Magnifying endoscopy for the diagnosis of specialized intestinal metaplasia in short-segment Barrett’s esophagus

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Abstract

AIM: To determine whether magnified observation of short-segment Barrett’s esophagus (BE) is useful for the detection of specialized intestinal metaplasia (SIM).

METHODS: Thirty patients with suspected short-segment BE underwent magnifying endoscopy up to × 80. The magnified images were analyzed with respect to their pit-patterns, which were simultaneously classified into five epithelial types [Ⅰ (small round), Ⅱ (straight), Ⅲ (long oval), Ⅳ (tubular), V (villous)] by Endo’s classification. Then, a 0.5% solution of methylene blue (MB) was sprayed over columnar mucosa. The patterns of the magnified image and MB staining were analyzed. Biopsies were obtained from the regions previously observed by magnifying endoscopy and MB chromoendoscopy.

RESULTS: Three of five patients with a type V (villous) epithelial pattern had SIM, whereas 21 patients with a non-type V epithelial patterns did not have SIM. The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of pit-patterns in detecting SIM were 100%, 91.3%, 92.3%, 60%, and 100%, respectively (P = 0.004). Three of the 12 patients with positive MB staining had SIM, whereas 14 patients with negative MB staining did not have SIM. The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of MB staining in detecting SIM were 100%, 60.9%, 65.4%, 25% and 100%, respectively (P = 0.085). The specificity and accuracy of pit-pattern evaluation were significantly superior compared with MB staining for detecting SIM by comparison with the exact McNemar’s test (P = 0.0391).

CONCLUSION: The magnified observation of a short-segment BE according to the mucosal pattern and its classification can be predictive of SIM.

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Key words: Short-segment; Barrett’s esophagus; Magnifying endoscopy; Methylene blue chromoendoscopy; Specialized intestinal metaplasia; Dysplasia; Esophageal adenocarcinoma; Diagnosis

Core tip: Various endoscopic approaches and advancements have shown great promise. However, careful endoscopic observation and stepwise four quadrant bi-
opsies still represent the standard for the surveillance of Barrett’s esophagus (BE). In our study, we investigated the usefulness of magnifying endoscopy for the diagnosis of specialized intestinal metaplasia (SIM) in patients with short-segment BE compared with methylene blue chromoendoscopy. We found that the magnified observation of a short-segment BE according to its mucosal pattern and classification can be predictive of SIM.

MATERIALS AND METHODS

Patients with short-segment BE were prospectively enrolled into this study at Soonchunhyang University Hospital in South Korea between March 2002 and June 2002 (Figure 1). Patients underwent magnifying endoscopy, which could enhance the image up to \( \times 80 \) (Olympus GIF-Q240Z, Japan) (Figure 2). Mucus was removed by a 10% solution of acetylcysteine instillation. The magnified images were analyzed with respect to pit-patterns, which were simultaneously classified into five epithelial types [I (small round), II (straight), III (long oval), IV (tubular), V (villous)] by Endo’s classification (Figure 3). Then, a 0.5% solution of methylene blue was sprayed over the columnar mucosa. The excess of dye was flushed away with 50 mL of water after 2 min. The patterns of the magnified image and MB staining were analyzed. Biopsies were obtained from the regions previously observed by magnifying endoscopy and MB chromoendoscopy (Figure 4). If the biopsies were unsatisfactory or inaccurately targeted, other biopsies were performed. Every biopsy was classified into three types of epithelium by a pathologist: the fundic type, cardiac type and SIM (Figure 5). The usefulness of magnifying endoscopy, which provides images of fine mucosal detail that correspond to histologic structure, is now widely accepted for the detection of SIM and for the prediction of histologic diagnosis compared with MB chromoendoscopy.
To analyze the relationships among the variables, Fisher's exact test was used. We performed an exact McNemar's test to compare the diagnostic value of MB chromoendoscopy and magnifying endoscopy for detection of SIM. Data analysis was performed using SPSS 14.0. All statistical hypotheses were verified at a significance level of $P < 0.05$.

