Surg Endosc (2012) 26:2299–2305
DOI 10.1007/s00464-012-2178-7

Magnifying endoscopy for diagnosis of residual/local recurrent gastric neoplasms after previous endoscopic treatment

Ryo Kosaka · Kyosuke Tanaka · Shunsuke Tano · Reiko Takayama · Kenichiro Nishikawa · Yasuhiko Hamada · Hideki Toyoda · Katsuhito Ninomiya · Masaki Katsurahara · Hiroyuki Inoue · Noriyuki Horiki · Naoyuki Katayama · Yoshiyuki Takei

Received: 10 August 2011 / Accepted: 18 January 2012 / Published online: 21 February 2012

Abstract
Background Incomplete resection of gastric neoplasms by endoscopic treatment could lead to residual/local recurrence, which may be difficult to identify. This study aimed to evaluate the usefulness of magnifying endoscopy for identifying and demarcating residual/local recurrent gastric neoplasms after endoscopic treatment.
Methods Between December 2004 and November 2010, magnifying endoscopy was performed in 15 patients with residual/local recurrent gastric neoplasms. All patients underwent conventional magnifying endoscopy (CME) and enhanced-magnification endoscopy with acetic acid instillation (EME) after conventional endoscopy (CE). Eleven patients additionally underwent magnifying endoscopy using narrow-band imaging (NBI-ME) and a combination of narrow-band imaging and acetic acid instillation (NBI-EME). For each procedure, it was recorded whether the location and circumferential demarcation of the lesions were identified. All lesions were resected by endoscopic submucosal dissection.
Results Eleven lesions were identified using CE. However, two and four additional lesions were identified using CME and EME, respectively. In 11 cases, NBI-ME and NBI-EME were performed and all lesions were identified. Three lesions, which were identified by CME, were not demarcated circumferentially. All 15 lesions were well demarcated by EME and 11 by NBI-ME and NBI-EME. Of the resected specimens, histopathology indicated that ten lesions were differentiated tubular adenocarcinomas and five lesions were adenomas. The histopathological diagnosis of the location and demarcation of all neoplasms corresponded to endoscopic findings.
Conclusions Magnifying endoscopy techniques (CME, EME, NBI-ME, and NBI-EME) may be useful for identifying and demarcating residual/local recurrent gastric neoplasms after previous endoscopic treatment.

Keywords Endoscopy · Stomach neoplasms · Recurrence · Residual neoplasm · Acetic acid

Abbreviations

APC	Argon plasma coagulation
CE	Conventional endoscopy
CME	Conventional magnifying endoscopy
EME	Enhanced-magnification endoscopy with acetic acid instillation
EMR	Endoscopic mucosal resection

R. Kosaka and K. Tanaka contributed equally to this work.

Electronic supplementary material The online version of this article (doi:10.1007/s00464-012-2178-7) contains supplementary material, which is available to authorized users.

R. Kosaka · K. Tanaka · M. Katsurahara · N. Horiki
Department of Endoscopic Medicine, Mie University Hospital, Tsu, Japan

K. Tanaka (✉)
Department of Endoscopic Medicine, Mie University Hospital, 2-174 Edobashi, Tsu, Mie 514-8507, Japan
e-mail: kyosuket@qa2.so-net.ne.jp

S. Tano · R. Takayama · K. Nishikawa · Y. Hamada · K. Ninomiya · H. Inoue · Y. Takei
Department of Gastroenterology, Mie University Graduate School of Medicine, Tsu, Japan

H. Toyoda
Happy GI Clinic, Kameyama, Japan

N. Katayama
Department of Hematology and Oncology, Mie University Graduate School of Medicine, Tsu, Japan

ESD	Endoscopic submucosal dissection
ME	Magnifying endoscopy
NBI	Narrow-band imaging
NBI-ME	ME with narrow-band imaging
NBI-EME	Magnifying endoscopy with the combined use of narrow-band imaging and acetic acid instillation

Endoscopic treatment, which includes endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD), is widely accepted as a standard and useful treatment for gastric neoplasms [1, 2]. Complete resection is not easily performed by EMR, whereas ESD is useful for complete resection. In addition, gastric neoplasms often have obscure demarcations. Incomplete resection of a gastric neoplasm by endoscopic treatment could lead to residual/local recurrence. The residual/local recurrence rates associated with incomplete EMR have been reported to be between 4.4 and 18% [2–5]. Additional treatment may be necessary in patients with residual/local recurrence. For additional endoscopic treatment of residual/local recurrence, it is essential that the lesion be identified and demarcated. However, it sometimes has been difficult to identify residual/local recurrent neoplasms by conventional endoscopy (CE), although recurrence has been diagnosed histopathologically by random biopsy [6, 7].

