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**Kyoto classification of gastritis: Advances and future perspectives in endoscopic diagnosis of gastritis**

Toyoshima O *et al*. Kyoto classification of gastritis

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**Abstract**

This editorial provides an update of the recent evidence on the endoscopy-based Kyoto classification of gastritis, clarifying the shortcomings of the Kyoto classification, and providing prospects for future research, with particular focus on the histological subtypes of gastric cancer (GC) and *Helicobacter pylori* (*H. pylori*) infection status. The total Kyoto score is designed to express GC risk on a score ranging from 0 to 8, based on the following five endoscopic findings: Atrophy, intestinal metaplasia (IM), enlarged folds (EF), nodularity, and diffuse redness (DR). The total Kyoto score reflects *H. pylori* status as follows: 0, ≥ 2, and ≥ 4 indicate a normal stomach, *H. pylori*-infected gastritis, and gastritis at risk for GC, respectively. Regular arrangement of collecting venules (RAC) predicts non-infection; EF, nodularity, and DR predict current infection; map-like redness (MLR) predicts past infection; and atrophy and IM predict current or past infection. Atrophy, IM, and EF all increase the incidence of *H. pylori*-infected GC. MLR is a specific risk factor for *H. pylori*-eradicated GC, while RAC results in less GC. Diffuse-type GC can be induced by active inflammation, which presents as EF, nodularity, and atrophy on endoscopy, as well as neutrophil and mononuclear cell infiltration on histology. In contrast, intestinal-type GC develops *via* atrophy and IM, and is consistent between endoscopy and histology. However, this GC risk-scoring design needs to be improved.

**Key Words:** Kyoto classification; Gastritis; Endoscopy; Gastric cancer; *Helicobacter pylori*; Histology

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**Core Tip:** Endoscopy-based Kyoto classification of gastritis assesses gastric cancer (GC) risk and *Helicobacter pylori* (*H. pylori*) infection status. Total Kyoto scores of 0, ≥ 2, and ≥ 4 indicate a normal stomach, *H. pylori*-infected gastritis, and gastritis at risk for GC, respectively. Atrophy, intestinal metaplasia (IM), and enlarged folds (EF) increase *H. pylori*-infected GC incidence. Map-like redness is a specific risk factor for *H. pylori*-eradicated GC, while regular arrangement of collecting venules result in less GC risk. Diffuse-type GC is induced by active inflammation, depicting EF, nodularity, and atrophy. Intestinal-type GC develops through atrophy and IM; however, the GC risk-scoring design still needs to be improved.

**INTRODUCTION**

The Kyoto classification of gastritis aims to match the endoscopic and histopathological findings of gastritis. It further aims to evaluate gastric cancer (GC) risk and *Helicobacter pylori* (*H. pylori*) infection of gastritis. The Kyoto classification was first advocated by the Japan Gastroenterological Endoscopy Society in 2013 and is widely used in recent clinical practice worldwide[1]. Technological advances in endoscopy have significantly improved the accuracy of identifying premalignant mucosal changes[2]. This editorial provides an update of the recent evidence on the Kyoto classification, clarifying the shortcomings of the Kyoto classification, and providing prospects for future research. This article is divided into the following four chapters: (1) *H. pylori* infection according to the Kyoto classification; (2) The histological consistency of the Kyoto classification; (3) Risk of GC according to the Kyoto classification; and (4) Future prospects in the Kyoto classification.

In the Kyoto classification, the total Kyoto score has been developed as a GC risk score. The total Kyoto score is calculated as the sum of the following 5 endoscopic findings: Atrophy, intestinal metaplasia (IM), enlarged folds (EF), nodularity, and diffuse redness (DR); and ranges from 0 to 8 (Table 1 and Figure 1)[1]. The Kyoto DR score includes the disappearance of the regular arrangement of collecting venules (RAC). Map-like redness (MLR) frequently appears after *H. pylori* eradication, and is generally pathologically consistent with IM[3]. This article describes the total Kyoto score and its five individual findings along with RAC and MLR.

GCs consist of two distinct histological subtypes: Lauren’s diffuse and intestinal GC[4]. Diffuse-type GC develops directly from highly active inflammation, whereas intestinal-type GC develops through destruction and replacement of tissues, such as atrophy and IM, and is termed Correa’s cascade[5-7]. GCs can also be described according to the different rates of incidence[8,9], lesion characteristics[10-12], and prognoses[13-16] as per the corresponding *H. pylori* infection status. In this editorial, we specifically describe the histological subtypes of GC and *H. pylori* infection status.