**RESULTS**

**Patient characteristics**
Thirty patients, 16 men and 14 women, with an average age of 44.8 years (range 17-75 years), were enrolled into this study. All of the patients had tongue-like columnar epithelium in the tubular esophagus within 3 cm from the
pattern, MB staining, histologic diagnosis and reflux esophagitis, are listed in Table 1. Distributions of the types of pit-pattern, MB staining, and histologic diagnosis are shown in Figure 6.

Esophagogastric junction, as identified by previous standard endoscopy. No patient had previous histologically proven SIM in the columnar lined epithelium.

The results for individual patients, including the pit-pattern, MB staining, histologic diagnosis and reflux esophagitis, are listed in Table 1. Distributions of the types of pit-pattern, MB staining, and histologic diagnosis are shown in Figure 6.
Table 1 Individual results

| Patient | Type      | Stain | Histology | Reflux | Patient | Type      | Stain | Histology | Reflux |
|---------|-----------|-------|-----------|--------|---------|-----------|-------|-----------|--------|
| 1       | Villous   | Yes   | SIM       | Yes    | 16      | Tubular   | No    | Insufficiency | Yes    |
| 2       | Oval      | No    | Cardiac   | No     | 17      | Villous   | Yes   | SIM       | Yes    |
| 3       | Oval      | No    | Cardiac   | No     | 18      | Oval      | No    | Fundic    | Yes    |
| 4       | Straight  | No    | Fundic    | No     | 19      | Tubular   | No    | Insufficiency | No    |
| 5       | Straight  | Yes   | Fundic    | No     | 20      | Oval      | Yes   | Fundic    | Yes    |
| 6       | Tubular   | No    | Cardiac   | No     | 21      | Villous   | Yes   | SIM       | No     |
| 7       | Oval      | No    | Cardiac   | No     | 22      | Tubular   | No    | Insufficiency | No    |
| 8       | Tubular   | Yes   | Cardiac   | No     | 23      | Tubular   | Yes   | Cardiac    | Yes    |
| 9       | Tubular   | No    | Cardiac   | No     | 24      | Villous   | Yes   | Cardiac    | Yes    |
| 10      | Small round | Yes | Fundic | No | 25 | Oval    | Yes   | No Cardiac | Yes    |
| 11      | Tubular   | No    | Cardiac   | Yes   | 26      | Villous   | No    | Cardiac    | No     |
| 12      | Tubular   | No    | Cardiac   | No     | 27      | Straight  | No    | Cardiac    | No     |
| 13      | Tubular   | No    | Fundic    | No     | 28      | Tubular   | No    | Cardiac    | No     |
| 14      | Tubular   | Yes   | Insufficiency | No | 29      | Oval    | Yes   | Cardiac    | Yes    |
| 15      | Tubular   | Yes   | Cardiac   | No     | 30      | Oval     | Yes   | Cardiac    | Yes    |

SIM: Specialized intestinal metaplasia.

Table 2 Relationship between specialized intestinal metaplasia and variables

| Variables            | SIM (+) | SIM (-) | Total |
|----------------------|---------|---------|-------|
| Reflux esophagitis   | 2       | 9       | 11    |
| No-Reflux esophagitis| 16      | 4       | 20    |
| Total                | 18      | 13      | 31    |
| Villous              | 3       | 2       | 5     |
| Non-villous          | 0       | 21      | 21    |
| Total                | 3       | 23      | 26    |
| MB stain             | 3       | 9       | 12    |
| Non-MB stain         | 0       | 14      | 14    |
| Total                | 3       | 23      | 26    |

1Fisher’s exact test: P = 0.538; 2Sensitivity = 100%, specificity = 91.3%, accuracy = 92.3%, PPV = 60%, NPV = 100%, Fisher’s exact test: P = 0.004; 3Sensitivity = 100%, specificity = 60.9%, accuracy = 65.4%, PPV = 25%, NPV = 100%, Fisher’s exact test: P = 0.085 SIM: Specialized intestinal metaplasia; PPV: Positive predictive value; NPV: Negative predictive value; MB: Methylene blue.