The fine surface pattern of gastric mucosa can be observed with magnifying endoscopy (ME). Furthermore, the usefulness of ME for the diagnosis of gastric cancer has been reported [8–10]. A technique that combines ME with the instillation of acetic acid was designated as enhanced-magnification endoscopy (EME) [11]. The transient white color of the epithelial surface, which occurs following spraying with acetic acid, is a consequence of increased surface opacity [12]. EME is a useful method for observing fine surface patterns in Barrett's esophagus [11, 13] and in the stomach [14–16]. Narrow-band imaging (NBI) is an innovative method of endoscopic imaging [17]. The technology is based on the principle of modifying the spectral characteristics of the illuminating light by narrowing the bandwidth of the optical filter in the light source. The diagnostic value of combining the NBI system with ME (NBI-ME) in various organs has been described previously [18, 19]. Furthermore, we reported that ME combined with NBI and acetic acid instillation (NBI-EME) might improve visualization of the microstructure of gastric mucosa [20–22].

Published data on ME for residual/local recurrent neoplasms after endoscopic treatment are scant. The aim of this study was to investigate the usefulness of ME (including EME, NBI-ME, and NBI-EME) for identifying and demarcating residual/local recurrent neoplasms after the initial endoscopic treatment.

Patients and methods

Patients

During the period from December 2004 through November 2010 at Mie University Hospital, MEs were performed in 15 consecutive patients with residual/local recurrence of a gastric neoplasm after endoscopic treatment. We confirmed that the lesions in this study were residual/local recurrent lesions by comparing endoscopic findings, images, or pathological findings. The initial endoscopic treatment for the gastric neoplasm had been performed at our hospital in six patients and at an affiliated hospital in nine patients. The endoscopic images of the initial lesions of the six patients treated at our hospital, which had been taken before the first endoscopic treatment, were available to us. In all patients, the gastric neoplasms had been diagnosed previously by random biopsy from the scar with histopathological confirmation. However, the location and extent of each neoplasm were not known at the time of ME.

The current study was performed in accordance with the Helsinki Declaration as revised in 1989. The hospital ethics committee approved the study protocol, and all participating patients provided written informed consent before endoscopic procedures were performed.

Magnifying endoscopy

All magnifying endoscopic procedures were performed using a GIF-Q240Z (Olympus Medical Systems Co., Tokyo, Japan) according to the following protocol. After routine observation, both CE and conventional magnifying endoscopy (CME) were performed for identifying and demarcating the neoplasm. Subsequently, 20–40 ml of 1.5% acetic acid was sprinkled at low pressure onto the gastric mucosa with a syringe through the accessory channel of the endoscope. After this procedure, EME was performed for identifying and demarcating the neoplasm. When the NBI system could be used, both NBI-ME and NBI-EME were performed for identifying and demarcating the neoplasm. Using CE, CME, EME, NBI-ME, and NBI-EME, it was recorded whether the location and circumferential demarcation of the neoplasm were identified. In this study, the criterion for diagnosing a gastric neoplasm by ME was a surface pattern different from the surrounding mucosa, and, in particular, gastric cancer typically has an irregular surface pattern with or without irregular microvessels.

One endoscopist (KT) performed all the endoscopic procedures and evaluated the endoscopic findings. All examinations were recorded in a digital filing system and on videotapes. The Japanese Classification of Gastric Carcinoma was used for descriptions of the neoplasms [23].

Endoscopic treatment

All patients rejected surgical treatment and requested endoscopic treatment as the initial treatment of the residual/local recurrent neoplasm. All lesions were treated by ESD. We used a magnifying endoscope (GIF-Q240Z), an electrosurgical generator (VIO 300D; Erbe Co., Tübingen, Germany), a needle knife (KD-10Q-1; Olympus Medical Systems Co.), an insulated-tip (IT) knife (KD-610L and 611L; Olympus Medical Systems Co.), and a hook knife (KD-620LR; Olympus Medical Systems Co.) to perform ESD. Several spots were marked 5–10 mm outside of each lesion and the location of all marks was confirmed by using all four methods of ME that we evaluated. Following an injection of saline with epinephrine (0.0005%) or sodium hyaluronate (Mucoup; Johnson & Johnson, Tokyo, Japan) into the submucosa, a mucosal incision outside of the spots was made with a needle knife and exfoliation of the submucosa was performed with an IT knife and a hook knife.