***H. PYLORI* INFECTION IN THE KYOTO CLASSIFICATION**

***H. pylori non-infection***

Evidence of RAC as an indicator of non-infection has been reported in both in Japan[17,18] and several other countries[19-21], including in the west[22-24], as shown in Table 2. Two recent meta-analyses reported that the sensitivity and specificity of RAC for predicting non-infection were 78%-80% and 94%-97%, respectively[25,26]. The high reliability of RAC for non-infectious cases has also been verified.

***H. pylori current and past infection***

All five Kyoto scores, atrophy (61.1%-85.8% and 58.5%-85.3%)[19,23,27], IM (95.6% and 86.0%)[27], EF (96.6%-99.1% and 85.0%-85.3%)[17,27], nodularity (98.3%-100% and 76.5%-89.1%)[17,20,27,28], and DR (73.6%-97.6% and 65.0%-89.7%)[17,19,20,27], commonly offer high specificity and accuracy for categorizing current infections (Table 2).

Three studies have previously compared patients with non-infectious, current, and past infections, all of which reported that RAC was strongly correlated with non-infection [odds ratios (ORs) = 4.6-55.0]; MLR was a highly specific finding indicative of past infection (ORs = 7.8-12.9), and DR, EF, and nodularity provided high ORs of 10.5-26.4, 6.0-8.6, and 4.0-22.5, respectively, for current infection. Atrophy and IM were associated with both current (ORs = 1.9-21.6 and 4.3) and past infections (ORs = 1.9-22.8 and 4.4), respectively[17,19,25]. A previous study reported an algorithm with an accuracy of 80.0% for defining the presence of RAC as non-infection, DR and mucosal edema as current infection, and MLR as post-eradication[24]. *H. pylori* eradication decreases the Kyoto EF, nodularity, and DR scores, but does not improve the Kyoto atrophy and IM scores[29]. These results indicate that the presence of RAC predicts non-infection; EF, nodularity, and DR predict current infection; MLR predicts past infection; and atrophy and IM predict current or past infection.

***Total Kyoto score***

Several studies have previously focused on the association between the total Kyoto score and *H. pylori* infection. The sensitivity and specificity of the total Kyoto score for current infection were good at 78.3%-98.7% and 92.0%-98.4%, respectively (Table 2)[27,30]. The area under the curve (AUC) of the total Kyoto score for predicting current infection was 0.85, with a cutoff value of 2[27]. Current infection rates increased stepwise, with total Kyoto scores of 0-1, 2-3, and ≥ 4 (8.6%, 61.4%, and 85.7%, respectively)[31]. The mean total Kyoto scores differed among patients with current, past, and non-infection (3.4, 1.1, and 0.0, respectively)[32]. A combination of the total Kyoto score and serum *H. pylori* antibody titer allows for the accurate diagnosis of current infection[33]. The total Kyoto score decreases from 3.9 to 2.8 following *H. pylori* eradication[29]. In summary, total Kyoto scores of 0 and ≥ 2 express non-infection and current infection, respectively.

**HISTOLOGICAL CONSISTENCY OF KYOTO CLASSIFICATION**

The purpose of the Kyoto classification is to match endoscopic and histological findings of gastritis. Regarding atrophy and IM, considerable evidence exists to indicate the consistency between endoscopy and histology. In recent studies, a high Kyoto atrophy score and severe endoscopic IM are associated with histologically advanced stages of operative link for gastritis assessment and operative link for gastric IM assessment, respectively[34,35].

Consistency between the endoscopic findings of the Kyoto scores and histological grading of the updated Sydney system (USS) scores has been examined individually. All five Kyoto scores were associated withhistological inflammation, namely the USS score for neutrophil and mononuclear cell infiltration, which is an indicator of *H. pylori* infection. The Kyoto atrophy and IM scores correlated with both histological atrophy and IM in the corpus[34,36]. Among *H. pylori*-infected patients, the Kyoto EF, nodularity, and DR scores indicated histologically high inflammation in the corpus[36-38]. In summary, the Kyoto atrophy and IM scores were concordant with histological corpus atrophy and IM scores. The Kyoto EF and nodularity scores were associated with the histological corpus inflammation.

