Endoscopic scoring system for gastric atrophy and intestinal metaplasia: correlation with OLGA and OLGIM staging: a single-center prospective pilot study in Korea

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ABSTRACT

Background/Aims: We aimed to develop an endoscopic scoring system to evaluate gastric atrophy and intestinal metaplasia using narrow-band imaging (NBI) and near focus mode (NFM) to compare endoscopic scores with the Operative link for gastritis assessment (OLGA) and the Operative link for gastric intestinal metaplasia assessment (OLGIM).

Methods: A total of 51 patients who underwent diagnostic esophagogastroduodenoscopy were prospectively enrolled and endoscopic scoring using NBI and NFM was performed. Four areas (the lesser and greater curvatures of the antrum and the lesser and greater curvature side of the corpus) were observed and biopsies were taken. The degree of atrophy was scored from 0 to 2 according to the Kimura-Takemoto classification. The degree of intestinal metaplasia was scored from 0 to 4 according to the location and the extent of the intestinal metaplasia.

Results: The correlation coefficient for atrophy between the endoscopic and histologic scores was 0.70 (95% CI: 0.52–0.81 p < .001) and for intestinal metaplasia, it was 0.75 (95% CI: 0.60–0.85; p < .001). For atrophic gastritis, an endoscopic score ≥3 correlated with high OLGIM stage III and IV with a sensitivity, specificity, positive predictive value, negative predictive value, and agreement of 88, 74, 75, 87, and 80.4%, respectively, and for intestinal metaplasia, an endoscopic score ≥3 correlated with high OLGIM stage III and IV with 100, 59, 69, 100, and 78.4%, respectively.

Conclusions: Endoscopic scoring for gastric atrophy and intestinal metaplasia using NBI-NFM likely correlates with histologic staging in Korea, a high-risk region for gastric cancer.

Introduction

Atrophic gastritis and intestinal metaplasia are some of the first steps in the precancerous cascade for intestinal-type gastric cancer according to the Correa hypothesis [1]. In a nationwide cohort study in the Netherlands, the annual incidence of gastric cancer was reported as 0.1% for atrophic gastritis and 0.25% for intestinal metaplasia [2]. The extension and severity of the atrophy and intestinal metaplasia were significantly associated with an increased risk of intestinal-type gastric cancer [3–5].

The Operative Link for Gastritis Assessment (OLGA) system and the Operative Link for Intestinal Metaplasia (OLGIM) system were suggested for reporting the staging and grading of gastric atrophy and metaplasia according to the updated Sydney system classification [6,7]. However, to apply the OLGA and OLGIM systems, multiple biopsies from at least four sites are mandatory, and they are therefore difficult to apply in a clinical setting because they are time-consuming and have a risk of bleeding.

Diagnosis using narrow-band imaging (NBI) and magnification endoscopy (ME) for observing atrophy and intestinal metaplasia of the gastric mucosa has been reported [8–13]. The sensitivity and specificity of NBI-ME findings for atrophy and metaplasia, based on histological diagnosis, were reported as high as 70–100% [8,10,12,13]. However, conventional magnifying endoscopy requires substantial skill and time, especially when operating at the zoom level.

Magnification using NFM has been recently introduced to enable 45-fold magnification on a 26-inch monitor under the control of a single button, which is easily applicable [14]. Studies using NBI with near focus mode have been reported, mainly for colon polyps [15–17]. As far as we know, there is no prior report using NBI with NFM in the stomach. Therefore, this study aimed to develop an endoscopic scoring system to evaluate atrophic gastritis and intestinal...
metaplasia using NBI and NFM and compare the endoscopic scores with the histology-OLGA and OLGIM staging systems.

**Patients and methods**

**Patients**

This study was a single-center, prospective pilot study. Between 2017 and 2019, consecutive patients who underwent diagnostic esophagogastroduodenoscopy (EGD) at Asan Medical Center, Seoul, Korea was enrolled. The following patients were excluded during screening: (1) patients who did not have an alert mentality, (2) patients who had unstable vital signs, (3) patients who were suspicious for gastrointestinal bleeding, (4) patients who were prescribed anticoagulant or antiplatelet agents and could not quit their medication, (5) patients who had undergone gastrectomy, (6) patients who had coagulopathy, and (7) patients who could not have multiple biopsies taken for any reason. Written informed consent was obtained from 61 patients, and 10 patients withdrew their consent. Finally, 51 patients were included in the study.

