). **C,** Magnified endoscopic view after crystal violet dye stain.

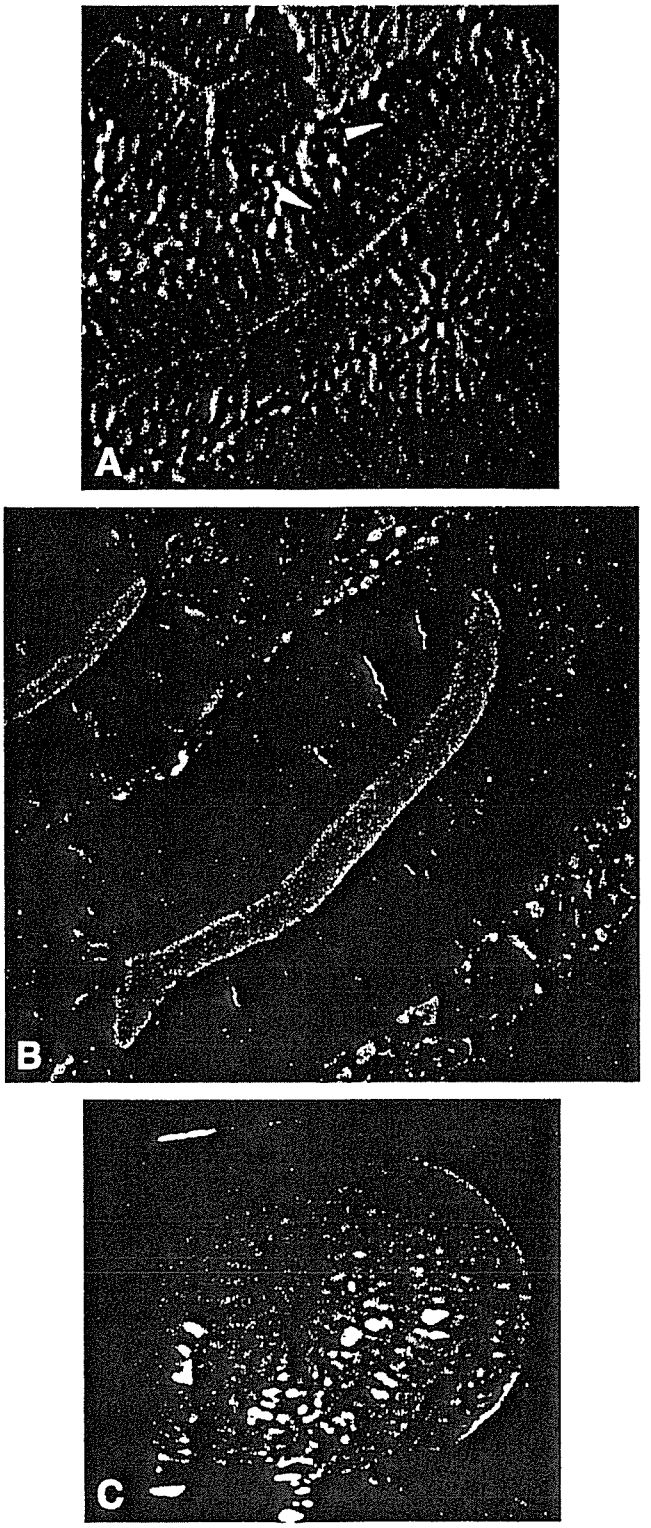

Figure 4. Low-grade dysplasia. **A,** Endocytoscopic image. Nuclei (*yellow arrowhead*) were fusiform and regularly arranged along the basement membrane (orig. mag. ×450). **B,** Image (H&E, orig. mag. ×400). **C,** Magnified endoscopic view after indigo carmine dye spraying.

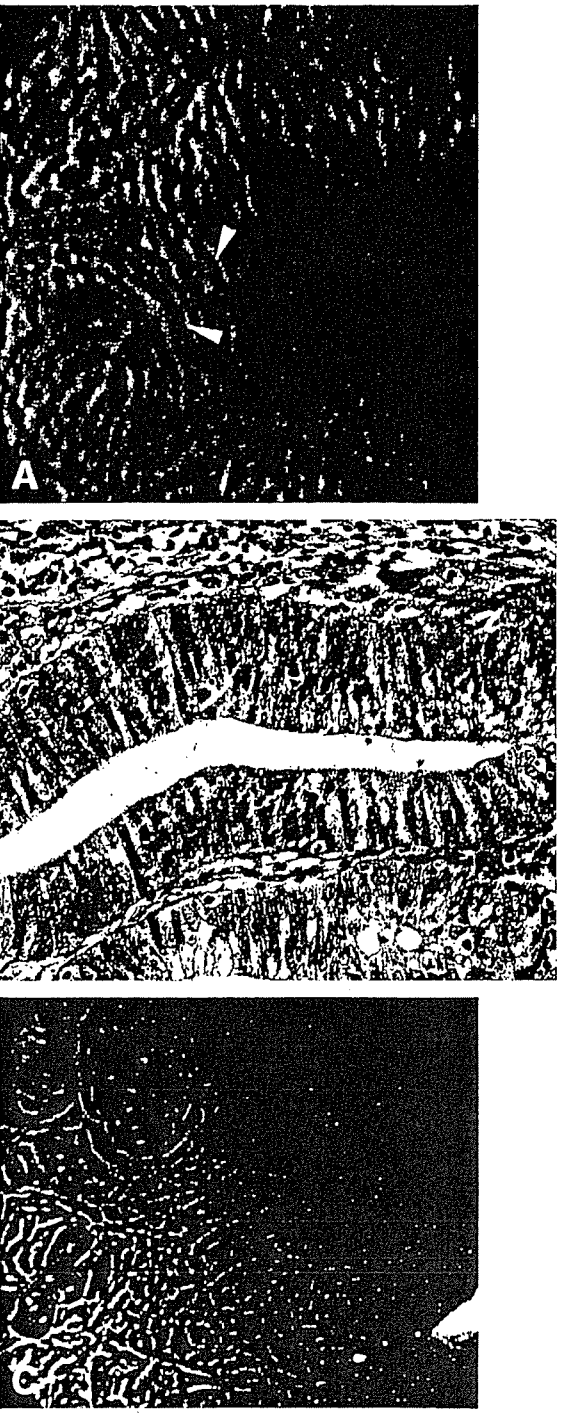

Figure 5. High-grade dysplasia. **A,** Endocytoscopic image. Disorder of polarity was recognized (orig. mag. ×450; *yellow arrowhead*). **B,** Image (H&E, orig. mag. ×400). **C,** Magnified endoscopic view after crystal violet dye stain. Fine structure of the surface was slightly irregular.