Histopathological protocol

The resected specimens were extended on boards with pins, and all specimens were fixed in 20% formalin. The lesions, together with the surrounding noncancerous mucosa, were cut into 2-mm-wide serial-step sections; these dimensions were determined by the endoscopist who performed the study to correspond to the portion of the magnified endoscopic images. The histopathological diagnostic criteria of gastric neoplasms were based on the Japanese Classification of Gastric Carcinoma [23].

Results

The clinical characteristics of the patients with gastric neoplasms are given in Table 1. The median age of the patients was 73 years (range = 60–86 years). Three patients had neoplasms in the upper stomach, 10 in the middle stomach, and 2 in the lower stomach. The maximum diameter of the lesions treated initially ranged from 10 to 30 mm (median = 20 mm). The initial resection had been performed en bloc in seven patients and piecemeal in eight patients. All of the lesions were diagnosed as having a histopathologically incomplete resection because the margins of the resected specimens were positive.

Table 1 Clinical characteristics of patients with gastric neoplasms

Characteristics	*N*
Patients/lesions	15/15
Median age (years)	73 (60–86)
Gender (male/female)	10/5
Location (upper/middle/lower)	3/10/2
Initial neoplasms	
Median size (mm)	20 (10–30)
Macroscopic type (IIa/IIc)	9/6
Treatment (EMR/ESD)	13/2
Resection (en bloc/piecemeal)	7/8
Residual/local recurrent neoplasms	
Median interval after initial treatment (months)	37 (3–142)
Median size (mm)	12 (4–30)
Macroscopic type (IIa/IIc)	9/6
Treatment (EMR/ESD)	0/15
Resection (en bloc/piecemeal)	15/0
Histopathology (tub1/tub2/adenoma)	9/1/5

IIa superficial elevated type, *IIc* superficial depressed type, *tub1* well-differentiated tubular adenocarcinoma, *tub2* moderately differentiated tubular adenocarcinoma

Results of the endoscopic procedures are given in Table 2. Although 11 lesions were identified by CE, 4 lesions could not be identified by CE. Two of these four lesions, however, could be identified by CME. All 15 lesions were identified by EME. Both NBI-ME and NBI-EME were performed for 11 lesions and all lesions were identified. Six lesions, including the four lesions that could not be identified only by CE, were not demarcated circumferentially by CE. One of those six lesions could be demarcated circumferentially by CME. All 15 lesions were observed to be well-demarcated circumferentially by EME and 11 by NBI-ME and NBI-EME. Table 3 summarizes the identification and circumferential demarcation of the gastric neoplasms by each endoscopic procedure.

All lesions were resected en bloc by ESD without complications and all resected specimens were diagnosed to be histopathologically complete resections. Histopathological evaluation identified ten of the resected specimens as tubular adenocarcinomas (well-differentiated type, 9; moderately differentiated type, 1) and five as adenomas. The median size of the neoplasms was 12 mm (range = 4–30 mm). Four lesions were 5 mm or less. Regarding the extent of the neoplasms, the histopathological diagnoses corresponded with the findings of EME, NBI-ME, and NBI-EME in all ESD specimens.

Figure 1 shows conventional endoscopic (Fig. 1A) and chromoendoscopic views (Fig. 1B) of a lesion near the post-treatment scar in the gastric angle (case #6). The residual cancer could not be identified. Using ME, the

Table 2 Residual/local recurrent neoplasms and endoscopic findings

Case	Size (mm)	Macroscopic type	Pathology	Depth	Endoscopic findings									
					Identified neoplasm					Circumferential demarcation				
					CE	CME	EME	NBI-ME	NBI-EME	CE	CME	EME	NBI-ME	NBI-EME
1	30	IIa	tub1	M	P	P	P	–	–	P	P	P	–	–
2	5	IIc	tub1	M	I	P	P	–	–	I	P	P	–	–
3	4	IIa	tub1	M	P	P	P	–	–	P	P	P	–	–
4	28	IIa	tub1	M	P	P	P	–	–	P	P	P	–	–
5	14	IIa	adenoma	–	P	P	P	P	P	P	P	P	P	P
6	4	IIc	tub1	M	I	I	P	P	P	I	I	P	P	P
7	14	IIa	adenoma	–	P	P	P	P	P	P	P	P	P	P
8	12	IIc	adenoma	–	I	P	P	P	P	I	I	P	P	P
9	17	IIa	tub2	M	P	P	P	P	P	P	P	P	P	P
10	25	IIa	tub1	M	P	P	P	P	P	P	P	P	P	P
11	10	IIa	adenoma	–	P	P	P	P	P	I	I	P	P	P
12	6	IIc	tub1	M	P	P	P	P	P	P	P	P	P	P
13	7	IIc	tub1	M	P	P	P	P	P	P	P	P	P	P
14	5	IIa	tub1	M	P	P	P	P	P	I	I	P	P	P
15	15	IIc	adenoma	–	I	I	P	P	P	I	P	P	P	P