Histologic examination revealed SIM in 3 of 26 patients (11.5%). The remaining four patients could not be diagnosed due to the insufficiency of the specimens for histologic examination. Reflux esophagitis was diagnosed by histologic examination in 11 of 26 patients (42.3%). The patients without RE did not have a history of GERD. SIM in BE was not more common in patients with reflux esophagitis (2 patients, 18.1%) than in those without it (1 patient, 5.2%; P = 0.538, Table 2).

Relationship between type of pit-pattern and SIM

The fine mucosal patterns (pit-pattern) of 30 patients were recorded and classified according to Endo’s classification. The specimens obtained previously from the regions observed by magnification without MB staining underwent histologic examinations to determine the relationship between the type of pit-pattern and SIM by magnifying endoscopy.

Of the 30 patients, one case was type I (small round); four cases were type II (straight); eight cases were type III (long oval); 12 cases were type IV (tubular); and five cases were type V (villous). Type IV (tubular) was the most common epithelial type. As shown in Table 1 and Figure 6, three of five patients with a type V (villous) epithelial pattern had SIM. Twenty-one patients without type V epithelial patterns did not have SIM (P = 0.004). These results suggest that a type V (villous) epithelial pattern is compatible with SIM, and the sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of type V pit-pattern in detecting SIM were 100%, 91.3%, 92.3%, 60% and 100%, respectively (Table 2).

Relationship between MB staining and SIM

Out of 30 patients, 13 patients (43.3%) had positive MB staining, and 17 patients (56.7%) had negative MB staining. One of the 13 patients with positive MB staining and three of the 17 patients with negative MB staining did not receive a histological diagnosis due to insufficient specimens. As shown in Table 1 and Figure 6, three of 12 patients with positive MB staining had SIM, whereas 14 patients with negative MB staining did not have SIM (P = 0.085). The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of MB staining in detecting SIM were 100%, 60.9%, 65.4%, 25% and 100%, respectively (Table 2).

Diagnostic value of pit-pattern evaluation and MB staining for detecting SIM

In comparison with MB staining, pit-pattern evaluation according to Endo’s classification had much higher specificity (91.3% vs 60.9%), accuracy (92.3% vs 65.4%), and positive predictive value (60% vs 20%) for the detection of SIM in BE; however, it had a similar sensitivity (both 100%) and negative predictive value (both 100%). The exact McNemar’s test revealed that the specificity and accuracy of pit-pattern evaluation was significantly superior to that of MB staining for detecting SIM by (P = 0.0391;
Table 3 Diagnostic value of pit-pattern evaluation and metaplasia staining for detection of specialized intestinal metaplasia (n = 3)

| Pit-pattern | TP | TN | P value |
|-------------|----|----|---------|
| MB stain    | 3  | 21 |         |
| Sensitivity | 91.30% | 60.90% | 0.0391 |
| Specificity | 92.30% | 65.40% | 0.0391 |
| Accuracy    | 100.00% | 100.00% |         |
| PPV         | 60.00% | 25.00% | 0.1643 |
| NPV         | 100.00% | 100.00% |         |

1P value by exact McNemar's test. TP: True positive; TN: True negative; PPV: Positive predictive value; NPV: Negative predictive value; MB: Methylene blue.

**DISCUSSION**

SIM in BE is a risk factor for EAC. A strong relationship has been established between the presence of SIM and the subsequent development of adenocarcinoma[14].

Detecting esophageal neoplasias at an earlier stages will allow for the possibility of intervening more quickly and lowering the mortality from EAC. However, the effectiveness of the screening and surveillance of BE has not been studied in randomized, controlled trials. For example, various endoscopic approaches and advancements have shown great promise, yet the confirmation of their utility in high-quality clinical trials has yet to occur[21,22].