This study was approved by the Institutional Review Board of Asan Medical Center (number: 2017-0947) and was registered with a clinical research information service (http://cris.nih.go.kr, KCT0004377).

**Endoscopic evaluation**

Conscious sedation with midazolam (0.05–0.1 mg/kg) was performed at the request of the patient. Upper endoscopy was performed using a white light endoscope with NBI and dual focus (standard and NFM) using GIF-HQ290 scope and EVIS-HQ290 (Olympus Medical System Co. Ltd, Tokyo, Japan). All endoscopic examinations were performed by two expert endoscopists (CKD and NHK). The gastric mucosa of the antrum and corpus were examined with white light endoscopy (WLE), NBI, and NFM. Representative endoscopic pictures using WLE, NBI, and NFM were taken at four sites: the lesser curvature of the antrum, the greater curvature of the antrum, the lesser curvature of the corpus, and the greater curvature of the corpus, and video of the endoscopic examination was also taken. Endoscopic scoring for gastric atrophy and intestinal metaplasia was performed during the exam by a performing endoscopist. If there are ambiguous findings for scoring, it was scored after a discussion of two endoscopists with the endoscopic images. The endoscopic exam using NBI and dual focus mode required an additive several minutes compared to the exam using white light endoscopy alone.

Biopsies were taken from the same four sites (the lesser curvature of the antrum, the greater curvature of the antrum, the lesser curvature of the corpus, and the greater curvature of the corpus). A rapid urease test (Hp Kit: Chongkungdang Pharm. Corp., Seoul, Korea) was performed for the antrum and the corpus to evaluate *Helicobacter pylori* infection. Blood sampling was performed to determine *H. pylori* Ig G antibody titer using Immulite 2000® immunoassay system (Diagnostic Product Corporation, Los Angeles, CA, USA). *H. pylori* Ig G titer was classified as negative (<0.9 U/mL), equivocal (0.9–1.5 U/mL), and positive (≥1.6 U/mL). *H. pylori* status was defined as follows: No infection was defined as showing both negative *H. pylori* tests and having no history of *H. pylori* eradication. Past infection was defined as positive test *H. pylori* Ig G and negative rapid urease test results or a history of *H. pylori* eradication and negative rapid urease test. Current *H. pylori* infection was defined as positive any of the test results without a history of *H. pylori* eradication.

**Endoscopic score**

Endoscopic scoring of gastric atrophy using WLE, NBI, and NFM was assessed and classified according to the Kimura-Takemoto classification: C0 (no atrophy) and C1 (mild) were scored as 0, C2 and C3 (moderate) as 1, and O-1, O-2, and O-3 (severe) as 2 [18–20]. Endoscopic scoring for intestinal metaplasia was defined as at least one of the following findings under NBI-NFM: light blue crest (LBS, Figure 1(A)), white opaque substances (WOS, Figure 1(B)), and/or a tubular/ granular pit pattern of the corpus (Figure 1(C)) [8]. LBS was a fine, blue-whitish line observed on the crests of the epithelial surface or gyri [10]. WOS was a white opaque substance appearing on part of the surface under the NBI-magnifying view [21]. Score 0 was none of the three findings suggestive of intestinal metaplasia. Score 1 was the presence of at least one finding on the antrum. Score 2 was the presence of at least one finding on the corpus. If findings suggestive of intestinal metaplasia were observed >1/2 of the picture at the antrum, score 1 was added and if the findings were observed >1/2 of the picture at the corpus, score 2 was added. Therefore, the score for atrophic gastritis ranged from 0 to 2 and the score for intestinal metaplasia ranged from 0 to 4.