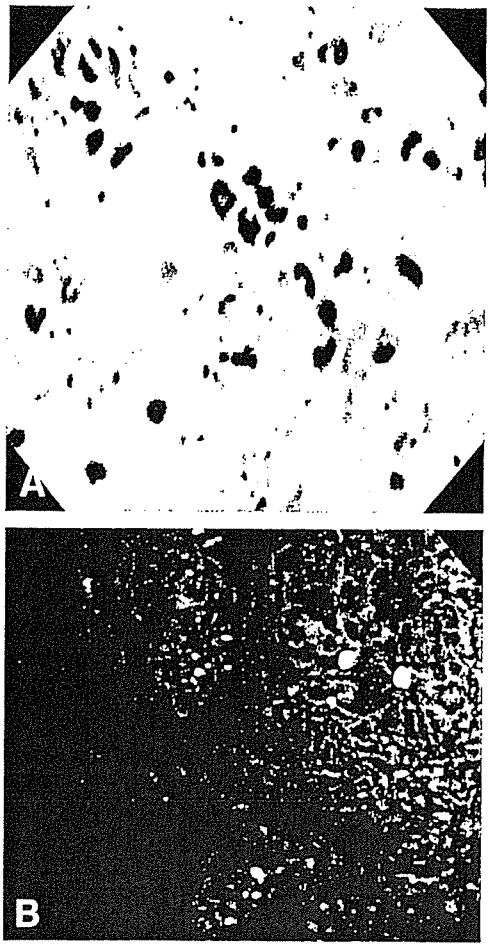

Figure 6. Invasive cancer. **A,** Endocytoscopic image (orig. mag. ×1125). **B,** Magnified endoscopic view after indigo carmine dye spraying. Fine structure of the surface was destroyed.

TABLE 2. Differential diagnosis between neoplastic and non-neoplastic lesions

	Histologic diagnosis	
E-C diagnosis	Non-neoplastic	Neoplastic
Non-neoplastic	16	0
Neoplastic	0	59

$P < .01$.

Cellular atypia is usually judged by variation in cell size, disorder of polarity, deformity of nuclei, hyperchromatin, and distinct nucleolus in the light microscopic images of an H&E-stained histologic specimen. E-C by using the prototype I endocytoscope made it possible to judge the degree of cellular atypia by visualizing variation in cell size, disorder of polarity, and deformity of nuclei. E-C images with the prototype II endocytoscope made it possible to observe hyperchromatin and distinct nucleolus in adenocarcinoma. In other words, we can evaluate not only the structural atypia but also cellular atypia in vivo with the E-C system. In this sense, E-C system is superior to the current magnifying endoscopy. E-C system provides real-time histologic images in vivo during endoscopy, corresponding to the H&E-stained microscopic images and allows us to make the correct diagnosis. The images obtained by the E-C system were almost comparable with the microscopic images, therefore, we believe that this method can be called "optical biopsy."

TABLE 3. Differential diagnosis between adenoma and invasive cancer

	Histologic diagnosis	
E-C diagnosis	Adenoma	Invasive cancer
Adenoma	46	1
Invasive cancer	0	12

$P < .01$.

The present E-C study of colorectal lesions included normal mucosa, hyperplastic polyps, adenomas, and invasive cancers. In E-C images of normal mucosa, glands were uniform and neatly arranged. In hyperplastic polyps, serrated glands were observed clearly and small vacuoles appeared to correspond to foamy change of cytoplasm of epithelial cells. In low-grade adenomas, tubular glands were almost homogeneous. Fusiform nuclei were clearly seen and regularly arranged along the basement membrane. In high-grade adenomas, nuclei were arranged in the luminal side of the gland. The glands branched out irregularly. There was disorder of polarity, deformity of nuclei, enlargement of nuclei, and various sizes of cells from the viewpoint of cellular atypia.

For the diagnosis of hyperplastic polyps and adenomas, the prototype I endocytoscope was usually enough. The prototype II endocytoscope could provide images corresponding well to cytology. The enlarged and round nuclei, vesicular, and coarse chromatin in invasive cancers were distinctly visualized by using the prototype II endocytoscope.

The correlation was significant between the E-C diagnosis and the histologic diagnosis. With the E-C system, it was possible to distinguish between neoplastic and non-neoplastic lesions, between adenomas and invasive cancers. This system would no doubt be useful for determining the treatment option, endoscopic or surgical.

In the near future, a pathologist at a distant site may be able to receive transmitted E-C images and to diagnose the histologic character of the lesion during endoscopy. The technologic innovation and improvement of E-C images would make it possible to reduce a good many biopsy specimens during endoscopic examination by providing real-time virtual histologic images.

There were some difficulties during the observation by using the E-C system in vivo. The presence of mucus or

bleeding made the visualization of the underlying cells more difficult. It was also difficult to obtain clear images from the target that was affected by respiratory or cardiac movements. The images could be obtained only by touching the object softly; therefore, we needed to attach a cap at the end of the colonoscope to fix the E-C scope onto the target site. Moreover, the device made it possible to obtain images in a distant location from the distal side, such as the cecum, and the ascending, transverse, and descending colon. Those images are just as clear as in the rectum.

In conclusion, E-C system provides real-time histologic images, which are almost as good as H&E-stained images during endoscopy.

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DISCLOSURE

None.

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早期大腸癌 2006 Vol.10 No.2

II 各々の定義による IIc および IIc 由来 sm 癌の転移と転移危険因子

(1) 内視鏡的，外科的切除後リンパ節転移陽性 sm 癌症例の臨床病理学的特徴について

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はじめに

近年，大腸内視鏡機器は拡大内視鏡等の進歩によって観察精度が飛躍的に向上した．一方，治療面でも 1992 年に腹腔鏡下手術がわが国に紹介されて以来，大腸手術にも腹腔鏡下手術が導入されるに至った．腹腔鏡下手術手技の開発と適応の拡大によって，さらに低侵襲な手術治療が可能となってきた．また近年，内視鏡においても内視鏡的粘膜下層剝離術(endoscopic submucosal dissection；以下，ESD)が大腸に導入されて，治療法の選択がより多彩になっている[1]．

当院では，通常観察の後にインジゴカルミンによるコントラスト法，クリスタルバイオレットによる染色法により腫瘍の表面の拡大観察を行い，pit pattern 診断[2]により深達度診断の補助診断として用いる．これらの所見を総合的に判断して病変の深達度を術前に推測し，その他，患者の状態も考慮したうえで適応であると考えられた場合に内視鏡的治療を行う．適応外と考えられた病変については腹腔鏡補助下，開腹等外科的切除を行っている．