**GC RISK OF KYOTO CLASSIFICATION**

Significant evidence to indicate endoscopic atrophy as a risk factor for GC has been accumulated. The incidence of GC based on atrophy is summarized in Table 3. GC incidences for mild, moderate, and severe atrophy are 0.06%-0.15%, 0.12%-0.34%, 0.31%-1.60%, respectively, indicating the severity of atrophy as a risk factor for GC development, even after *H. pylori* eradication[39-41]. A recent study from Western countries also showed that a Kyoto atrophy score of 2 was associated with GC development with a hazard ratio of 6.4 in patients with baseline IM[42].

The ORs for the histological subtypes of GC based on the Kyoto classification are summarized in Table 4. The Kyoto atrophy score is a predictor of GC with ORs of 2.5-7.4[43-45]. Two recent meta-analyses showed that a Kyoto atrophy score of 2 had high risk ratios (2.8-8.0 for developing GC)[46,47]. In an examination based on histological subtypes, a high Kyoto atrophy score was found to be associated with both diffuse-type and intestinal-type GCs with ORs of 2.3 and 6.2, respectively[44].

A high Kyoto IM score indicates a high risk for GC (OR = 1.6), especially intestinal-type GC (OR = 1.7), but a low risk for diffuse-type GC (OR = 0.2)[44,45,48,49]. In a direct comparison of diffuse-type and intestinal-type GCs, a high Kyoto IM score was associated with intestinal-type GC (ORs = 1.7-2.1)[44,49]. Furthermore, a high Kyoto IM score was associated with multiple GCs[50].

In a study on asymptomatic *H. pylori*-infected patients, the hazard ratio of patients with EF for GC development during the 5 years was high at 43.3[51]. In contrast, EF was associated with a low risk of intestinal-type GC (OR = 0.5)[44]. Furthermore, a direct comparison between diffuse-type and intestinal-type GCs indicated EF as a risk factor for diffuse-type GC (OR = 1.3)[44]. EF is reported to be an indicator of submucosal invasion in patients with GC (OR = 3.4; submucosal invasion *vs* intramucosal depth)[52].

The risk of nodularity is controversial. Previous studies found that nodularity was associated with a high risk for diffuse-type GC (OR = 10.0)[53], notably in young *H. pylori-*infected patients (OR = 64.2)[54]. In contrast, nodularity was described as a low risk factor for GC (OR = 0.5), especially intestinal-type GC (OR = 0.3)[44]. Nodularity decreases with age and the risk of intestinal-type GC increases with age[28]. Therefore, the risk of nodularity in GC should be stratified according to age.

Previously, RAC has been revealed as a predictor of non-GC[45]. Collectively, the Kyoto atrophy, EF, and nodularity scores were associated with diffuse-type GC, whereas the Kyoto atrophy and IM scores were related to intestinal-type GC, as shown in Figure 2.

***GC risk after H. pylori eradication***

Recently, the risk of GC after *H. pylori* eradication has been intensively investigated. Table 5 shows the risk of GC following *H. pylori* eradication. A Kyoto atrophy score of 2 and MLR are both indicators of GC after eradication, with ORs of 8.1 and 1.8-5.3, respectively[55-57]. Additionally, RAC was inversely associated with eradicated GC (ORs = 0.3-0.4)[56,58]. Studies have further revealed that the hazard ratios of Kyoto atrophy 2 and MLR for GC development were 4.9 and 3.6, respectively[55,59]. Take *et al*[41] previously reported the long-term incidence of GC after eradication based on endoscopic atrophy. The incidence of diffuse-type GC was higher in the second decade of follow-up than in the first decade. This increase was only observed in patients with mild-to-moderate gastric atrophy, indicating that even if atrophy is not severe, the risk of GC can persist long after eradication.