IIa superficial elevated type, *IIc* superficial depressed type, *tub1* well-differentiated tubular adenocarcinoma, *tub2* moderately differentiated tubular adenocarcinoma, *M* tumor invasion of mucosa and/or muscularis mucosa, *CE* conventional endoscopy, *CME* conventional magnifying endoscopy, *EME* enhanced-magnification endoscopy with acetic acid, *NBI-ME* magnifying endoscopy with narrow-band imaging, *NBI-EME* magnifying endoscopy with acetic acid and narrow-band imaging, *P* possible, *I* impossible, – not used

Table 3 Identification of neoplasm and demarcating lesion circumferentially according to endoscopic procedure

Procedure	Identification of neoplasm	Circumferential demarcation
CE	11/15 (73.3%)	9/15 (60.0%)
CME	13/15 (86.7%)	11/15 (73.3%)
EME	15/15 (100%)	15/15 (100%)
NBI-ME	11/11 (100%)	11/11 (100%)
NBI-EME	11/11 (100%)	11/11 (100%)

CE conventional endoscopy, *CME* conventional magnifying endoscopy, *EME* enhanced-magnification endoscopy with acetic acid, *NBI-ME* magnifying endoscopy with narrow-band imaging, *NBI-EME* magnifying endoscopy with acetic acid and narrow-band imaging

recurrent cancer also could not be identified (Fig. 1C). NBI-ME (Fig. 1D), EME (Fig. 1E), and NBI-EME (Fig. 1F) clearly revealed that the lesion had an irregular surface pattern and irregular microvessels and was well-demarcated circumferentially. The pathological examination of the resected specimen indicated a well-differentiated tubular adenocarcinoma, and the pathological area of the cancer corresponded to the endoscopic findings (Fig. 1G).

Figure 2 shows conventional endoscopic (Fig. 2A) and chromoendoscopic views (Fig. 2B) of a lesion in the lesser curvature of the middle stomach (case #8). The depressed lesion could be identified as a neoplasm by CE. Using ME, the residual neoplasm could be identified (Fig. 2C). NBI-ME (Fig. 2D), EME (Fig. 2E), and NBI-EME (Fig. 2F) clearly revealed the surface pattern and the demarcation line of the lesion. The pathological examination of the resected specimen indicated a tubular adenoma.

Discussion

Endoscopic treatment is a standard therapy for intramucosal gastric neoplasms because of its relatively low cost and because it is less invasive than surgery. EMR is the conventional method of endoscopic treatment and ESD is a more recent method. However, incomplete resection sometimes results in residual/local recurrent neoplasms. Generally, repeated EMR or neoplasm destruction using methods such as argon plasma coagulation (APC) are indicated for a residual/local recurrent lesion. However, repeated EMR procedures are very difficult to perform due to scar formation after the first EMR. Although neoplasm-destroying treatment is often performed, it may not provide a radical cure in some cases. Oka et al. [24] and Yokoi et al. [25] reported that ESD for residual/local recurrent early gastric cancer after EMR was a safe, effective, and