大腸内視鏡検査時に病変を発見した場合，検査医であるわれわれがまず念頭におくことは，それが内視鏡治療適応なのか否かである．言い換えればその病変がリンパ節転移をきたしうる病変か否かということである．しかし，とくに腫瘍径が小さくて深部浸潤をきたしていることが多いとされる陥凹型病変を中心として，内視鏡治療を行うべきか，検査時に判断が困難である症例が少なくない．

箱根合意以降，sm massive 癌の明確な指標となった明らかな無構造領域をもつ VN pit pattern や VI 高度不整[3]，局注による non-lifting sign，超音波内視鏡所見等による明らかな sm 深部浸潤を疑わせる所見を有する場合はともかくとして，内視鏡的に深達度が判断困難だが切除をしえた病変に対しては，追加腸切除を行っていくかを判断するために病理組織学的検討が必要となる．

当院におけるリンパ節転移陽性の大腸 sm 癌について，その特徴といかなる臨床病理学的因子が関連しているかについて，陥凹型を中心に検討を行った．

I. 対象と方法

今回検討した症例は，2001 年 4 月～2005 年 10

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月の期間に昭和大学横浜市北部病院消化器センターにおいて内視鏡的，外科的に切除された病変のうち詳細な検討が可能であった大腸 sm 癌 157 病変である．そのうちリンパ節転移の有無についての評価の可能な外科的切除を行った初発かつ単発の 104 病変〔陥凹型 31 病変，平坦(表面隆起)型 31 病変，隆起型 42 病変〕を用いた．

sm 浸潤度分類は工藤分類[4]を用い，sm_{1a} と sm_{1b} を sm 微小浸潤癌，$sm_{1c\sim3}$ を sm 深部浸潤癌として取り扱った．

癌の組織学的分化度は『大腸癌取扱い規約』[5]に基づき，高分化腺癌，中分化腺癌，低分化腺癌，粘液癌等に分類した．各病変について面積的に優位なもの(主組織)と先進部(先進部組織)について検討を行った．

また簇出については第 63 回大腸癌研究会の際の定義に準じ，癌の先進部に癌細胞が 5 個未満の個細胞あるいは小腺管からなる浸潤性病変とし，明らかなリンパ管侵襲や膿瘍等の炎症の結果，簇出の組織形態を取ったことが明らかなものは除外とした．

統計学的処理はそれぞれの諸因子でのリンパ節陽性群，陰性群との関連性についてはカイ 2 乗検定および Fisher の直接確率検定を用い，p 値 5 % 以下を有意差ありとした．

II. 結　果

1. sm 癌における肉眼形態別深達度と腫瘍径(表 1)

外科的切除を行った sm 癌 104 病変のうち，陥凹型 31 病変(30 %)，平坦(表面隆起)型 31 病変(30 %)，隆起型 42 病変(40 %)であった．sm 癌の肉眼別の平均径は陥凹型が 13.2 mm，平坦型 26.1 mm，隆起型 17.2 mm であった．肉眼形態別の深達度と平均径は表 1 のごとく表され，同じ深達度で陥凹型は腫瘍径が小さいことが確認された．

2. sm 癌における肉眼形態別深達度と組織学的分化度(主組織と先進部組織の検討)

sm 癌 104 病変について肉眼形態別の主組織の組織学的分化度と深達度についての検討を行った(表 2)．組織別では 81 病変(78 %)が高分化腺癌であり，23 病変(22 %)が中分化腺癌であった．その他の組織が腫瘍となった腫瘍は今回認めなかった．隆起型 sm 癌は主要な組織型として高分化腺癌を多く認める傾向があるのに対し，陥凹型 sm 癌は中分化腺癌が多い傾向にあった．

次に腫瘍の先進部の組織学的分化度と深達度

表 1　肉眼形態別深達度と腫瘍径

		肉眼形態の平均径(mm)		
		陥凹型	平坦型	隆起型
深達度	sm_{1a}	9.3	24.0	16.9
	sm_{1b}	9.0	26.6	14.0
	sm_{1c}	9.0		18.0
	sm_2	12.8	27.1	17.1
	sm_3	16.0	27.5	21.0
	total	13.2	26.1	17.2

表 2　主組織の組織学的分化度と深達度

		陥凹型		平坦型		隆起型		total
		高分化	中分化	高分化	中分化	高分化	中分化	
深達度	sm_{1a}	1		7		3		11
	sm_{1b}			2		1		3
	sm_{1c}	1	1			5	1	8
	sm_2	8	6	9	2	23	1	49
	sm_3	7	7	7	4	7	1	33
	total	17	14	25	6	39	3	104

の関係は表3のとおりである．組織別では高分化腺癌45病変(43％)，中分化腺癌49病変(47％)，低分化腺癌5病変(5％)，粘液癌5病変(5％)であった．先進部が低分化腺癌や粘液癌の病変は，全例sm深部浸潤癌であった．同じ深達度での肉眼形態別の先進部組織の比較では，特徴的な組織は指摘されなかったが，どの肉眼形態も深達度が深くなれば先進部が中分化，低分化，粘液癌の割合が増える傾向がみられた．

3. sm癌における肉眼形態別深達度とリンパ管侵襲，静脈侵襲の検討

sm癌の深達度とリンパ管侵襲，静脈侵襲の関係について検討を行った．sm癌とリンパ管侵襲の関係は，sm癌104病変中ly_0 33病変，ly_1 54病変，ly_2 17病変であった(表4)．またsm癌と静

表3　先進部の組織学的分化度と深達度

		陥凹型			平坦型			隆起型			total
		高分化	中分化	低分化／粘液	高分化	中分化	低分化／粘液	高分化	中分化	低分化／粘液	
深達度	sm_{1a}	1			5	2		3			11
	sm_{1b}				2			1			3
	sm_{1c}		1	1				3	2	1	8
	sm_2	6	7	1	3	6	2	14	8	2	49
	sm_3	1	12	1	4	7		2	4	2	33
	total	8	20	3	14	15	2	23	14	5	104

表4　深達度とリンパ管侵襲

		ly_0				ly_1				ly_2			
		陥凹型	平坦型	隆起型	total	陥凹型	平坦型	隆起型	total	陥凹型	平坦型	隆起型	total
深達度	sm_{1a}	1	6	3	10		1		1				
	sm_{1b}		1	1	2		1		1				
	sm_{1c}	1		2	3	1		4	5				
	sm_2	2	4	8	14	9	6	13	28	3	1	3	7
	sm_3	1	1	2	4	8	5	6	19	5	5		10
	total	5	12	16	33	18	13	23	54	8	6	3	17