***Total Kyoto score***

The total Kyoto scores of patients with GC, *H. pylori*-infected GC, and *H. pylori*-eradicated GC were 4.0-4.6, 4.8-5.6, and 4.2, respectively[44,50,58,60]. A high total Kyoto score was associated not only with GC (ORs = 1.5-1.6), but also with both diffuse-type and intestinal-type GCs (ORs = 1.3 and 1.7, respectively, Table 4)[44,61]. Additionally, some investigators showed that the incidence of GC increased stepwise with the total Kyoto scores of 0-1, 2-3, ≥ 4, and that the AUC of the nomogram to predict GC using the total Kyoto score was 0.79[31,61]. Taken together, a total Kyoto score of 4 or more is useful for determining GC risks, including histological subtypes, even after *H. pylori* eradication.

**FUTURE PERSPECTIVES IN KYOTO CASSIFICATION**

The total Kyoto score was developed to evaluate GC risk, with a score ≥ 4 indicating risk. However, designing a method to simply add each component of the Kyoto score is problematic. First, the GC risks of the diffuse and intestinal types were distinctly different. For example, IM is associated with a high risk of intestinal-type GC but a low risk of diffuse-type GC. Conversely, EF and nodularity are high risk factors for diffuse-type GC, but indicate a low risk of intestinal-type GC (Table 4 and Figure 2). The majority of GC cases are classified as intestinal type, which indicates that the intestinal-type GC risk may be overestimated, whereas the diffuse-type GC risk may be underestimated. Second, two points were assigned to Kyoto atrophy, IM, and DR scores in the total Kyoto score. The verification of the weighting of the total Kyoto score is a future task. Therefore, this scoring method should be revised in the future. A modified Kyoto score has been suggested as the sum of the following points: 2 points for invisible RAC, and 1 point each for Kyoto atrophy score 2, Kyoto IM score 2, and corpus MLR. Compared with the scores of 0-1, the ORs of the GC morbidity for the modified Kyoto scores of 2-3 and 4-5 were higher, at 8.6 and 28.0, respectively. Although statistical significance was not reached, the AUC of the modified Kyoto score had a higher predictive ability than that of the original total Kyoto score (0.75 *vs* 0.71, respectively)[45]. Furthermore, a scoring system specific to histological GC subtypes is needed. Third, MLR has been shown to predict GC after *H. pylori* eradication. Since IM manifests as MLR after *H. pylori* eradication[3], MLR may be more suitable than IM to assess the risk of eradicated GC.

In Western countries, RAC and endoscopic IM have been extensively studied; however, other endoscopic findings, such as atrophy, EF, nodularity, DR, and MLR, have been less extensively explored, and further studies in more varied populations are required. This article does not mention a variety of important endoscopic findings, including spotty redness as a predictor of *H. pylori* infection[62]; xanthoma[57,63,64], foveolar hyperplastic polyp[65], refluxed bile[66], and a lack of fundic gland polyp[64] to predict GC; and depressive erosion and fundic gland polyp as indicators of functional dyspepsia[32,67]. Further research is required to confirm these findings. RAC provides high kappa values of intra-observer and inter-observer agreements of 0.88-0.91 and 0.74-0.79, respectively[21,68]; however, agreement between the other endoscopic findings needs to be clarified.

Autoimmune gastritis (AIG) is gaining attention as an important factor owing to the decrease in *H. pylori* infection[69]. Both severe endoscopic atrophy and a Kyoto IM score of 2 have been reported as AIG features[70,71]. Further steps should be taken to elucidate the differential diagnosis between AIG and *H. pylori*-associated gastritis using the Kyoto classification.

Recently, image-enhanced endoscopy (IEE) has been widely used in clinical practice. Two meta-analyses previously reported the utility of narrow-band imaging (NBI) for the diagnosis of IM[72,73]. Additionally, an improved diagnostic accuracy on using NBI, blue laser imaging, and linked color imaging have been reported[74-77]. In the future, research on endoscopic assessment using IEE, including texture and color enhancement imaging[78,79] will be required.

**CONCLUSION**

In conclusion, the total Kyoto score and individual Kyoto score, including atrophy, IM, EF, nodularity, and DR, can predict GC risk and *H. pylori* infection. Total Kyoto scores of 0, ≥ 2, and ≥ 4 indicate a normal stomach, *H. pylori*-infected gastritis, and gastritis at risk for GC, respectively; RAC predicts non-infection; EF, nodularity, and DR predict current infection; MLR predicts past infection; and atrophy and IM predict current or past infection. Atrophy, IM, and EF all increase in *H. pylori*-infected GC, MLR is a specific risk factor for *H. pylori*-eradicated GC, while RAC indicates a lesser GC risk. Diffuse-type GC can be induced by active inflammation, which presents as EF, nodularity, and atrophy on endoscopy, and neutrophil and mononuclear cell infiltration on histological examination. In contrast, intestinal-type GC develops *via* atrophy and IM, and is consistent on endoscopy and histology. However, the GC risk-scoring design still needs to be improved.