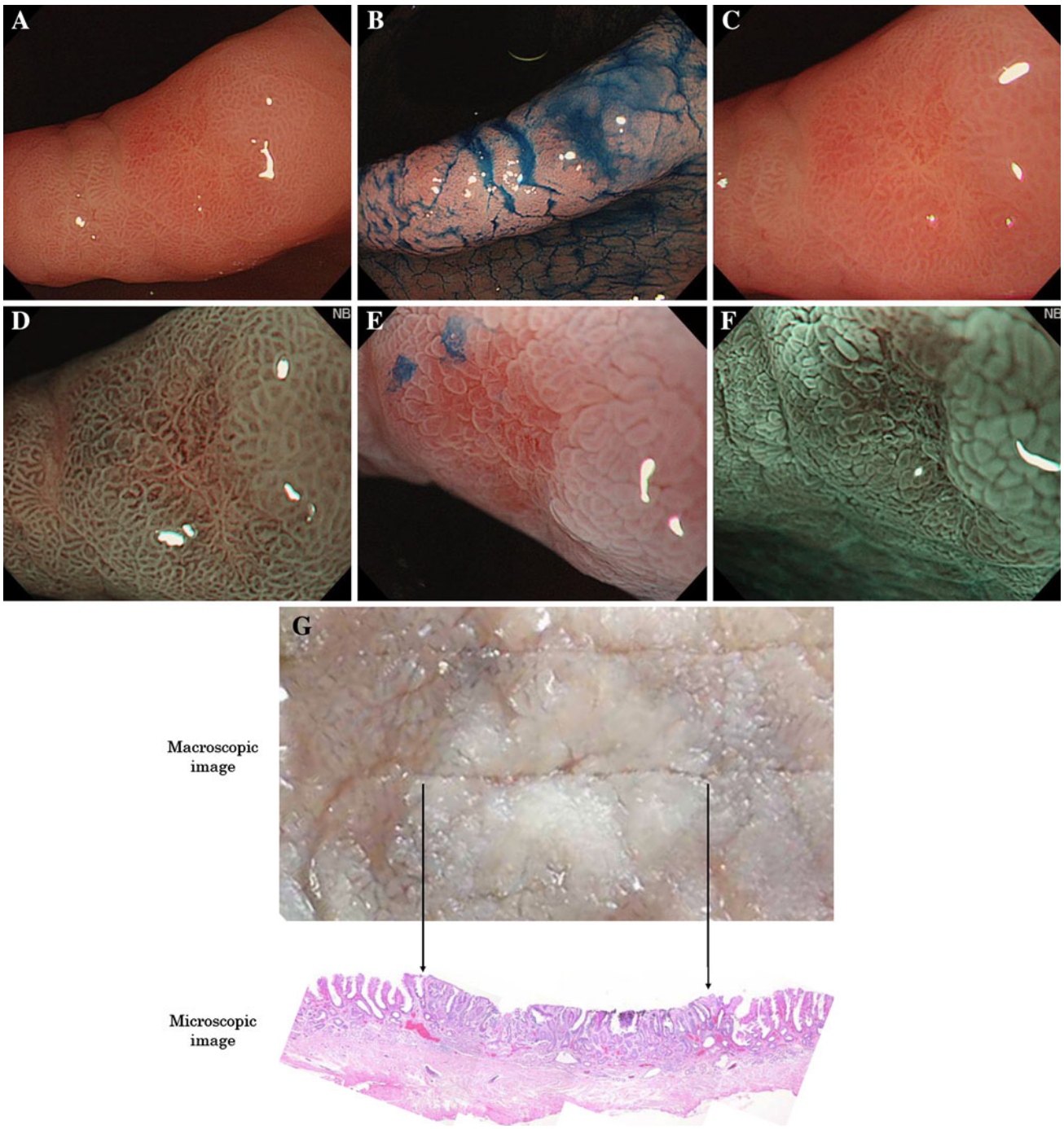

Fig. 1 Endoscopic images of locally recurrent early gastric cancer after endoscopic treatment (case #6). **A** Conventional endoscopic image shows a post-treatment scar in the gastric angle. Although recurrent cancer, which was proved pathologically by biopsy, was present, the lesion could not be identified. **B** Chromoendoscopy with indigo carmine dye. The lesion could not be identified. **C** Conventional magnifying endoscopic image of the lesion. Identification of the lesion was not possible. **D** Magnifying endoscopy with narrow-band imaging (NBI) revealed the lesion clearly as a brownish area. The lesion had an irregular surface pattern with irregular microvessels and was well demarcated. **E** Enhanced-magnification endoscopy with acetic acid instillation revealed a clearly irregular surface pattern and the lesion was well-demarcated. **F** Magnifying endoscopy with the combined use of NBI and acetic acid instillation revealed the irregular surface pattern more clearly. **G** The lesion was resected en bloc and the specimen was 4 mm in diameter. The macroscopic view of the resected specimen corresponded to the microscopic view (*arrows*). The pathological diagnosis was "a well-differentiated tubular adenocarcinoma," which corresponded to the endoscopic findings (H&E, ×40)