表5　深達度と静脈侵襲

		V_0				V_1				V_2			
		陥凹型	平坦型	隆起型	total	陥凹型	平坦型	隆起型	total	陥凹型	平坦型	隆起型	total
深達度	sm_{1a}	1	5	3	9		2		2				
	sm_{1b}		2	1	3								
	sm_{1c}	1		6	7	1			1				
	sm_2	4	8	16	28	7	2	8	17	3	1		4
	sm_3	2	2	4	8	10	7	4	21	2	2		4
	total	8	17	30	55	18	11	12	41	5	3		8

脈侵襲との関係は，sm 癌 104 病変中，v_0 55 病変，v_1 41 病変，v_2 8 病変であった(表 5)．

同じ深達度での肉眼形態別の脈管侵襲の比較では特徴を認めなかったが，どの肉眼形態でも深達度が深くなれば脈管侵襲の割合が増える傾向が認められた．

4. リンパ節転移陽性 sm 癌例における特徴

外科的切除を行った sm 癌 104 病変のうち，リンパ節転移陽性例は 12 病変〔n_1(+)9 病変，n_2(+)3 病変〕であった(表 6)．

肉眼形態別では n_1(+)9 病変は陥凹型 2 病変，平坦型 2 病変，隆起型 5 病変，n_2(+)3 病変では陥凹型 1 病変，平坦型 1 病変，隆起型 1 病変であり，リンパ節転移陽性例のなかでとくに多い肉眼形態については指摘されなかった．

深達度については n_1(+)9 病変のうち sm_{1c} 2 病変，sm_2 4 病変，sm_3 3 病変であり，n_2(+)3 病変のうち sm_2 2 病変，sm_3 1 病変と，リンパ節転移陽性例はすべて sm 深部浸潤癌であった．

リンパ管侵襲については n_1(+)9 病変は ly_0 1 病変，ly_1 5 病変，ly_2 3 病変であり，n_2(+)3 病変は ly_1 1 病変，ly_2 2 病変であった．静脈侵襲については n_1(+)9 病変は v_0 4 病変，v_1 5 病変であり，n_2(+)3 病変は v_0 1 病変，v_1 2 病変であった．

リンパ節転移陽性 12 病変のうち ly(+)が 11 病変でリンパ節転移陽性例は有意にリンパ管侵襲を認めた．

リンパ節転移陽性 12 病変の主組織の分化度については高分化腺癌 10 病変，中分化腺癌 2 病変であり，先進部組織については高分化腺癌が 6 病変，中分化腺癌が 5 病変，低分化腺癌が 1 病変であった．

簇出とリンパ節転移症例については+1 が 6 病

表 6　リンパ節転移陽性の症例

	肉眼型	大きさ (mm)	占居部位	pit pattern	初回治療方法	深達度	主組織	先進部組織	簇出	静脈侵襲	リンパ管侵襲	リンパ節転移
1	Isp	23	Sd	V_I	polypectomy	sm_{1c}	Well	Well	+1	v_0	ly_1	n_1+
2	Isp	22	Ra	V_I	EMR	sm_2	Well (Wel>Mode)	Mode	+2	v_0	ly_1	n_1+
3	IIa+IIc	13	Ap	V_N	operation	sm_3	Well	Well	+1	v_1	ly_2	n_1+
4	Is+IIc	8	Rs	V_I	operation	sm_2	Well	Mode (Mod>Por)	+2	v_0	ly_1	n_1+
5	Isp	7	Rs	V_I	EMR	sm_{1c}	Well (Wel>Mode)	Mode	+2	v_0	ly_1	n_1+
6	Is	19	Td	V_N	operation	sm_2	Well	Well	+3	v_1	ly_2	n_1+
7	LST (G-mix)	72	Rs	V_I	operation	sm_3	Well (Wel>Mode)	Mode	+1	v_1	ly_1	n_1+
8	Isp	18	Sd	V_N	EMR	sm_2	Well	Well	+1	v_1	ly_0	n_1+
9	LST (NG-F)	30	Sd	V_N	operation	sm_3	Mode (Mod>Well)	Mode	+2	v_1	ly_2	n_1+
10	IIa+IIc	13	Sp	V_N	EMR	sm_2	Mode	Por	+3	v_1	ly_2	n_2+
11	Isp	40	Sp	V_N	polypectomy	sm_2	Well	Well	+1	v_0	ly_1	n_2+
12	LST (NG-PD)	15	Sd	V_N	operation	sm_3	Well	Well	+1	v_1	ly_2	n_2+

変，＋2が4病変，＋3が2病変であり，リンパ節転移症例はいずれも簇出を認めていた．

5. 転移陽性症例・陰性症例と各因子との関係について

sm癌104病変について転移陽性12病変，転移陰性92病変に対してそれぞれの因子について検討を行った．

1) 肉眼形態

陥凹型31病変中リンパ節転移は3病変(9.7％)，平坦型31病変中3病変(9.7％)，隆起型42病変中6病変(14.3%)であった．肉眼形態とリンパ節転移については有意差を認めなかった(表7)．

2) sm浸潤度

$sm_{1a,b}$をsm微小浸潤，sm_{1c}～sm_3までを深部浸潤癌とし2群間で比較した．リンパ節転移をきたしたものは微小浸潤病変14病変中0病変，深部浸潤病変90病変中12病変(13.3％)と，深部浸潤病変群でリンパ節転移率が高い傾向が認められた(表7)．

3) 組織型

リンパ節転移群と陰性群の組織の分化度について，高分化腺癌とそれ以外の分化度の腺癌について比較を行った．まず腫瘍の主要な分化度とリンパ節転移については高分化腺癌であったsm癌81病変中10病変(12.3％)，高分化腺癌以外(Mode/Por)であった23病変中2病変(8.7％)にリンパ節転移を認めた(表8)．これら2群間の比較では有意差を認めなかった．

次に病変の先進部の分化度についても同様の検討を行った．先進部が高分化腺癌であった45病変中6病変(13.3％)，高分化腺癌以外(Mode/Por)59病変中6病変(10.1％)にリンパ節転移を認めた(表8)．これら2群間の比較でも有意差を

表7　リンパ節転移の有無と肉眼形態，深達度

		肉眼形態			深達度		total
		陥凹型	平坦型	隆起型	$sm_{1a,b}$	sm_{1c}～sm_3	
転移の有無	あり	3	3	6	0	12	12
	なし	28	28	36	14	78	92
total		31	31	42	14	90	104

表8　リンパ節転移とsm主組織，先進部組織

		主組織		先進部組織		total
		Well	Mode/Por	Well	Mode/Por	
転移の有無	あり	10	2	6	6	12
	なし	71	21	39	53	92
total		81	23	45	59	104

表9　リンパ節転移とリンパ管侵襲，静脈侵襲と簇出

		リンパ管侵襲		静脈侵襲		簇出		total
		陽性	陰性	陽性	陰性	陽性	陰性	
転移の有無	あり	11	1	6	6	12	0	12
	なし	60	32	43	49	63	29	92
total		71	33	49	55	75	29	104

認めなかった.