**Histology**

Biopsy specimens were fixed and paraffin-embedded, and each section was stained with hematoxylin and eosin (H&E). Atrophic gastritis and intestinal metaplasia were interpreted by an experienced gastrointestinal pathologist (PYS) who was unaware of the endoscopic scores, using the updated Sydney system. The presence of atrophy was assessed based on findings of shrinking or vanishing of the glands and fibrosis of the lamina propria. The presence of metaplasia was assessed based on findings of intestinal metaplasia or pseudo-metaplasia of the corpus. OLGA and OLGIM staging were applied according to the OLGA and OLGIM guidelines [7,22,23]. In each of the two areas (the lesser curvature and greater curvature), overall atrophy and metaplasia score expressed the sum of the percentages of atrophy/metaplasia changes and was divided by two [22]. Atrophic gastritis was graded as no, mild (1–30%), moderate (31–60%), or severe (>60%) atrophy of the observed biopsy tissue from the antrum and corpus, respectively [22]. Intestinal metaplasia was graded as non-existent, mild (1–9), moderate (10–29), or severe metaplasia (≥30%) at each antrum and corpus biopsy.
level, respectively. Stages 0, 1, 2 were placed into the low-risk group whereas stages 3 and 4 were the high-risk group.

**Statistical analysis**

Continuous and categorical variables are presented as median (interquartile range) and number (%), respectively. Correlations between the endoscopic score and histology were calculated using Spearman correlation analysis. Sensitivity analysis was performed to find the best correlation between the high-risk endoscopic score and the high-risk OLGA or OLGIM staging. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for each cut-off value of the endoscopic scores were calculated. Receiver Operating Characteristic (ROC) curves and the area under the curve (AUCs) were calculated for binary classification. Logistic regression and odds ratios were used to assess the endoscopic risk group for high OLGA and OLGIM stages. Statistical analyses were performed using SAS (Statistical Analysis Software 9.4, SAS Institute Inc., Cary, NC, USA), and p-values <.05 were considered statistically significant.

**Results**

**Baseline characteristics**

The baseline characteristics of the patients are summarized in Table 1. Their median age was 59 years old and 58.8% (30/51) were men. The reasons for undergoing EGD were as follows: abnormal findings from the local hospital (25/51, 49.0%), dyspepsia (12/51, 23.5%), screening (6/51, 11.8%), abdominal pain (4/51, 7.8%), chest pain (3/51, 5.9%), and reflux symptoms (1/51, 2.0%). Ten patients (19.6%) had a history of *H. pylori* eradication. *H. pylori* IgG was positive in 34 patients (66.7%) and the rapid urease test was positive in 26 patients (51.0%).

**Endoscopic scores and histologic staging**

Endoscopic scores of the study population are shown in Figures 2(A,B). As for the atrophy score, score 0 (C-0, and C-1) was assessed in 10 patients (19.6%), score 1 (C-2, and C-3) in 13 patients (25.5%), and score 2 (O-1, O-2, and O-3) in 28 patients (54.9%). For the intestinal metaplasia score, 13 patients scored a 0 after assessment (25.5%), three patients scored a 1 (5.9%), 24 patients scored a 2 (47.1%), five

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*Figure 1.* Representative endoscopic images using narrow-band imaging with near focus mode. (A) Light blue crest (LBS) in antrum (box). (B) White opaque substances (WOC) in antrum (box). (C) Tubular or granular pit pattern in corpus.

*Table 1.* Baseline characteristics of the study population.

| Characteristics                  | Patients |
|----------------------------------|----------|
| Age, years                       | 59 (52–63) |
| Male                             | 30 (58.8) |
| Body mass index (kg/m²)          | 25.4 (23.1–26.9) |
| Smoking                          |          |
| Non-smoking                      | 29 (56.9) |
| Past smoker                      | 15 (29.4) |
| Current smoker                   | 7 (13.7)  |
| Alcohol consumption              |          |
| Non-drinker                      | 21 (41.2) |
| Past drinker                     | 4 (7.8)   |
| Current drinker                  | 26 (51.0) |
| Current medication               |          |
| Acid suppressant                 | 10 (19.6) |
| Hypoglycemic agents              | 6 (11.8)  |
| Antihypertensive drugs           | 11 (21.6) |
| Lipid lowering gents             | 11 (21.6) |
| Acid suppressant                 | 10 (19.6) |
| Aspirin                          | 2 (3.9)   |
| NSAIDs                           | 3 (5.9)   |
| Reason for EGD                   |          |
| Abnormal finding on outside endoscopy | 25 (49.0) |
| Abdominal pain                   | 4 (7.8)   |
| Dyspepsia                        | 12 (23.5) |
| Chest pain                       | 3 (5.9)   |
| Screening                        | 6 (11.8)  |
| Reflux                           | 1 (2.0)   |
| Family history of gastric cancer | 11 (21.6) |
| History of peptic ulcer disease  | 3 (5.9)   |
| History of upper GI bleeding     | 0 (0)     |
| History of endoscopic resection  | 1 (2.0)   |
| History of *H. pylori* eradication | 10 (19.6) |
| *H. pylori* IgG                   |          |
| Positive                         | 34 (66.7) |
| Titer                            | 4.5 (2.5–6) |
| Positive rapid urease test       | 26 (51.0) |
| Laboratory findings              |          |
| WBC                              | 6.5 (5.5–7.2) |
| Hemoglobin                       | 14.2 (13–15.4) |
| Platelet                         | 233 (211–269) |
| Systolic blood pressure (mmHg)   | 134 (123–150) |
| Diastolic blood pressure (mmHg)  | 79 (71–89)  |
| Pulse rate (/min)                | 77 (68–86)  |