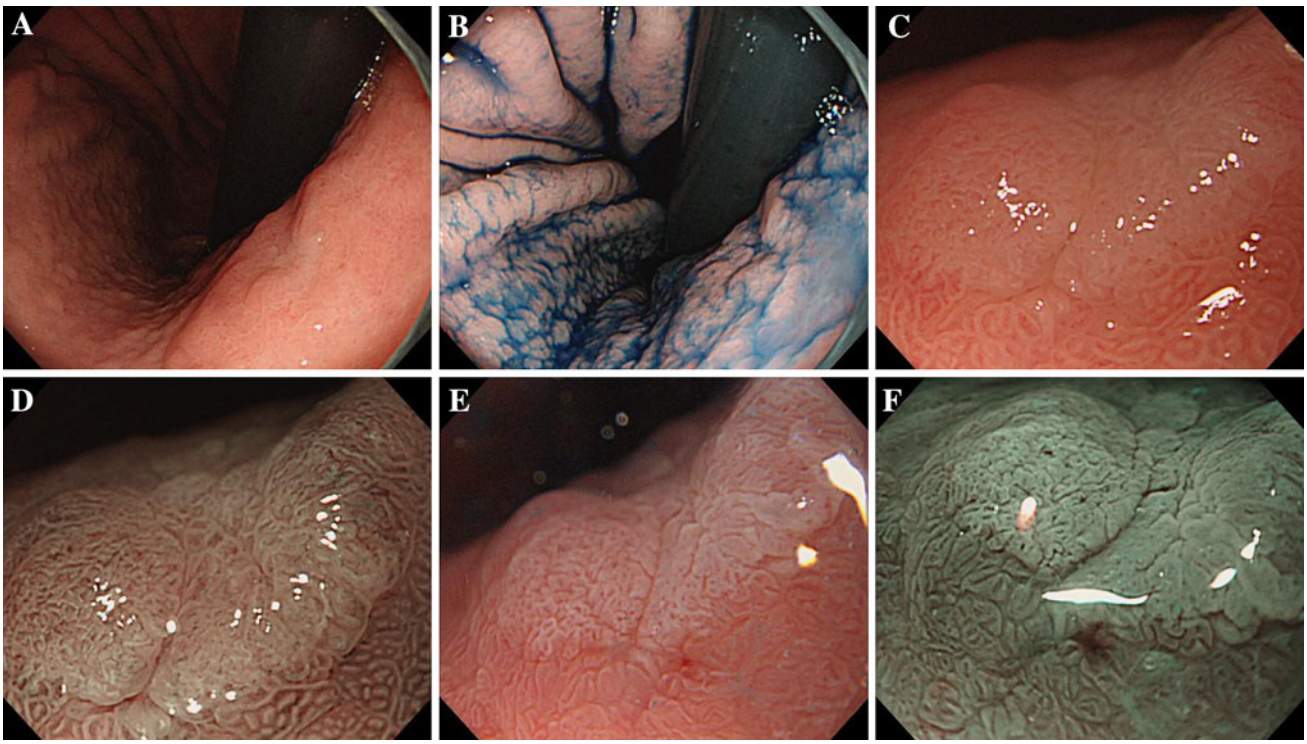

Fig. 2 Endoscopic images of local recurrence after endoscopic treatment of gastric adenoma (case #8). **A** Conventional endoscopic image shows a depressed lesion in the middle stomach but identification of the lesion was not possible. **B** Chromoendoscopy with indigo carmine dye. The lesion was not as clear as with conventional endoscopy. **C** Conventional magnifying endoscopic image of the lesion. Identification of the lesion was possible but slightly difficult. **D** Magnifying endoscopy with NBI revealed the lesion clearly as a faint whitish area. The surface pattern of the lesion was different from that of the surrounding mucosa and the lesion was well-demarcated. **E** Enhanced-magnification endoscopy with acetic acid instillation clearly revealed a fine surface pattern and the lesion was well-demarcated. **F** Magnifying endoscopy with the combined use of NBI and acetic acid instillation clearly revealed a fine surface pattern and the lesion was well-demarcated

minimally invasive procedure. However, a recurrent neoplasm and its demarcation cannot always be clearly visualized. Thus, Chonan et al. [6] reported that 21% of residual/local recurrent lesions could not be diagnosed macroscopically. Precise identification of a residual neoplasm is important when a secondary endoscopic treatment such as ESD or destructive therapy is performed.

In the upper gastrointestinal tract, the use of ME has become popular. Through its use, elucidation of the microvascular pattern or the caliber of the capillaries also has been reported as useful for the diagnosis of early gastric cancer [8, 9, 18, 26]. Yao et al. [8] reported that ME was useful for determining the extent of differentiated carcinomas. EME was devised to improve the diagnosis of Barrett's esophagus and to avoid sampling errors [11, 13]. Since EME can reveal differences in surface patterns, the demarcation line between the surrounding mucosa and the neoplasm is evident by this technique [14, 16]. Furthermore, NBI-ME, which yields very clear images of microvessels on mucosal surfaces, is capable of predicting the histological characteristics of gastric cancers and may be useful for identifying the demarcation line [18]. We have reported that NBI-EME improved the visualization of the fine surface pattern [20, 21] and demarcation of gastric cancer [22].