4) リンパ管侵襲

リンパ節転移陽群 12 病変のうち，リンパ管侵襲陽性は 11 病変，陰性は 1 病変であった．これらはそれぞれリンパ管陽性 71 病変中 15.5 %，陰性 33 病変中 3.0 % であり，リンパ管侵襲陽性病変は陰性病変に比較してリンパ節転移率は高い傾向にあった(表 9).

5) 静脈侵襲

リンパ節転移陽性群 12 病変のうち，静脈侵襲陽性は 6 病変，陰性は 6 病変であった．これらはそれぞれ静脈侵襲陽性 49 病変中 12.2 %，陰性 55 病変中 10.9 % であり，これら 2 群間に有意差を認めなかった(表 9).

6) 簇　出

リンパ節転移陽性群 12 病変のうち，簇出陽性は 12 病変，陰性は 0 病変であった．これらはそれぞれ簇出陽性 75 病変中 16.0 %，陰性 29 病変中 0 % であり，簇出陽性病変は陰性病変に比較してリンパ節転移率は高い傾向にあった(表 9).

III. 考　察

大腸 sm 癌を内視鏡的治療で完了とするか否かについては，リンパ節転移の可能性の有無が重要となってくる．そのために sm 癌のなかでリンパ節転移をきたす病変の特徴について，その危険因子を知ることはきわめて重要なことといえる.

『大腸癌治療ガイドライン 2005 年版』[6]によると摘除病変が sm 癌の場合，外科的追加治療を考慮する条件として，sm 断端陽性，sm 浸潤度 1,000 μm 以上，脈管侵襲陽性等があげられる．また主組織が低分化腺癌，未分化癌以外でも sm 浸潤先進部に簇出所見があればリンパ節転移の危険性が高いとしている.

今回，当施設の大腸 sm 癌症例について，いかなる病理組織学的因子がリンパ節転移因子に関与しているかについて検討を行った.

まず，陥凹型は，腫瘍径が小さいにもかかわらず sm 深部浸潤をきたしている傾向が強いといえる．どの肉眼形態でも深達度が深くなれば高分化腺癌以外の組織形態の割合が増えている．低分化腺癌の存在がリンパ節転移あるいは予後に大きく関わることは報告されているが[7)~10)]，低分化な癌が認められる症例数は少なく，今回の検討でもリンパ節転移陽性症例の数から見れば中分化腺癌も無視できない結果となった．大倉らの報告するように中分化腺癌の所見にも十分注意すべきであり，分化の悪い組織所見を記載することが脈管侵襲の記載とともに大腸 sm 癌の追加治療を選択す

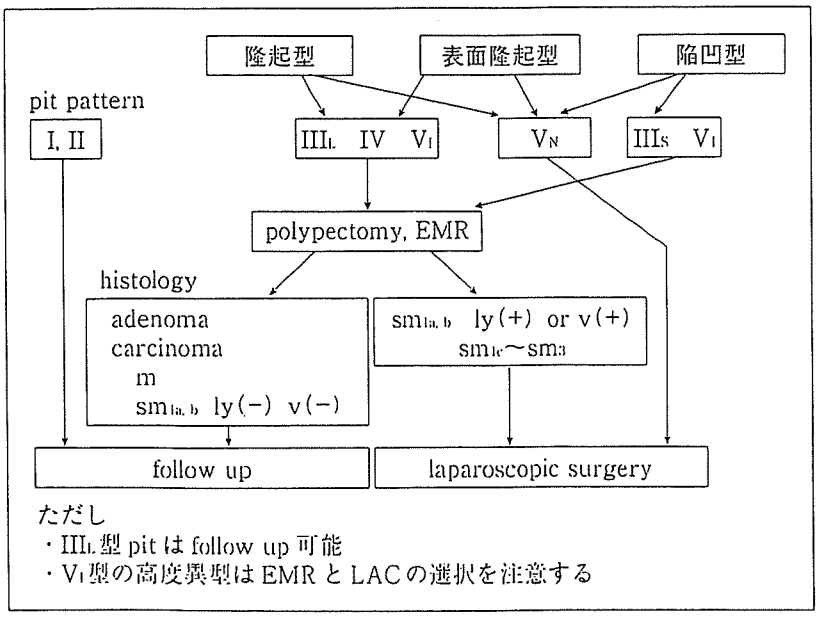

図　肉眼形態，pit pattern から見た大腸腫瘍性病変の治療方針

るうえで役立つと思われる[11].

脈管侵襲，簇出に対しても同様で，深達度が深くなれば肉眼形態に関係なくその割合が増す傾向が認められた．

外科的治療を行ったsm癌全体でのリンパ節転移の病理組織学的因子の検討ではリンパ管侵襲，sm浸潤度，組織型等がリンパ節転移に関係が深いことが明らかとなった．内視鏡的診断能や内視鏡治療法の進歩により，sm微小浸潤癌(sm_{1a}, sm_{1b})については内視鏡的治療で終了し，リンパ節郭清を行っていないため今回の検討からは省いた．これまでの報告[12),13)]同様にリンパ管侵襲を伴う病変，sm深部浸潤の病変，浸潤部の先進部の組織が高分化腺癌以外であった場合，リンパ節転移の危険性を考えなければいけないと考えられる．また肉眼形態別での検討では，同じ大きさの腫瘍では陥凹型由来の腫瘍が深部浸潤をきたしている傾向があり，その分リンパ節転移の危険性が高い可能性があると考えられる．

