Usefulness of Magnifying Endoscopy for Diagnosing Tumorous Lesions of the Colorectum

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Summary: The usefulness of magnifying endoscopy was assessed by examining the extent to which a magnifying endoscope can provide images of pits and by analyzing the consistency of the pit patterns visualized by magnifying endoscopy with the pit patterns visible under a stereomicroscope. Study materials consisted of 83 cases of tumorous colorectal lesions. Under a magnifying endoscope, pits were visible across the entire surface of the lesion in 46 (55.4%) of the 83 cases. The pit pattern visualized by magnifying endoscope in 32 (69.6%) of the 46 cases was identical to the pattern observed under a stereomicroscope. Of various pit patterns, type III (tubular, round pit that is smaller than normal pit), type II (tubular, round pit that is larger than normal pit) and type IV (dendritic, gyrus-like type pit) were relatively well visualized under a magnifying endoscope. It was difficult to obtain images of type V (irregular or amorphous pit) with a magnifying endoscope. It seems therefore easy to distinguish tumors from non-tumorous lesions using a magnifying endoscope. This imaging technique may provide information more useful for the diagnosing tumorous colorectal lesions and selecting therapeutic strategy, if staining methods and mucus-removing methods are improved.

Key words colorectum, tumorous lesion, magnifying endoscope, stereomicroscope, pit pattern

INTRODUCTION

Morphological analysis of the pit (the shape of the opening of a colorectal crypt) on colorectal specimens under a stereomicroscope is reported to be useful for evaluating the quality of the lesion and depth of tumor invasion [1-6]. In recent years, the magnifying endoscope was developed as a clinical version of the stereomicroscope. With this type of endoscope, objects can be observed at a magnification of ×1 to ×100 and this device can be used to observe pits in vivo [7]. To date, however, no consensus has been reached concerning the clinical usefulness of this endoscope.

The present study was undertaken to evaluate the usefulness of a magnifying endoscope, by examining the extent to which it provides images of pits and analyzing the consistency of pit patterns visualized by magnifying endoscopy with those observed under a stereomicroscope.

MATERIALS AND METHODS

The lesions consisted of 83 cases of tumorous colorectal lesions in which magnifying endoscopy was possible before surgery and stereomicroscopy of pits using surgical specimens was possible. The lesion was the protruded type in 21 cases, the superficial elevated type in 39 cases, the superficial depressed type in 18 cases and the nodule aggregating type in 5 cases (Table 1).

According to the General Rules for Surgical and Pathological Studies on Colorectal Cancer [8], lesions were macroscopically classified as type I (protruded type; Ip, Isp and Is) and type II (superficial type; Ila, Iib and Iic). Lesions composed of 3 or more evident nodes were regarded as the nodule aggregating type. Of the superficial elevated...
type lesions, those demonstrating a predominantly elevated plane, although central depression was present, were rated as IIa+IIc. Of the superficial depressed type lesions, those in which tumors components were present only in the depressed plane were rated as IIc, irrespective of the presence or absence of marginal elevation. Lesions with a predominantly depressed plane, even though tumor components were also present in the marginal elevated area, were rated as IIc+IIa.

Pit patterns were classified according to the classifications proposed by Kudo et al. [1]; type I; round pit, type II; asteroid pit, type III; tubular, round pit that is smaller than normal pit (type I), type III; tubular, round pit that is larger than normal pit (type I), type IV; dendritic, gyrus-like type pit, and type V; irregular or amorphous pit. Furthermore, type V was subdivided into type VI (irregular); irregular, non-uniform pit pattern and type VIA (amorphous); amorphous or nearly amorphous pits with a decrease in the number of pits [6]. As a consequence, the pit patterns were classified into seven types in total.

For observation of pits using a magnifying endoscope (CF200Z, Olympus), the lesion was washed with water, then 0.1% methylene blue was sprayed onto the lesion under endoscopic guidance. Thereafter, stained lesion was then observed at an appropriate magnification and photographed simultaneously.

After examination of the pit pattern, the tissue was sectioned by making a cut near the center of the lesion when the lesion was 5 mm or less in size, and at 3-5 mm intervals when the lesion was 6 mm or more. Each section was embedded in paraffin and stained with hematoxylin and eosin.

The pit visualizing capacity of the magnifying endoscope was assessed using the following three groups of lesions: lesions in which pits were visible across almost the entire surface of the lesion, lesions in which pits were partially visible, and lesions in which few pits were observed. For lesions in which pits were visible across almost the entire surface of the lesion, the pit pattern visible with a magnifying endoscope was compared with that visible under a stereomicroscope. To identify pit patterns which can be easily observed under a magnifying endoscope and those which are difficult to observed, the pits visible under a stereomicroscope were divided into the following three groups: pits quite visible with a magnifying endoscope, pits that were only partially visible, and pits that were hardly visible. Furthermore, the relationship between the ability of the magnifying endoscope to obtain images of pits across the entire lesion and the degree of mucus produced by lesion was analyzed, by dividing the lesions into the following three groups by the degree of mucus production: lesions that have many glands with high mucus-producing ability, lesions that have many glands with low mucus-producing ability, and lesions with glands that produce little mucus.