We describe here 15 cases that underwent ME (including CME, EME, NBI-ME, and NBI-EME) for identification and demarcation of residual/local recurrence of gastric neoplasms. Although ME is useful for identifying tiny lesions and demarcating obscure lesions circumferentially, for such lesions it is advantageous to use acetic acid instillation and NBI.

Diagnosis of a gastric neoplasm involves detection of the neoplasm and demarcation of its extent, and ME is suitable for both purposes. For demarcating the extent of a recurrent neoplasm, ME is particularly useful during preparation for endoscopic treatment. Therefore, ME with NBI or/and acetic acid may be necessary for follow-up of lesions that were incompletely resected at a previous endoscopic treatment. If a secondary endoscopic treatment is performed, ME with acetic acid and/or NBI also may be necessary to identify circumferential demarcations.

Our study has several limitations. The number of patients enrolled in this study was small, so the findings

reported here should be confirmed with a larger cohort. In addition, all of the lesions had already been diagnosed as gastric neoplasms in biopsy specimens before ME. The biopsy specimen from each lesion was taken randomly from the scar after endoscopic treatment. Thus, the location and demarcation of the neoplasms had not been clarified before this study.

In conclusion, despite these limitations and the need for further study, we believe that NBI and acetic acid instillation are promising approaches in ME for identifying and demarcating residual/local recurrent gastric neoplasms. These approaches may be helpful for a complete secondary endoscopic resection of residual/local recurrent neoplasm.

Disclosures Drs. Ryo Kosaka, Kyosuke Tanaka, Shunsuke Tano, Reiko Takayama, Kenichiro Nishikawa, Yasuhiko Hamada, Hideki Toyoda, Katsuhito Ninomiya, Masaki Katsurahara, Hiroyuki Inoue, Noriyuki Horiki, Naoyuki Katayama, and Yoshiyuki Takei have no conflicts of interest or financial ties to disclose.