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**REFERENCES**

1 **Kato M**, Kamada T. Endoscopic Findings for Risk Stratification of Gastric Cancer. In: Haruma K, Kato M, Inoue K, Murakami K, Kamada T. Kyoto Classification of Gastritis. 1st ed. Tokyo: Nihon Medical Center, 2017: 97-110

2 **Shah SC**, Piazuelo MB, Kuipers EJ, Li D. AGA Clinical Practice Update on the Diagnosis and Management of Atrophic Gastritis: Expert Review. *Gastroenterology* 2021; **161**: 1325-1332.e7 [PMID: 34454714 DOI: 10.1053/j.gastro.2021.06.078]

3 **Nagata N**, Shimbo T, Akiyama J, Nakashima R, Kim HH, Yoshida T, Hoshimoto K, Uemura N. Predictability of Gastric Intestinal Metaplasia by Mottled Patchy Erythema Seen on Endoscopy. *Gastroenterology Res* 2011; **4**: 203-209 [PMID: 27957016 DOI: 10.4021/gr357w]

4 **Lauren P**. The two histological main types of gastric carcinoma: diffuse and so-called intestinal-type carcinoma. an attempt at a histo-clinical classification. *Acta Pathol Microbiol Scand* 1965; **64**: 31-49 [PMID: 14320675 DOI: 10.1111/apm.1965.64.1.31]

5 **Dixon MF**. Pathology of Gastritis and Peptic Ulceration. In: *Helicobacter pylori*: Physiology and Genetics. Washington (DC): ASM Press; 2001– [PMID: 21290752]

6 **Nardone G**, Rocco A, Malfertheiner P. Review article: helicobacter pylori and molecular events in precancerous gastric lesions. *Aliment Pharmacol Ther* 2004; **20**: 261-270 [PMID: 15274662 DOI: 10.1111/j.1365-2036.2004.02075.x]

7 **Correa P**, Houghton J. Carcinogenesis of Helicobacter pylori. *Gastroenterology* 2007; **133**: 659-672 [PMID: 17681184 DOI: 10.1053/j.gastro.2007.06.026]

8 **Kumar S**, Metz DC, Ellenberg S, Kaplan DE, Goldberg DS. Risk Factors and Incidence of Gastric Cancer After Detection of Helicobacter pylori Infection: A Large Cohort Study. *Gastroenterology* 2020; **158**: 527-536.e7 [PMID: 31654635 DOI: 10.1053/j.gastro.2019.10.019]

9 **Kawai S**, Wang C, Lin Y, Sasakabe T, Okuda M, Kikuchi S. Lifetime incidence risk for gastric cancer in the Helicobacter pylori-infected and uninfected population in Japan: A Monte Carlo simulation study. *Int J Cancer* 2022; **150**: 18-27 [PMID: 34449868 DOI: 10.1002/ijc.33773]

10 **Tahara S**, Tahara T, Horiguchi N, Kato T, Shinkai Y, Yamashita H, Yamada H, Kawamura T, Terada T, Okubo M, Nagasaka M, Nakagawa Y, Shibata T, Yamada S, Urano M, Tsukamoto T, Kurahashi H, Kuroda M, Ohmiya N. DNA methylation accumulation in gastric mucosa adjacent to cancer after Helicobacter pylori eradication. *Int J Cancer* 2019; **144**: 80-88 [PMID: 29978464 DOI: 10.1002/ijc.31667]

11 **Okada K**, Suzuki S, Naito S, Yamada Y, Haruki S, Kubota M, Nakajima Y, Shimizu T, Ando K, Uchida Y, Hirasawa T, Fujisaki J, Tsuchida T. Incidence of metachronous gastric cancer in patients whose primary gastric neoplasms were discovered after Helicobacter pylori eradication. *Gastrointest Endosc* 2019; **89**: 1152-1159.e1 [PMID: 30825537 DOI: 10.1016/j.gie.2019.02.026]