Values are presented as number (percent) or median (interquartile range).

The cut-off value for *H. pylori* sero-positivity was defined as ≥1.6 and seronegativity was defined as the value was <0.9.
patients scored a 3 (9.8%), and six patients scored a 4 (11.8%).

The OLGA and OLGIM scores are shown in Figures 2(C,D). As for OLGA staging, stage 0 was found in 10 patients (19.6%), stage I in eight patients (15.7%), stage II in nine patients (17.6%), stage III in seven patients (13.7%), and stage IV in 17 patients (33.3%). Regarding OLGIM staging, stage 0 was observed in 13 patients (25.5%), stage I in nine patients (17.6%), stage II in five patients (9.8%), stage III in 14 patients (27.5%), and stage IV in 10 patients (19.6%). Therefore, 47.0% of the patients were in the high-risk OLGA group (stage III or IV) and 47.1% of the patients were in the high-risk OLGIM group (stage III or IV).

Endoscopic scores and histologic staging according to *H. pylori* infection status are shown in Figure 3. Endoscopic scores for gastric atrophy and metaplasia were significantly higher in current *H. pylori*-infected patients (*p* = .002 and .012, respectively, Figures 3(A,B)). OLGA and OLGIM staging were also significantly higher in current *H. pylori*-infected patients (*p* = .002 and .003, respectively, Figures 3(C,D)).

**Correlation between endoscopic scores and histology**

The correlation coefficient for atrophy between the endoscopic and histologic scores was 0.70 (95% CI: 0.52–0.81, *p* < .001), and for intestinal metaplasia it was 0.75 (95% CI: 0.60–0.85; *p* < .001). The distribution of risk groups using NBI-NFM and OLGA or OLGIM staging is shown in Table 2.

For atrophic gastritis, endoscopic score >1 correlated with OLGA Stage III and IV with a sensitivity, specificity, PPV, NPV, and accuracy of 88%, 74%, 75%, 87%, and 80.4%, respectively. On ROC curve analysis, the area under the curve for atrophy was 0.81 (Figure 4(A)) and the kappa value was 0.61 (95% CI: 0.4–0.82, *p* < .001).

For intestinal metaplasia, an endoscopic score >1 correlated with high OLGIM Stage III and IV with sensitivity, specificity, PPV, NPV, and accuracy of 100%, 59%, 69%, 100%, and 78.4%, respectively. On ROC curve analysis, the area under the curve was 0.87 (Figure 4(B)) and the kappa value was 0.58 (95% CI: 0.38–0.78, *p* < .001).

Among low-risk OLGA and OLGIM-staged patients, endoscopic scores’ diagnostic accuracy was 0.74 (95% CI: 0.54–0.89, by exact method) and 0.59 (95% CI: 0.38–0.77%, by exact method), respectively.

**Discussion**

In this study, we developed endoscopic scores evaluating the atrophy and intestinal metaplasia of the gastric mucosa using NBI and NFM and assessed the correlation between the endoscopic scores and histology. Previous studies evaluating atrophy and intestinal metaplasia reported the usefulness of NBI and/or magnifying endoscopy, not the diagnostic...
performance of NFM. Conventional magnifying endoscopy is
time-consuming for observation and can be performed only
by an experienced endoscopist. However, the near focus
function can be used with several additional minutes and is
easily applicable without special training. In our study, an
atrophic border (F-line) could be readily observed by adding
an NBI examination and typical findings of intestinal meta-
plasia (LBC, WOS, and tubular or granular pit of the corpus),

Figure 3. Endoscopic and histologic scores according to H. pylori status. (A) Endoscopic score for gastric atrophy. (B) Endoscopic score for intestinal metaplasia. (C) OLGA stage. (D) OLGIM stage.