以上より，当院での大腸腫瘍性病変の治療方針を図に示す．まず肉眼形態を発育形態分類より認識し，pit pattern診断を行うことである．そのことで，腫瘍の病理組織学的診断が推測され，病変に対する主要な治療方針— EMRかLAC(laparoscopically assisted surgery)か—を判断することが可能となる[14]．また内視鏡切除された標本については病理学的検索を行い，追加切除の必要性を検討する[15]．今後さらに症例を積み重ね，精度の高い診断学とそれに基づいた適切な治療学[16]を構築していきたいと念ずる次第である．

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Summary

Significance of histopathological findings on submucosal colorectal carcinoma in relation to regional lymph node metastasis

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One hundred and four submucosal carcinomas were clinicopathologically examine to evaluate risk factors for lymph node metastasis. Twelve cases were accompanied by lymph node metastasis. In relation to lymph vessel permeation, 54 cases were determined to be ly_1 and 17 cases were ly_2. In cases involving venous permeation, 41 cases were considered to be v_1 and 8 cases were v_2. There were no liver metastasis cases. All cases having lymph node metastasis were of the invasive type ($sm_{1c\sim3}$). All cases were classified into two groups ; those with or without lymphnodal metastasis. Six factors were compared in the two groups. 1. Classification of gross appearamce 2. Degree of submucosal invasion 3. Histolocal type 4. The presense or absence of lymphatic permeations in the colorectal wall. 5. the presence or absence of venous permeation in colorectal walls. 6. The presense or absence of budding. With these Six factors, lymphatic permeation, histological type and degree of submucosal invasion showed higher rates of lymphnode metastasis, compared to those without these findings. Chromoendoscopy and magnifying endoscopic images of colorectal lesions are useful for accurate diagnosis. These modalities may also be used to predict histology, and therefore are useful in determining treatment opinions ; whether endoscopic or surgical. We also explained strategies for colonrectal lesion treatment used in our institution.

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Key words : submucosal colorectal carcinoma, lymph node metastasis, histological types vessel invasion, budding

Original Paper

Colonic J-Pouch Decreases Bowel Frequency by Improving the Evacuation Ratio

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KEY WORDS:
Colonic J-pouch; Defecography; Transit study; Evacuation ratio; Contraction ratio

ABSTRACT

Background/Aims: To compare the functional outcome of ultra-low anterior resection for rectal cancer with colonic J-pouch reconstruction with that of straight reconstruction.

Methodology: Twenty-three patients who underwent ultra-low anterior resection with or without J-pouch reconstruction underwent bowel transit study, videodefecography, and answered a questionnaire survey 4 months and 1 year after surgery. Eleven healthy subjects underwent similar testing as controls.

Results: Patients with a J-pouch had less frequent stools than patients with straight reconstruction 4 months after surgery ($p<0.05$), but the two groups were similar at 1 year. Bowel transit time was similar at both study points. The evacuation ratio was higher after J-pouch than straight reconstruction 4 months after surgery ($p<0.05$). However, the ratio improved in the straight group, and no difference existed at 1 year. Colonic contraction was seen only near the anastomosis 4 months after surgery, but the contraction proximal to the anastomosis improved over the next 8 months.

Conclusions: J-pouch reconstruction facilitates evacuation by improving the evacuation ratio. Although straight anastomosis caused excessive stool frequency 4 months after surgery, colonic function continued to improve and was comparable with J-pouch and straight reconstruction 1 year after surgery because the contraction ratio proximal to the anastomosis improved.

INTRODUCTION

Generally, ultra-low anterior resection for rectal cancer avoids the need to create a permanent colostomy, but it often results in excessive stool frequency which decreases the quality of life. It has been reported that functional outcome after low anterior resection for rectal cancer can be improved by the construction of a colonic J-pouch. However the reasons for this improvement are poorly understood. Therefore construction of a colonic J-pouch is a controversial procedure, and its use varies from institution to institution.

This study compared the functional outcome of ultra-low anterior resection with and without colonic J-pouch reconstruction using new indicators of bowel function termed the evacuation ratio and the contraction ratio.

METHODOLOGY

Between April 1999 and March 2001, ultra-low anterior resection with the primary anastomosis (<4cm above the dentate line) was performed in 23 rectal cancer patients. Patients were assigned randomly to the J-pouch with a 5-cm limb (n=13) or to the straight anastomosis (n=10) by a computer-generated table of random numbers. Informed consent was obtained from all patients.

Patients in the two groups were similar with respect to age, gender, distance between the anastomosis and the dentate line, nerve preservation, and Dukes stage **(Table 1)**.

Bowel function was evaluated by a bowel transit study, a videodefecography, and a questionnaire administered before surgery, 4 months and 1 year after surgery.

Bowel Transit Study

Twenty radiopaque markers within a gelatin capsule (Sitzmarks: Konsyl Pharmaceuticals, U.S.A.) were ingested, and a plain film of the abdomen was taken 8, 24, 32, 48, and 96 h after ingestion. The half-dose transit method was used, and segment transit time for each segment of the colon was calculated before surgery and 4 months after surgery. Each segment was defined as follows; Ascending colon: A, Transverse colon: T, Descending colon: D, Sigmoid colon and (neo) Rectum: SR.

Videodefecography

Thick barium sulfate of standardized consistency and viscosity was introduced into the (neo) rectum using a caulking gun injector until the contrast reached the sacral promontory (approximately 120g). Evacuation was videotaped fluoroscopically with the

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patient in the sitting position.

The weight of infused contrast (W1) and evacuated contrast in 1 minute (W2) were recorded. The evacuation ratio was given by calculating W2/W1 x 100(%). The contraction ratio (CR) was the post-evacuation diameter of the colon divided by the pre-evacuation diameter (x 100(%)) which were calculated by lateral view of pelvic X-ray. The CR was calculated 5, 10, and 15cm above the anastomosis (CR5, CR10, and CR15, respectively).

Videodefecography was taken only postoperation (4 months and 1 year after surgery) because the examination was prevented by the existence of the tumor preoperation, so eleven healthy volunteers underwent the same examination and served as normal controls.

Questionnaire Survey

A questionnaire was administered 4 months and 1 year after surgery inquiring as to the number of bowel movements per day, fecal soiling, and urgency.

Student's *t* test was used for intergroup comparisons. *P* values less than 0.05 were considered significant.

RESULTS

1. Relationship between Bowel Frequency and Results of the Examination

The patients were divided into two groups to evaluate a relationship between bowel transit time and bowel frequency: high frequency (>5 bowel movements per day) and low frequency. The left colonic transit time was longer in patients in the high bowel frequency group than those in the low **(Figure 1)**.

There was a tendency towards an inverse correlation between the evacuation ratio by videodefecography and the number of bowel movements per day. The patients with a low evacuation ratio tended to have more frequent stools **(Figure 2)**.