12 **Miyaoka M**, Yao K, Tanabe H, Kanemitsu T, Imamura K, Ono Y, Ohtsu K, Ishikawa S, Kojima T, Hasegawa R, Hirano A, Ikezono G, Hisabe T, Ueki T, Ota A, Haraoka S, Iwashita A. Usefulness of vessel plus surface classification system for the diagnosis of early gastric cancer after *Helicobacter pylori* eradication. *Ann Gastroenterol* 2021; **34**: 354-360 [PMID: 33948060 DOI: 10.20524/aog.2021.0605]

13 **Maehata Y**, Nakamura S, Fujisawa K, Esaki M, Moriyama T, Asano K, Fuyuno Y, Yamaguchi K, Egashira I, Kim H, Kanda M, Hirahashi M, Matsumoto T. Long-term effect of Helicobacter pylori eradication on the development of metachronous gastric cancer after endoscopic resection of early gastric cancer. *Gastrointest Endosc* 2012; **75**: 39-46 [PMID: 22018552 DOI: 10.1016/j.gie.2011.08.030]

14 **Mori G**, Nakajima T, Asada K, Shimazu T, Yamamichi N, Maekita T, Yokoi C, Fujishiro M, Gotoda T, Ichinose M, Ushijima T, Oda I. Incidence of and risk factors for metachronous gastric cancer after endoscopic resection and successful Helicobacter pylori eradication: results of a large-scale, multicenter cohort study in Japan. *Gastric Cancer* 2016; **19**: 911-918 [PMID: 26420267 DOI: 10.1007/s10120-015-0544-6]

15 **Kim HJ**, Kim YJ, Seo SI, Shin WG, Park CH. Impact of the timing of Helicobacter pylori eradication on the risk of development of metachronous lesions after treatment of early gastric cancer: a population-based cohort study. *Gastrointest Endosc* 2020; **92**: 613-622.e1 [PMID: 32473251 DOI: 10.1016/j.gie.2020.05.029]

16 **Nakata R**, Nagami Y, Hashimoto A, Sakai T, Ominami M, Fukunaga S, Otani K, Hosomi S, Tanaka F, Ohira M, Taira K, Yamagami H, Tanigawa T, Watanabe T, Fujiwara Y. Successful Eradication of Helicobacter pylori Could Prevent Metachronous Gastric Cancer: A Propensity Matching Analysis. *Digestion* 2021; **102**: 236-245 [PMID: 31678978 DOI: 10.1159/000504132]

17 **Yoshii S**, Mabe K, Watano K, Ohno M, Matsumoto M, Ono S, Kudo T, Nojima M, Kato M, Sakamoto N. Validity of endoscopic features for the diagnosis of Helicobacter pylori infection status based on the Kyoto classification of gastritis. *Dig Endosc* 2020; **32**: 74-83 [PMID: 31309632 DOI: 10.1111/den.13486]

18 **Hirai R**, Hirai M, Shimodate Y, Minami M, Ishikawa S, Kanadani T, Takezawa R, Doi A, Nishimura N, Mouri H, Matsueda K, Yamamoto H, Mizuno M. Feasibility of endoscopic evaluation of *Helicobacter pylori* infection status by using the Kyoto classification of gastritis in the population-based gastric cancer screening program: A prospective cohort study. *Health Sci Rep* 2021; **4**: e325 [PMID: 34277955 DOI: 10.1002/hsr2.325]

19 **Zhao J**, Xu S, Gao Y, Lei Y, Zou B, Zhou M, Chang D, Dong L, Qin B. Accuracy of Endoscopic Diagnosis of *Helicobacter pylori* Based on the Kyoto Classification of Gastritis: A Multicenter Study. *Front Oncol* 2020; **10**: 599218 [PMID: 33344250 DOI: 10.3389/fonc.2020.599218]

20 **Fiuza F**, Maluf-Filho F, Ide E, Furuya CK Jr, Fylyk SN, Ruas JN, Stabach L, Araujo GA, Matuguma SE, Uemura RS, Sakai CM, Yamazaki K, Ueda SS, Sakai P, Martins BC. Association between mucosal surface pattern under near focus technology and Helicobacter pylori infection. *World J Gastrointest Endosc* 2021; **13**: 518-528 [PMID: 34733412 DOI: 10.4253/wjge.v13.i10.518]