Table 2. Distribution of risk groups of endoscopic score using NBI-NFM and OLGA and OLGIM staging.

| Endoscopic atrophy/metaplasia score | Low risk | High risk | Agreement | p-Value |
|------------------------------------|---------|----------|-----------|---------|
| OLGA                               | Low risk (0–2) 20 (87.0%) | 7 (25.0%) | 80.4% | <.001 |
| High risk (3, 4) | 3 (13.0%) | 21 (75.0%) | | |
| OLGIM                               | Low risk (0–2) 16 (100%) | 11 (31.4%) | 78.4% | <.001 |
| High risk (3, 4) | 0 (0) | 24 (68.6%) | | |
which has been previously reported using NBI magnifying endoscopy, and it could also easily be seen with NBI with NFM. When applying endoscopic atrophy scores based on the Kimura-Takemoto classification and the endoscopic intestinal metaplasia score based on the typical NBI-magnification view of the metaplasia and the extent, a score >1 indicated a high-risk group for both atrophy and intestinal metaplasia and demonstrated a positive correlation (0.70 for atrophy and 0.75 for metaplasia) with high-risk OLGA and OLGIM staging.

Discrepancies between endoscopic and histologic diagnosis of gastric atrophy and intestinal metaplasia have been reported. In a study reporting discrepancies between histological and endoscopic findings for atrophic gastritis in 1330 patients, the sensitivity and specificity of atrophic gastritis in the antrum were 61.5 and 57.7%, and in the corpus were 46.8 and 76.4% [24]. As for intestinal metaplasia, they were 24.0 and 91.9% in the antrum and 24.2 and 88% in the corpus [25]. In this study, the sensitivities for the diagnosis of endoscopic intestinal metaplasia were lower than our results because their diagnosis of intestinal metaplasia was evaluated only with white light endoscopy. In a recent multicenter validation study for endoscopic grading of gastric intestinal metaplasia, endoscopic score >4 correlated with stage III and IV OLGIM with 89.4% of sensitivity, 94.6% of specificity, 79.2% of PPV, and 97.5% of NPV [12]. In the study, the authors used white light endoscopy and NBI (without magnification) and the score ranged from 0 to 10. Our result showed higher sensitivity and PPV whereas lower specificity and NPV than this European study. We assume that a scoring system with high sensitivity and PPV is more useful to screen gastric cancer in the countries with a high prevalence of gastric cancer.

Endoscopic grading of atrophic gastritis according to the Kimura-Takemoto classification is widely used. This system significantly reflects both the extent and severity of gastric atrophy because the extent correlates with the degree of severity. The endoscopic atrophic score was graded as 0 (none, C0 or mild, C1), 1 (moderate, C2 and C3), and 2 (severe, O1, O2, and O3), and when the score was 2, the score correlated well with OLGA Stage III and IV in our result. Recent studies showed the risk of cancer differs according to this grading [26,27]. In a study evaluating 9378 subjects who underwent cancer screening, C0-1, C2-3, and open type showed 0.10, 0.16, and 0.31% of the annual rate of gastric cancer occurrence, respectively [27].

_H. pylori_ infection status was also significantly associated with high endoscopic atrophy or intestinal metaplasia scores, and high OLGA and OLGIM system scores. Our result is consistent with the data from the previous report evaluating OLGA and OLGIM systems according to age and _H. pylori_ status in the Korean population [28]. In the study, the proportion of high OLGA and OLGIM stages was significantly increased with _H. pylori_ infection (OR = 8.46), and high-risk OLGA and OLGIM stages were uncommon in the _H. pylori_-negative subjects.