2. Comparison of Colonic Function between J-Pouch and Straight Reconstruction

Patients who underwent J-pouch reconstruction had fewer stools per day than patients who received straight reconstruction 4 months after surgery, but the two groups were similar at 1 year. Soiling and urgency were similar at both sampling points **(Table 2)**.

The bowel transit time was longer postoperatively than it was preoperatively, especially in the left colon (D, SR), and that was similar in the two groups postoperatively **(Figure 3)**.

Patients with a J-pouch had a higher evacuation ratio (71%) than patients with a straight reconstruction (48%) 4 months after surgery. At 1 year, however, the two groups were similar **(Table 3)**.

The contraction ratio at different distances proximal to the anastomosis shows that powerful contractions occurred only near the anastomosis (CR5). The CR5 in J-pouch patients was higher than it was in patients with a straight reconstruction. One year after surgery, CR5, CR10 and CR15 in straight reconstruction patients both were higher than they were 4 months after surgery **(Table 3)**.

TABLE 1 Patients' Characteristics

	Type of reconstruction		
	J-pouch (n=13)	Straight (n=10)	
Age (yr)	55±10	64±9	(ns)
Gender ratio (M:F)	7:6	6:4	(ns)
Distance from dentate line (cm)			
anterior wall	2.6±1.2	2.4±1.2	(ns)
posterior wall	2.0±1.5	2.3±1.2	(ns)
Nerve preservation			
hypogastric nerve	complete : 4, partial : 0	complete : 4, partial : 0	(ns)
pelvic plexus	complete : 5, partial : 7	complete : 6, partial : 3	(ns)
Dukes stage (A:B:C:D)	6:1:5:1	3:1:6:0	(ns)

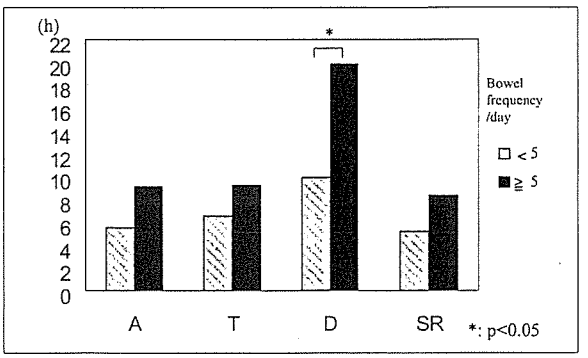

FIGURE 1 Segmental transit time between high and low bowel frequency group. Each segment was defined as follows; Ascending colon: A, Transverse colon: T, Descending colon: D, Sigmoid colon and (neo) Rectum: SR. The left colonic transit time was longer in patients in the high bowel frequency group (>5 bowel movements per day) than in patients in the low.

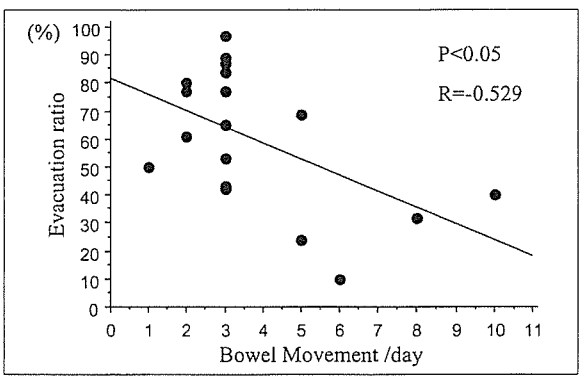

FIGURE 2 Relationship between evacuation ratio and bowel frequency. There was a tendency towards an inverse correlation between the evacuation ratio and the number of bowel movements per day. The patients with a low evacuation ratio tended to have more frequent stools.

DISCUSSION

The introduction of stapling devices has improved the safety of ultra-low anterior resection for rectal cancer. However, the ability of the rectum to function as a stool reservoir decreases in proportion to the amount of rectum removed, and conventional low anterior resection can result in dyschezia. Lazorthes

TABLE 2 Postoperative Functional Results

	Stool frequency (/day)		Soiling (%)		Urgency (%)	
	J-pouch	Straight	J-pouch	Straight	J-pouch	Straight
4M	3.0*	6.2*	31	20	0	20
8M	3.2**	6.2**	15	0	0	0
1Y	2.7	2.5	0	0	0	0

*, **: $p<0.05$.
J-pouch (n=13), Straight (n=10).

TABLE 3 Evacuation Ratio and Contraction Ratio

	Period	ER (%)	CR5 (%)	CR10 (%)	CR15 (%)
Control		89±12*1	50±16*2	31±15*3*4*5	33±5*6*7
J-pouch	4M	71±19	52±24	16±10*3	4±4*6
	1Y	77±19	50±15	5±2*4	14±4
Straight	4M	48±21*1	31±10*2	7±4*5	3±3*7
	1Y	70±24	47±21	21±3	12±10

*1-6 $p<0.05$.
ER: Evacuation ratio, CRx: contraction ratio x cm above the anastomosis.
Control values were derived from 11 healthy volunteers.

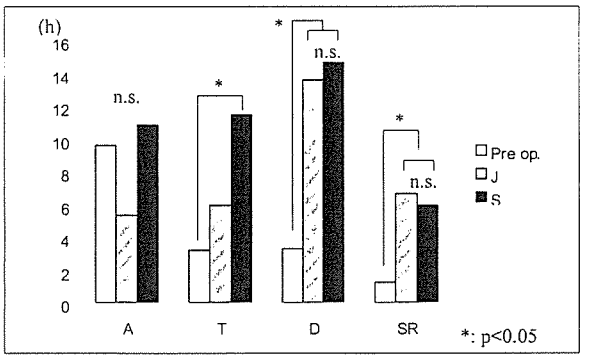

FIGURE 3 Segment transit time between J-pouch and straight reconstruction. The bowel transit time was longer postoperatively than it was preoperatively, especially in the left colon (D, SR). Bowel transit time was similar in patients with J-pouch and straight reconstruction.

(1) and Parc (2) reported in 1986 that colonic J-pouch improves postoperative rectal function. Hida *et al.* (3) recommended that a J-pouch be constructed when the anastomosis is <8cm from the anal verge because a satisfactory functional outcome can be obtained with straight reconstruction when the distance is >9cm. In recent years, a small J-pouch, with a 5 or 6-cm limb, has been recommended because it is difficult to evacuate a large pouch (4-7). Based on these recommendations, we used a J-pouch reconstruction with a 5-cm limb when the anastomosis was <4cm above the dentate line in this study.