Canto et al[21] found that the overall accuracy of MB staining for detecting SIM was 95%. However, the same level of accuracy was not achieved in other studies. Dave et al[14] reported that MB staining was associated with prolonged endoscopy, increased patient discomfort, and potentially serious adverse events; furthermore, it was neither very sensitive nor specific for SIM. According to Horwhat et al[23], chromoendoscopy might decrease the number of biopsies, improving the overall detection rate of dysplasia compared with a conventional four-quadrant biopsy. Wasielica-Berger et al[24] and Ferguson et al[25] found no convincing data indicating that pit-pattern evaluations may replace multiple biopsies, according to the Seattle recommendations for the detection of SIM in BE. Therefore, the aim of this study was to determine whether the magnified observation of short-segment BE is useful for the detection of SIM or for the prediction of histological diagnosis, compared with MB chromoendoscopy.

Oberg et al[26] showed that a long duration of reflux symptoms (RR = 1.3; 95%CI: 1.2-1.7) were independently associated with an increased risk of developing high-grade dysplasia or esophageal adenocarcinoma. However, SIM in BE was not more common in patients with reflux esophagitis who had a history of GERD compared with those without such a history (P = 0.538).

Endo’s study found that the type IV (tubular) and type V (villous) classifications were characterized of SIM. Similarly, we found a significant correlation between pit-patterns evaluated according to Endo’s classifications and histology. The differences in the frequency of SIM were related to the particular mucosal pit-pattern types. We frequently found SIM in places with a type V (villous) epithelial pit-pattern (3 of 5 patients). SIM did not coexist in any case with a non-type V epithelial pattern. Therefore, the surface structure of type V (villous) epithelial pattern is compatible with SIM (P = 0.004).

MB is a vital stain that is taken up by actively absorbing tissues, such as the small intestinal and colonic epithelium. In BE, areas of intestinal metaplasia are positively stained, whereas non-absorptive epithelia, such as those found in squamous or gastric mucosa, remain unstained. We found SIM in places with MB-positive stained epithelium (3 of 12 patients). No case of SIM was associated with MB-negative stained epithelium. However, MB-positive staining cannot be considered characteristic of SIM, as the difference was not significant (P = 0.085).

Compared with MB staining, the pit-pattern evaluation by magnifying endoscopy according to Endo's classification had much higher specificity (91.3% vs 60.9%) and positive predictive value (60% vs 20%) for the detection of SIM in BE, despite similar sensitivity (100% vs 100%) and negative predictive values (100% vs 100%). The specificity and accuracy of pit-pattern evaluations were significantly superior, according to McNemar's exact test, to those of MB staining for the detection of SIM (P = 0.0391).

There were some limitations to our study. First, we found no sites with dysplasia or cancer cells, which may be attributed to the relatively small number of patients. In addition, the present study enrolled too few patients (3 out of 5 patients with type V pit-pattern). However, this study was very difficult regarding the recruitment of patients due to the refusal of many of the patients and the quite rare prevalence of this condition in Korea[21,22]. Second, long-segment BEs were excluded in our study. The risk of progression to malignancy appears to increase significantly with increasing lengths of BE[26,27]. It would be worth knowing about pit-patterns in long-segment, salmon-colored mucosa and also pit-pattern correlation with histological diagnosis of BE. However, there is conflicting evidence in the literature[28]. Short-segment and long-segment BE are biologically identical and have significant if not equivalent malignant potential. In addition, Kim et al[29] showed that patients with long-segment BE are very rare in South Korea. So, we focused on short-segment BE in this study. Third, we did not address whether the simultaneous use of magnifying endoscopy and MB staining might improve the diagnostic yield. Sharma et al[30] reported that high magnification chromoendoscopy might be a useful clinical tool for the increased detection of patients with intestinal metaplasia. Statistically, there is no doubt that the results are improved when magnifying endoscopy is performed with MB staining simultaneously, if both are characteristics of SIM. In our study, MB-positive staining could not be considered a characteristic of SIM. Therefore, we did not...
try to demonstrate that the simultaneous performance of magnifying endoscopy and MB staining could improve the results. Fourth, we did not count the total number of biopsies. Thus, we could not show that the magnifying endoscopy might decrease the number of biopsies, generating an overall improvement in the detection rate of dysplasia compared with a conventional, four-quadrant biopsy.