Pits were evaluated in pictures taken during observation with the magnifying endoscope and the stereomicroscope. For lesions showing two or more
The ability of the magnifying endoscope to obtain images of pits across the entire lesion (Fig. 1)

Visualization of pits across almost the entire surface of the lesion was possible with the magnifying endoscope in 46 (55.4%) of the 83 lesions.

Results

Figs. 1-3. Pit patterns visible or not visible with a magnifying endoscope (Fig. 2)
The percentage of pits that were visible with a magnifying endoscope was examined for all pits that were visible under a stereomicroscope. This percentage was relatively high for type IIIs lesions (61.1%, 11/18) and IIIl. lesions (86.7%, 52/60), but was lower for type VI (11.1%, 1/9) and VA (0%, 0/1).

Comparison of pit patterns visible with stereomicroscopy and magnifying endoscopy (Table 2)
For lesions in which pits were visible across the surface of the entire lesion under a magnifying endoscope, the pit pattern visible under a stereomicroscope was compared with that visible with a magnifying endoscope. The pit pattern coincidence rate was 69.6% (32/46). This rate was as high as 79.5% (31/39) for lesions rated as IIIs, IIIl. or IV under a stereomicroscope. It was lower for type VI lesions (14.3%, 1/7).

Pit patterns visible or not visible with a magnifying endoscope (Fig. 2)
The percentage of pits that were visible with a magnifying endoscope was examined for all pits that were visible under a stereomicroscope. This percentage was relatively high for type IIIs lesions (61.1%, 11/18) and IIIl. lesions (86.7%, 52/60), but was lower for type VI (11.1%, 1/9) and VA (0%, 0/1).
TABLE 2.
Comparison of pit patterns visible with stereomicroscopy and magnifying endoscopy

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<tr>
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Fig. 4. A lesion in which type IIIl pits were predominant. a, A flat elevated lesion, 8 mm in diameter, was visible in the transverse colon. b, A lesion primarily showing type IIIl pits (larger than normal pits) was visible under a magnifying endoscope after methylene blue staining. c, A lesion primarily showing type IIIl pits was also visible under a stereomicroscope. d, The lesion was histologically diagnosed as adenoma.
Fig. 5. A lesion in which VI pits were predominant. a, A flat elevated lesion with a central depression, 10 mm in
diameter, was visible in the sigmoid colon. b, A lesion primarily showing type VI pits (irregular, non-uniform pits) was
visible under a magnifying endoscope after methylene blue staining. c, A lesion primarily showing type VI pits was also
visible under a stereomicroscope. d, The lesion was histologically diagnosed as early cancer invading the submucosal
layer.

The ability of the magnifying endoscope to obtain images of pits analyzed in relation to the degree of
mucus produced by lesion (Fig. 3)

The percentage of lesions with many mucus-producing glands did not differ significantly among the three groups of lesions. That is, the percentage was 67.4% (31/46) for lesions in which pits were visible across almost the entire surface of the lesion, 63.0% (17/27) for lesions in which pits were partially visible, and 60% (6/10) for lesions in which few pits were visible with a magnifying endoscope.

Case presentation
Case 1: A lesion in which IIIl pits were predominant (Fig. 4)
Endoscopically, a flat elevated lesion, 8 mm in diameter, was recognized in the transverse colon (Fig. 4a). A lesion primarily showing type IIIl pits (larger than normal pits) was visible under a magnifying endoscope after methylene blue staining (Fig. 4b). A lesion primarily showing type IIIl pits was also visible under a stereomicroscope (Fig. 4c). The lesion was histologically diagnosed as adenoma (Fig. 4d).

Case 2: A lesion in which VI pits were predominant (Fig. 5)
Endoscopy shows a flat elevated lesion with a central depression, 10 mm in diameter, in the sigmoid colon (Fig. 5a). A lesion primarily showing type VI pits (irregular, non-uniform pits) was visible under a magnifying endoscope after methylene blue staining (Fig. 5b). A lesion primarily showing type VI pits was also visible under a stereomicroscope (Fig. 5c). The lesion was histologically diagnosed as early cancer invading the submucosal layer (Fig. 5d).

Case 3: A lesion in which type VI and VA pits were predominant (Fig. 6)
Endoscopy showed a flat elevated lesion with an irregular depression, 10 mm in diameter, in the

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Fig. 6. A lesion in which type VI and VA pits were predominant. a, A flat elevated lesion with an irregular depression, 10 mm in diameter, was visible in the sigmoid colon. b, Tubular pits were visible but the surface of the lesion was not amorphous under a magnifying endoscope after methylene blue staining. c, Type VI and VA pits, not visible with a magnifying endoscope, were visible under a stereomicroscope. d, The lesion was histologically diagnosed as early cancer invading the submucosal layer. Desmoplastic reaction was evident.

sigmoid colon (Fig. 6a). Tubular pits were visible but the surface of the lesion was not amorphous under a magnifying endoscope after methylene blue staining (Fig. 6b). Type VI and VA pits, not visible with a magnifying endoscope, were visible under a stereomicroscope (Fig. 6c). The lesion was histologically rated as early cancer which had invaded the submucosal layer. Desmoplastic reaction was observed at the superficial layer of lesion (Fig. 6d).