We diagnosed endoscopic intestinal metaplasia demonstrating at least one finding of LBS, WOS, and tubular or granular pit pattern of the corpus using NBI-NFM. Those findings have been reported as a useful marker for endoscopic diagnosis of intestinal metaplasia with 50–89% sensitivity and 80–100% specificity [10,13,21]. However, these findings suggest only the presence of intestinal metaplasia and do not give information about the extent and the severity of intestinal metaplasia. Therefore, we added scores according to the site (antrum or corpus) and severity (whether the findings suggestive of intestinal metaplasia were observed in more than half of the pictured area), and our endoscopic intestinal metaplasia score exhibited a good correlation with histologic staging. In a cross-sectional study of 55 patients, the authors developed an endoscopic score using NBI magnifying endoscopy and they combined the scores for the antrum and the corpus mainly based on findings of intestinal metaplasia [8]. The degree of correspondence between the
high-risk NBI-ME finding and a high histology score was 89.1%, which was similar to our result.

Our endoscopic atrophic and intestinal metaplasia scores tended to overestimate the OLGA and OLGIM systems. We speculated that it was because multifocal atrophy or intestinal metaplasia could be underestimated on histologic examination if biopsy samples were not taken from the exact site of the atrophy or intestinal metaplasia. In addition, we omitted to take a biopsy sample from the incisura angularis, which could affect the histologic diagnosis. In a study assessing the value of incisura angularis biopsy, a general downgrading of the stage by 4.0% for OLGIM and 30–35% downgrading for high-risk OLGA/OLGIM stages were observed if the incisura angularis was excluded from the biopsy [29].

The proportion of high-risk OLGA and OLGIM (stage III or IV) patents was high at 47%. In a previous study on the OLGA and OLGIM stage distribution in a Korean screening population, high-risk OLGA patients were only 16.6% and high-risk OLGIM, 9.5% [28]. It is inferred that the differences came from the characteristics of our study population. Many of our patients (49%) underwent diagnostic endoscopy because of abnormal EGD findings, such as early gastric cancer or dysplasia at a local clinic. In a study evaluating OLGA and OLGIM stage in gastric cancer patients, the proportion of high-risk OLGA and OLGIM patients was similar to our study (46.2% OLGA and 46.1% OLGIM, respectively) [30]. Furthermore, the past history (19.6%) or current infection rate (51%) of *H. pylori* was relatively high in our population, and this may affect the high proportion of high-risk OLGA and OLGIM staging.

OLGA staging reliably predicts the risk of developing gastric cancer [31]. In a prospective study of 1755 patients followed up for 5 years, the risk for gastric dysplasia or cancer was null in patients stage 0, 1, and III, while it was 36.5 per 1000 person-years among patients at stage 3 and 63.1 per 1000 person-years among patients at stage IV [31]. In a retrospective cohort study, OLGIM showed a better predictive value for gastric cancer development than OLGA and the standardized incidence rate for high-risk OLGIM was 4.0 [32]. OLGIM staging has the advantage of the high inter-observer agreement, but a substantial proportion of high-risk patients would be missed if only OLGIM staging was applied [29]. Applying both OLGA and OLGIM staging is necessary for the accurate prediction of gastric cancer risk. In the same vein, we infer that evaluations of both atrophic gastritis and intestinal metaplasia are necessary to screen high-risk patients for gastric cancer.

This study has several limitations. First, the number of enrolled patients was small. Second, we could not evaluate the inter-observer agreement of the pathologists. Third, we did not take a biopsy of the incisura angularis, which could result in the downgrading of histology. Fourth, this study was performed in Korea, a high-risk region for gastric cancer, and it also included many patients (49%) with gastric dysplasia or early gastric cancer who needed endoscopic treatment, which increased the proportion of high-risk OLGA and OLGIM patients. However, our prospective study showed the feasibility of applying endoscopic scores using NBI and NFM, and the high-risk scores correlate with high OLGA and OLGIM staging. Further studies applying these endoscopic scores to large screening populations in low-risk regions for gastric cancer and evaluating the actual incidence of gastric cancer during long-term follow-up of the patients are needed.

In conclusion, we developed an endoscopic score for gastric atrophy and intestinal metaplasia using NBI-NFM, and the endoscopic scores appeared to correlate with OLGA/OLGIM staging in Korea, a high-risk region for gastric cancer.

**Author contributions**

This study was designed, directed, and coordinated by CKD, PYS, and NHK. CKD and NHK carried out recruitment of the patients and their endoscopies. A pathologic review was performed by PYS. KHJ performed the statistical analysis. CKD and NHK participated in data interpretation and drafted the manuscript. All authors reviewed the manuscript and approved the final version of the manuscript.

**Disclosure statement**

The authors declare no conflicts of interest.

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