In summary, we identified the usefulness of magnifying endoscopy for the diagnosis of SIM in patients with short-segment BE from preceding studies. However, we were still unable to demonstrate the usefulness of MB chromoendoscopy. Because we did not count the total number of biopsies, we could not confirm that both of the endoscopic examinations decreased the number of biopsies, costs and inspection time. We found that both methods were time-consuming and caused patient discomfort. These are among the disadvantages of the other studies.

Various endoscopic approaches and advancements have shown great promise. Still, careful endoscopic observation and stepwise four quadrant biopsy still represent the standard for the surveillance of BE. In our study, the evaluation of mucosal surfaces under magnification has potential to allow the selection of the biopsy site according to the pit-pattern. In conclusion, the magnified observation of short-segment BE according to the mucosal pattern and its classification can be predictive for SIM.

COMMENTS

Background
Cross-sectional and descriptive studies suggest that specialized intestinal metaplasia (SIM) either coexists with or precedes a significant majority of esophageal adenocarcinoma (EAC) cases and is the likely precursor lesion. Research frontiers
Detecting esophageal neoplasia at an earlier stage will allow for the possibility of intervening more quickly and the lowering mortality due to EAC. However, the effectiveness of screening and surveillance of Barrett’s esophagus (BE) has not been studied in randomized controlled trials. In addition, discerning SIM and obtaining satisfactory target biopsies at the region of interest by standard endoscopic observation is difficult.

Innovations and breakthroughs
The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of pit pattern in detecting SIM were 100%, 91.3%, 92.3%, 60% and 100%, respectively (P = 0.004). The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of methylene blue (MB) staining in detecting SIM were 100%, 60.9%, 65.4%, 25% and 100%, respectively (P = 0.085). The specificity and accuracy of the pit-pattern evaluation were significantly superior compared with MB staining for detecting SIM by comparison of exact McNemar’s test (P = 0.0391).

Applications
The study results suggests that the magnified observation of short-segment BE according to the mucosal pattern and its classification can be predictive for SIM.

Terminology
BE is characterized by the replacement of the squamous epithelium in the distal esophagus by columnar epithelia (gastric metaplasia), irrespective of the presence of specialized intestinal metaplasia.

Peer review
The paper found that the magnified observation of a short-segment BE according to its mucosal pattern and classification can be predictive of SIM. It’s an informative manuscript, nicely written.