21 **Yuan C**, Lin XM, Ou Y, Cai L, Cheng Q, Zhou P, Liao J. Association between regular arrangement of collecting venules and Helicobacter pylori status in routine endoscopy. *BMC Gastroenterol* 2021; **21**: 389 [PMID: 34670510 DOI: 10.1186/s12876-021-01960-w]

22 **Garcés-Durán R**, García-Rodríguez A, Córdova H, Cuatrecasas M, Ginès À, González-Suárez B, Araujo I, Llach J, Fernández-Esparrach G. Association between a regular arrangement of collecting venules and absence of Helicobacter pylori infection in a European population. *Gastrointest Endosc* 2019; **90**: 461-466 [PMID: 31108089 DOI: 10.1016/j.gie.2019.05.027]

23 **Ebigbo A**, Marienhagen J, Messmann H. Regular arrangement of collecting venules and the Kimura-Takemoto classification for the endoscopic diagnosis of Helicobacter pylori infection: Evaluation in a Western setting. *Dig Endosc* 2021; **33**: 587-591 [PMID: 32767790 DOI: 10.1111/den.13808]

24 **Glover B**, Teare J, Patel N. Assessment of Helicobacter pylori status by examination of gastric mucosal patterns: diagnostic accuracy of white-light endoscopy and narrow-band imaging. *BMJ Open Gastroenterol* 2021; **8**: e000608 [PMID: 34353822 DOI: 10.1136/bmjgast-2021-000608]

25 **Glover B**, Teare J, Ashrafian H, Patel N. The endoscopic predictors of *Helicobacter pylori* status: a meta-analysis of diagnostic performance. *Ther Adv Gastrointest Endosc* 2020; **13**: 2631774520950840 [PMID: 33150333 DOI: 10.1177/2631774520950840]

26 **Li L**, Jing J, Gao H, Zhang C, Lou H, Pan W. Regular arrangement of collecting venules under endoscopy for predicting a Helicobacter pylori-negative stomach: A systematic review and meta-analysis. *Gastroenterol Hepatol* 2021; **44**: 286-292 [PMID: 33097281 DOI: 10.1016/j.gastrohep.2020.08.003]

27 **Toyoshima O**, Nishizawa T, Arita M, Kataoka Y, Sakitani K, Yoshida S, Yamashita H, Hata K, Watanabe H, Suzuki H. *Helicobacter pylori* infection in subjects negative for high titer serum antibody. *World J Gastroenterol* 2018; **24**: 1419-1428 [PMID: 29632423 DOI: 10.3748/wjg.v24.i13.1419]

28 **Toyoshima O**, Nishizawa T, Sakitani K, Yamakawa T, Watanabe H, Yoshida S, Nakai Y, Hata K, Ebinuma H, Suzuki H, Koike K. Nodularity-like appearance in the cardia: novel endoscopic findings for *Helicobacter pylori* infection. *Endosc Int Open* 2020; **8**: E770-E774 [PMID: 32490162 DOI: 10.1055/a-1136-9890]

29 **Toyoshima O**, Nishizawa T, Sakitani K, Yamakawa T, Takahashi Y, Kinoshita K, Torii A, Yamada A, Suzuki H, Koike K. *Helicobacter pylori* eradication improved the Kyoto classification score on endoscopy. *JGH Open* 2020; **4**: 909-914 [PMID: 33102763 DOI: 10.1002/jgh3.12360]

30 **Sumi N**, Haruma K, Kamada T, Suehiro M, Manabe N, Akiyama T, Shiotani A, Yamanaka Y, Fujimoto S, Takao T. Diagnosis of histological gastritis based on the Kyoto classification of gastritis in Japanese subjects - including evaluation of aging and sex difference of histological gastritis. *Scand J Gastroenterol* 2022; **57**: 260-265 [PMID: 34807790 DOI: 10.1080/00365521.2021.2002927]

31 **Liu XM**, Ma XY, Liu F, Liu ZL, Tang XY, Ji MZ, Zheng JX. Gastric Cancer Screening Methods: A Comparative Study of the Chinese New Gastric Cancer Screening Score and Kyoto Classification of Gastritis. *Gastroenterol Res Pract* 2022; **2022**: 7639968 [PMID: 35309108 DOI: 10.1155/2022/7639968]