It has been reported that J-pouch reconstruction improves rectal compliance (8), reduces the frequency of strong contractions (9), and increases the anorectal pressure gradient (9,10), all of which improve function.

We used a colonic transit study with radiopaque markers to evaluate motor activity of the colon. The reproducibility of this method has been validated (11). The postoperative bowel transit time was longer than in healthy controls, especially in the left colon, and corresponded to excessive stool frequency. These results suggest that the bowel frequency is related to the transit time of the left side colon.

In videodefecography, evacuation ratio and contraction ratio were obtained to evaluate the evacuation function of the colonic segment above the anastomosis. Also patients with a low evacuation ratio tended to have more frequent stools (12). Decreased motor activity of the colon proximal to the anastomosis prolongs the transit time and decreases the evacuation ratio (13). Denervation (14), poor blood supply (15), and the appearance of strong contractions (15,16) are thought to be causes of decreased motor activity after low anterior resection, and contribute to dyschezia.

The motor activity proximal to the anastomosis was decreased at 4 months regardless of whether a J-pouch was constructed. Contraction of the colon occurred only near the anastomosis. However the evacuation ratio was higher when a J-pouch was constructed. These results show that the J-pouch does not improve colonic transit time, but decreases stool frequency by facilitating fuller evacuation during each bowel movement.

It has been reported that the advantages of J-pouch over straight reconstruction are short-term and that the functional results are similar after 1 or 2 years (17,18). Our study reproduced this finding. Interestingly, the CR10 and CR15 were both higher at 1 year than they were 4 months after surgery in both groups. Improvement has been attributed to recovery of the nerve function (18) and reduction in the frequency of strong contraction (15), but further study is needed to clarify the cause of dyschezia after ultra-low anterior resection.

CONCLUSIONS

Decreased motor activity of the colon proximal to the anastomosis increases stool frequency after ultra-low anterior resection. Colonic J-pouch reconstruction did not improve colonic transit time, but did decrease stool frequency secondary to an improvement in the evacuation ratio. Stool frequency in patients with a straight reconstruction decreased during the first year after surgery because the contraction ratio proximal to the anastomosis improved.

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GASTROINTESTINAL CANCER

Positron emission tomography scanning is not superior to whole body multidetector helical computed tomography in the preoperative staging of colorectal cancer

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Background: The role of positron emission tomography with the glucose analogue [18F] fluoro-2-deoxy-D-glucose (FDG-PET) in the initial staging of disease in patients with primary colorectal cancer (CRC) has not been adequately assessed.
Aims: To evaluate the additional value of FDG-PET as a staging modality, complementary to routine multidetector row computed tomography (MDCT) in patients with CRC.
Methods: Forty four patients with CRC underwent preoperative MDCT and FDG-PET. The accuracy of intraoperative macroscopic staging was also investigated compared with histopathological diagnosis. All FDG-PET images were evaluated with respect to detectability of the primary tumour, lymph node involvement, and distant metastases. Both MDCT and FDG-PET diagnoses and treatment plan were compared with surgical and histopathological results.
Results: Thirty seven patients underwent surgery. Tumour detection rate was 95% (42/44) for MDCT, 100% (44/44) for FDG-PET, and 100% (37/37) for intraoperative macroscopic diagnosis. Pathological diagnosis of T factor was T1 in five, T2 in four, T3 in 24, and T4 in four cases. Concordance rate with pathological findings of T factor was 57% (21/37) for MDCT and 62% (23/37) for macroscopic diagnosis. Lymph node involvement was pathologically positive in 19 cases. Regarding N factor, overall accuracy was 62% (23/37) for MDCT, 59% (22/37) for FDG-PET, and 70% (26/37) for macroscopic diagnosis. For all 44 patients, FDG-PET findings resulted in treatment changes in only one (2%) patient.
Conclusion: FDG-PET is not superior to routine MDCT in the initial staging of primary CRC.

Colorectal cancer (CRC) is an important cause of morbidity and mortality in Japan as well as in other countries.[1] The prognosis of CRC directly relates to extramural tumour spread, ability to achieve surgical clearance, and the presence of lymph node and distant metastases.[2 3] Optimal management of individual patients requires detailed assessment of the locoregional and distant extent of disease.

Conventional preoperative staging of CRC has been abdominal computed tomography (CT) and chest radiography to rule out liver, lung, or lymph node metastases and invasion of the surrounding organs, respectively. The introduction of multidetector row CT (MDCT) has provided high resolution imaging and shortened examination time.[4] This becomes an effective diagnostic technique in the evaluation of preoperative staging of CRC.

Positron emission tomography with the glucose analogue [18F] fluoro-2-deoxy-D-glucose (FDG-PET) is a sensitive diagnostic test that images tumours based on increased utilisation of glucose by tumour cells.[5 6] FDG-PET has been demonstrated to be more sensitive than conventional imaging in the detection of recurrent or metastatic CRC.[7–13] One meta-analysis revealed an overall sensitivity of 97% and an overall specificity of 76% for FDG-PET in detecting recurrent CRC.[14]

However, reports of FDG-PET in the staging of primary CRC are few.[15–18] Also, these studies had several limitation: patient numbers were small,[15 16] or diagnostic accuracy of FDG-PET was compared with conventional abdominal CT[17] or CT was performed at a different hospital.[18] Comparison of state of the art FDG-PET with CT using variable techniques and qualities is not meaningful. Thus the role of FDG-PET in the initial staging of disease in patients with primary CRC has not been fully investigated to date.[19]

The purpose of this study was to prospectively evaluate the additional value of FDG-PET as a staging modality complementary to routine MDCT in patients with primary CRC. In patients undergoing surgery, the accuracy of intraoperative macroscopic staging was also investigated compared with histopathological diagnosis, as well as preoperative imaging results. All studies were performed in one Japanese hospital.

METHODS

Patients

Between September 2002 and January 2004, 44 consecutive patients with CRC who approved of this study were enrolled after giving written informed consent in accordance with the regulations of the institutional review board. There were 33 men and 11 women with a mean age of 61.4 years (range 38–82). The primary tumour originated from the right colon (n = 2), sigmoid colon (n = 4), or rectum (n = 38). Histological diagnosis was performed in all patients by colonoscopy. All patients underwent preoperative MDCT and FDG-PET within one month (median 9 days (range 0–26)).

Abbreviations: PET, positron emission tomography; FDG-PET, [18F] fluoro-2-deoxy-D-glucose-positron emission tomography; CRC, colorectal cancer; CT, computed tomography; MDCT, multidetector row computed tomography