REFERENCES
1. Dulai GS, Shekelle PG, Jensen DM, Spiegel BM, Chen J, Oh D, Kahn KL. Dysplasia and risk of further neoplastic progression in a regional Veterans Administration Barrett’s cohort. *Am J Gastroenterol* 2005; 100: 775-783 [PMID: 15784018 DOI: 10.1111/j.1572-0241.2005.41300.x]
2. Gilbert EW, Luna RA, Harrison VL, Hunter JG. Barrett’s esophagus: a review of the literature. *J Gastrointest Surg* 2011; 15: 708-718 [PMID: 21461873 DOI: 10.1007/s11605-011-1485-y]
3. Oberg S, Wenner J, Johansson J, Walther B, Willén R. Barrett’s esophagus: risk factors for progression to dysplasia and adenocarcinoma. *Ann Surg* 2005; 242: 49-54 [PMID: 15973101]
4. Vakil N, van Zanten SV, Kahrilas P, Dent J, Jones R. The Montreal definition and classification of gastroesophageal reflux disease: a global evidence-based consensus. *Am J Gastroenterol* 2006; 101: 1900-120; quiz 1943 [PMID: 16928254 DOI: 10.1111/j.1572-0241.2006.00630.x]
5. Michalak J, Bansal A, Sharma P. Screening and surveillance of Barrett’s esophagus. *Curr Gastroenterol Rep* 2009; 11: 195-201 [PMID: 19463219]
6. Sharma P, McQuaid K, Dent J, Ferneyby MB, Sampliner R, Specchier S, Cameron A, Corley D, Falk G, Goldblum J, Hunter J, Jankowski J, Lundell L, Reid B, Shaheen NJ, Sonnenberg A, Wang K, Weinstein W. A critical review of the diagnosis and management of Barrett’s esophagus: the AGA Chicago Workshop. *Gastroenterology* 2004; 127: 310-330 [PMID: 15236196]
7. Conio M, Blanchi S, Lapertosa G, Ferraris R, Sablich R, Marchi S, D’Omonfo V, Lacchin T, Laiqunto G, Missale G, Ravelli P, Cestari R, Benedetti G, Macri G, Fiocca R, Munizzi F, Filiberti R. Long-term endoscopic surveillance of patients with Barrett’s esophagus. Incidence of dysplasia and adenocarcinoma: a prospective study. *Am J Gastroenterol* 2003; 98: 1931-1939 [PMID: 14499768 DOI: 10.1111/j.1572-0241.2003.07666.x]
8. Abela JE, Goings JJ, Mackenzie JF, McKernan M, O’Mahoney S, Stuart RC. Systematic four-quadrant biopsy detects Barrett’s dysplasia in more patients than nonsystematic biopsy. *Am J Gastroenterol* 2008; 103: 850-855 [PMID: 18731153 DOI: 10.1111/j.1572-0241.2007.01746.x]
9. Harrison R, Perry I, Haddadin W, McDonald S, Bryan R, Abrams K, Sampliner R, Talley NJ, Moayyedi P, Jankowski JA. Detection of intestinal metaplasia in Barrett’s esophagus: an observational comparator study suggests the need for an endoscopic biopsy for the diagnosis of dysplasia. *Am J Gastroenterol* 2007; 102: 1154-1161 [PMID: 17433019 DOI: 10.1111/j.1572-0241.2007.01230.x]
10. Reid BJ, Blount PL, Feng Z, Levine DS. Optimizing endoscopic biopsy detection of early cancers in Barrett’s high-grade dysplasia. *Am J Gastroenterol* 2000; 95: 3089-3096 [PMID: 11095322 DOI: 10.1111/j.1572-0241.2000.03182.x]
11. Canto MI, Setrakian S, Petras RE, Blades E, Chak A, Sivak MV. Methylene blue selectively stains intestinal metaplasia in Barrett’s esophagus. *Gastrointest Endosc* 1996; 44: 1-7 [PMID: 8836709]
12. Sharma P, Weston AP, Topalovski M, Cheriyan R, Bhattacharyya A, Sampliner RE. Magnification chromoendoscopy for the detection of intestinal metaplasia and dysplasia in Barrett’s oesophagus. *Gut* 2003; 52: 24-27 [PMID: 12477754]
13. Horwhat JD, Maydonovitch CL, Ramos F, Colina R, Gaertner E, Lee H, Wong RK. A randomized comparison of methylene blue-directed biopsy versus conventional four-quadrant biopsy for the detection of intestinal metaplasia and dysplasia in patients with long-segment Barrett’s esophagus. *Am J Gastroenterol* 2008; 103: 546-554 [PMID: 17970838]
Ham NS et al. Magnifying endoscopy and short-segment Barrett’s esophagus

DOI: 10.1111/j.1572-0241.2007.01601.x

14 Wasielecka-Berger J, Banukiewicz A, Wroblewski E, Chwiesko A, Dabrowski A. Magnification endoscopy and chromoendoscopy in evaluation of specialized intestinal metaplasia in Barrett’s Esophagus. Dig Dis Sci 2011; 56: 1987-1995 [PMID: 21255343 DOI: 10.1007/s10620-010-1551-4]

15 Canto MI, Setrakian S, Willis JE, Chak A, Petras RE, Sivak MV. Methylene blue staining of dysplastic and nondysplastic Barrett’s esophagus: an in vivo and ex vivo study. Endoscopy 2001; 33: 391-400 [PMID: 1196755 DOI: 10.1055/s-2001-14427]

16 Dave U, Shousha S, Westaby D. Methylene blue staining: is it really useful in Barrett’s esophagus? Gastrointest Endosc 2001; 53: 333-335 [PMID: 11231393]