References

1. Tada M, Murakami A, Karita M, Yanai H, Okita K (1993) Endoscopic resection of early gastric cancer. Endoscopy 25: 445–450
2. Ono H, Kondo H, Gotoda T, Shirao K, Yamaguchi H, Saito D, Hosokawa K, Shimoda T, Yoshida S (2001) Endoscopic mucosal resection for treatment of early gastric cancer. Gut 48:225–229
3. Kojima T, Parra-Blanco A, Takahashi H, Fujita R (1998) Outcome of endoscopic mucosal resection for early gastric cancer: review of the Japanese literature. Gastrointest Endosc 48:550–555
4. Tada M, Tokiyama H, Nakamura H, Yanai H, Yamaguchi K (1998) Criteria for evaluation of the need for multiple resection after imperfect resection during endoscopic therapy for early gastric cancer [in Japanese with English abstract]. Stomach Intestine 33:1559–1565
5. Oka S, Tanaka S, Kaneko I, Mouri R, Hirata M, Kawamura T, Yoshihara M, Chayama K (2006) Advantage of endoscopic submucosal dissection in comparison to endoscopic mucosal resection for early gastric cancer. Gastrointest Endosc 64:877–883
6. Chonan A, Mochizuki F, Ando M, Ando M, Mishima T, Atsumi M, Ozawa T, Fujita N, Yuki T, Ishida K (1998) Macroscopic findings and diagnosis of the depth of invasion of recurrent gastric cancer after EMR [in Japanese with English abstract]. Stomach Intestine 33:1705–1710
7. Nakamura N, Akamatsu T, Yokoyama T, Mochizuki T, Kawamura Y, Tateiwa N, Shinji A, Matsumoto A, Kiyosawa K (2002) Treatment for post EMR remnant lesions: limitation of endoscopic re-treatment. Stomach Intestine 37:1195–1200 [in Japanese with English abstract]
8. Yao K, Oishi T, Matsui T, Yao T, Iwashita A (2002) Novel magnified endoscopic findings of microvascular architecture in intramucosal gastric cancer. Gastrointest Endosc 56:279–284
9. Tajiri H, Doi T, Endo H, Nishida T, Terao T, Hyodo I, Matsuda K, Yagi K (2002) Routine endoscopy using a magnifying endoscope for gastric cancer diagnosis. Endoscopy 34:772–777
10. Otsuka Y, Niwa Y, Ohmiya N, Ando N, Ohashi A, Hirooka Y, Goto H (2004) Usefulness of magnifying endoscopy in the diagnosis of early gastric cancer. Endoscopy 36:165–169
11. Guelrud M, Herrera I, Essenfeld H, Castro J (2001) Enhanced magnification endoscopy: a new technique to identify specialized intestinal metaplasia in Barrett's esophagus. Gastrointest Endosc 53:559–565
12. Lambert R, Rey JF, Sankaranarayanan R (2003) Magnification and chromoscopy with the acetic acid test. Endoscopy 35: 437–445
13. Toyoda H, Rubio C, Befrits R, Hamamoto N, Adachi Y, Jaramillo E (2004) Detection of intestinal metaplasia in distal esophagus and esophagogastric junction by enhanced-magnification endoscopy. Gastrointest Endosc 59:15–21
14. Tanaka K, Toyoda H, Kadowaki S, Kosaka R, Shiraishi T, Imoto I, Shiku H, Adachi Y (2006) Features of early gastric cancer and gastric adenoma by enhanced-magnification endoscopy. J Gastroenterol 41:332–338
15. Tanaka K, Toyoda H, Kadowaki S, Hamada Y, Kosaka R, Matsuzaki S, Shiraishi T, Imoto I, Takei Y (2008) Surface pattern classification by enhanced-magnification endoscopy for identifying early gastric cancers. Gastrointest Endosc 67:430–437
16. Yagi K, Aruga Y, Nakamura A, Sekine A, Umezu H (2005) The study of dynamic chemical magnifying endoscopy in gastric neoplasia. Gastrointest Endosc 62:963–969
17. Gono K, Obi T, Yamaguchi M, Ohyama N, Machida H, Sano Y, Yoshida S, Hamamoto Y, Endo T (2004) Appearance of endoscopic tissue in narrow-band endoscopic imaging. J Biomed Opt 9:568–577
18. Nakayoshi T, Tajiri H, Matsuda K, Kaise M, Ikegami M, Sasaki H (2004) Magnifying endoscopy combined with narrow band imaging system for early gastric cancer: correlation of vascular pattern with histopathology (including video). Endoscopy 36: 1080–1084
19. Machida H, Sano Y, Hamamoto Y, Muto M, Kozu T, Tajiri H, Yoshida S (2004) Narrow-band imaging in the diagnosis of colorectal mucosal lesions: a pilot study. Endoscopy 36: 1094–1098
20. Toyoda H, Tanaka K, Hamada Y, Kosaka Y, Ichiro I (2006) Magnification endoscopic view of an early gastric cancer using acetic acid and narrow-band imaging system. Dig Endosc 18: S41–S43
21. Tanaka K, Toyoda H, Hamada Y, Aoki M, Kosaka R, Noda T, Katsurahara M, Inoue H, Imoto I, Takei Y (2008) Endoscopic submucosal dissection for early gastric cancer using magnifying endoscopy with a combination of narrow band imaging and acetic acid instillation. Dig Endosc 20:150–153
22. Kadowaki S, Tanaka K, Toyoda H, Kosaka R, Imoto I, Hamada Y, Katsurahara M, Inoue H, Aoki M, Noda T, Yamada T, Takei Y, Katayama N (2009) Ease of early gastric cancer demarcation recognition: a comparison of four magnifying endoscopy methods. J Gastroenterol Hepatol 24:1625–1630
23. Japanese Gastric Cancer Association (2010) Japanese classification of gastric carcinoma. Kanehara, Tokyo
24. Oka S, Tanaka S, Kaneko I, Mouri R, Hirata M, Kanao H, Kawamura T, Yoshida S, Yoshihara M, Chayama K (2006) Endoscopic submucosal dissection for residual/local recurrence of early gastric cancer after endoscopic mucosal resection. Endoscopy 38:996–1000
25. Yokoi C, Gotoda T, Hamanaka H, Oda I (2006) Endoscopic submucosal dissection allows curative resection of locally recurrent early gastric cancer after prior endoscopic mucosal resection. Gastrointest Endosc 64:212–218
26. Ohashi A, Niwa Y, Ohmiya N, Miyahara R, Itoh A, Hirooka Y, Goto H (2005) Quantitative analysis of the microvascular architecture observed on magnification endoscopy in cancerous and benign gastric lesions. Endoscopy 37:1215–1219