DISCUSSION

Regarding pit patterns visible under a stereomicroscope, it has been reported that type I and II pit patterns represent non-tumors lesions and type III, IIIr, IV and V represent tumors lesions [1-6]. It is highly likely that type III, IIIr and IV pit patterns represent adenoma, type VI (irregular) pit represents a high possibility of cancer and type VA (amorphous) represent desmoplastic reactions at the superficial layer of lesions which are mostly invasive cancers spreading deeply into the submucosal tissue [9]. Thus, pit pattern analysis of colorectal lesions using a stereomicroscope is thought to be useful for making a qualitative diagnosis of these lesions (distinction among tumors and non-tumors lesions, adenoma and cancer) and for assessing the depth of tumor invasion [1-6]. The aim of magnifying endoscopy is to make findings obtained from stereomicroscopy available for clinical use and to estimate the tissue architecture through observation of the pits in vivo. To assess the usefulness of magnifying endoscopy, it is essential to examine the extent to which magnifying endoscopy provides images of pits across the entire surface of the lesion and to assess the consistency of pit patterns visualized by magnifying endoscopy with pit patterns visible under a stereomicroscope. Prior to the present
study, only four reports (Kudo et al. [3], Kawano et al. [9], Fujii et al. [10], and Morikawa et al. [11]) related to magnifying endoscopy have been published.

In the present study, magnifying endoscopy allowed visualization of pits across the entire lesion in 46 (55.4%) of the 83 lesions, partial visualization of pits in 27 (32.5%) of the 83 lesions and pit visualization was almost impossible in 10 (12.1%) of the 83 lesions. Thus, magnifying endoscopy was not capable of satisfactorily obtaining images of pits. This result may be attributed to the following factors: (1) visualization of pit patterns across the entire surface of a given lesion is sometimes not possible, depending on the location of the lesion; and (2) mucus adherent to the surface of the lesion cannot be always removed completely, and residual mucus makes staining of the lesion difficult, though no correlation was observed between the ability to obtain images of a pit with a magnifying endoscope and the degree of mucus produced by the lesions in the present study.

In cases where pits were visible across the entire surface of a lesion under a magnifying endoscope, the next issue is determining whether the pit patterns visible with the endoscope are identical to those visible under a stereomicroscope. In the present study, the pit pattern coincidence rate between magnifying endoscopy images and stereomicroscope images was relatively high (69.6%). The coincidence rate was higher (79.5%) when type V pit pattern was excluded from the calculation. The coincidence rate for type V pit pattern (a pattern useful for distinguishing between cancer and adenoma and for diagnosing the depth of tumor invasion) was low (14.3%). This is a problem with magnifying endoscopy. Furthermore, visualization of type V pit pattern was more difficult to obtain than that of type III, III, and IV pit patterns under a magnifying endoscope. Although the number of cases showing type V pit pattern under a magnifying endoscope was small, the coincidence rate for this type of pit pattern between stereomicroscope and magnifying endoscope images was low in the present study. Frequent discrepancies in pattern assessment results for type V lesions between the two imaging techniques may be associated with the difference in staining methods (Carazzi’s hematoxylin staining for stereomicroscopy and methylene blue staining for magnifying endoscopy). Another factor probably contributing to this discrepancy is the possibility that magnifying endoscope images are often out of focus, because focusing is difficult due to the very narrow focusing width (2-3 mm) possible with this technique [12]. However, the visualization rate and the coincidence rate for other types of lesions (IIIs, III, and IV) were high, consistent with previous reports [3,10,11]. It seems therefore easy to distinguish tumors from non-tumorous lesions using a magnifying endoscope. Possible methods of improving visualization of type V lesions with a magnifying endoscope include: (1) thorough removal of mucus, (2) careful focusing, and (3) adoption of a new staining method such as the recently developed pyoctanin (crystal violet) staining [11]. If these measures improve visualization of pits (especially type V pit pattern), magnifying endoscopy will allow diagnosis of not only cancer but also submucosal invasive carcinoma.

Although the use of magnifying endoscopy for the analysis of pit patterns of colorectal lesions involves some unresolved problems related to the type and concentration of stain to be used and the method of removing mucus, this modality provides information useful for the diagnosis of colorectal tumorous lesions (especially distinction among tumors and non-tumors lesions) and the selection of therapeutic methods. If the existing problems are resolved, its clinical value will increase further.

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REFERENCES