17 Endo T, Awakawa T, Takahashi H, Arimura Y, Itoh F, Yamashita K, Sasaki S, Yamamoto H, Tang X, Imai K. Classification of Barrett’s epithelium by magnifying endoscopy. Gastrointest Endosc 2002; 55: 641-647 [PMID: 11979244]

18 Sharma P, Morales TG, Sampliner RE. Short segment Barrett’s esophagus—the need for standardization of the definition and of endoscopic criteria. Am J Gastroenterol 1998; 93: 1033-1036 [PMID: 9672225]

19 Cameron AJ, Lomboy CT, Pera M, Carpenter HA. Adenocarcinoma of the esophagogastric junction and Barrett’s esophagus. Gastroenterology 1995; 109: 1541-1546 [PMID: 7557137]

20 Hamilton SR, Smith RR. The relationship between columnar epithelial dysplasia and invasive adenocarcinoma arising in Barrett’s esophagus. Am J Clin Pathol 1987; 87: 301-312 [PMID: 3825997]

21 Almond LM, Barr H. Advanced endoscopic imaging in Barrett’s esophagus. Int J Surg 2012; 10: 236-241 [PMID: 22510441 DOI: 10.1016/j.ijsu.2012.04.003]

22 Kara MA, Peters FP, Rosmolen WD, Krishnadath KK, ten Kate FJ,ockens P, Bergman JJ. High-resolution endoscopy plus chromoendoscopy or narrow-band imaging in Barrett’s esophagus: a prospective randomized crossover study. Endoscopy 2005; 37: 929-936 [PMID: 16189764 DOI: 10.1055/s-2005-870433]

23 Ferguson DD, DeVault KR, Krishna M, Loeb DS, Wollsen HC, Wallace MB. Enhanced magnification-directed biopsies do not increase the detection of intestinal metaplasia in patients with GERD. Am J Gastroenterol 2006; 101: 1611-1616 [PMID: 16863568 DOI: 10.1111/j.1572-0241.2006.00622.x]

24 Shin HR, Jung KW, Won YJ, Park JG. 2002 annual report of the Korea Central Cancer Registry: based on registered data from 139 hospitals. Cancer Res Treat 2004; 36: 103-114 [PMID: 20396549]

25 Son JI, Park HJ, Song KS, Kim KJ, Lee CY, Lee SL, Park IS. A single center’s 30 years’ experience of esophageal adenocarcinoma. Korean J Intern Med 2001; 16: 250-253 [PMID: 11855155]

26 Martinek J, Benes M, Brandtl P, Hucl T, Vasicek M, Voska L, Lanska V, Nosek V, Spicka J. Low incidence of adenocarcinoma and high-grade intraepithelial neoplasia in patients with Barrett’s esophagus: a prospective cohort study. Endoscopy 2008; 40: 711-716 [PMID: 18698534 DOI: 10.1055/s-2008-107502]

27 Weston AP, Sharma P, Mathur S, Banerjee S, Jafri AK, Cherian R, McGregor D, Hassanein RS, Hall M. Risk stratification of Barrett’s esophagus: updated prospective multivariate analysis. Am J Gastroenterol 2004; 99: 1657-1666 [PMID: 1530898]

28 Rudolph RE, Vaughan TL, Storer BE, Haggitt RC, Rabino-vitch FS, Levine DS, Reid BJ. Effect of segment length on risk for neoplastic progression in patients with Barrett esophagus. Ann Intern Med 2000; 132: 612-620 [PMID: 10766679]

29 Kim JY, Kim YS, Jung MK, Park JJ, Kang DH, Kim JS, Song CW, Lee SW, Bak YT. Prevalence of Barrett’s esophagus in Korea. J Gastroenterol Hepatol 2005; 20: 633-636 [PMID: 15836715]

30 Egger K, Werner M, Meining A, Ott R, Allescher HD, Höfler H, Classen M, Rösch T. Biopsy surveillance is still necessary in patients with Barrett’s oesophagus despite endoscopic imaging techniques. Gut 2005; 52: 18-23 [PMID: 12477753]

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