32 **Takahashi K**, Sugimoto M, Kawai Y, Hamada M, Iwata E, Niikura R, Nagata N, Fukuzawa M, Itoi T, Ohtsubo T, Kawai T. Association between dyspeptic symptoms and endoscopic findings based on the Kyoto classification of gastritis in Japanese male. *J Clin Biochem Nutr* 2022; **70**: 79-85 [PMID: 35068685 DOI: 10.3164/jcbn.21-79]

33 **Nishizawa T**, Sakitani K, Suzuki H, Yamakawa T, Takahashi Y, Yamamichi N, Watanabe H, Seto Y, Koike K, Toyoshima O. A combination of serum anti-*Helicobacter pylori* antibody titer and Kyoto classification score could provide a more accurate diagnosis of *H pylori*. *United European Gastroenterol J* 2019; **7**: 343-348 [PMID: 31019702 DOI: 10.1177/2050640619825947]

34 **Quach DT**, Hiyama T, Le HM, Nguyen TS, Gotoda T. Use of endoscopic assessment of gastric atrophy for gastric cancer risk stratification to reduce the need for gastric mapping. *Scand J Gastroenterol* 2020; **55**: 402-407 [PMID: 32223458 DOI: 10.1080/00365521.2020.1740777]

35 **Na HK**, Choi KD, Park YS, Kim HJ, Ahn JY, Lee JH, Jung KW, Kim DH, Song HJ, Lee GH, Jung HY. Endoscopic scoring system for gastric atrophy and intestinal metaplasia: correlation with OLGA and OLGIM staging: a single-center prospective pilot study in Korea. *Scand J Gastroenterol* 2022; **57**: 1097-1104 [PMID: 35387540 DOI: 10.1080/00365521.2022.2055974]

36 **Toyoshima O**, Nishizawa T, Yoshida S, Matsuno T, Odawara N, Toyoshima A, Sakitani K, Watanabe H, Fujishiro M, Suzuki H. Consistency between the endoscopic Kyoto classification and pathological updated Sydney system for gastritis: A cross-sectional study. *J Gastroenterol Hepatol* 2022; **37**: 291-300 [PMID: 34569096 DOI: 10.1111/jgh.15693]

37 **Kako S**, Iwaya Y, Nagaya T, Hara D, Okamura T, Iwaya M, Kurasawa S, Kato S, Nakayama Y, Akamatsu T, Umemura T. Clinicopathological features of nodular gastritis in three classes of age. *Helicobacter* 2021; **26**: e12845 [PMID: 34396629 DOI: 10.1111/hel.12845]

38 **Okamoto K**, Kodama M, Mizukami K, Okimoto T, Abe H, Ogawa R, Fukuda K, Matsunari O, Hirashita Y, Wada Y, Fukuda M, Murakami K. Immunohistochemical differences in gastric mucosal damage between nodular and non-nodular gastritis caused by *Helicobacter pylori* infection. *J Clin Biochem Nutr* 2021; **69**: 216-221 [PMID: 34616112 DOI: 10.3164/jcbn.20-179]

39 **Shichijo S**, Hirata Y, Niikura R, Hayakawa Y, Yamada A, Ushiku T, Fukayama M, Koike K. Histologic intestinal metaplasia and endoscopic atrophy are predictors of gastric cancer development after Helicobacter pylori eradication. *Gastrointest Endosc* 2016; **84**: 618-624 [PMID: 26995689 DOI: 10.1016/j.gie.2016.03.791]

40 **Kaji K**, Hashiba A, Uotani C, Yamaguchi Y, Ueno T, Ohno K, Takabatake I, Wakabayashi T, Doyama H, Ninomiya I, Kiriyama M, Ohyama S, Yoneshima M, Koyama N, Takeda Y, Yasuda K. Grading of Atrophic Gastritis is Useful for Risk Stratification in Endoscopic Screening for Gastric Cancer. *Am J Gastroenterol* 2019; **114**: 71-79 [PMID: 30315306 DOI: 10.1038/s41395-018-0259-5]

41 **Take S**, Mizuno M, Ishiki K, Kusumoto C, Imada T, Hamada F, Yoshida T, Yokota K, Mitsuhashi T, Okada H. Risk of gastric cancer in the second decade of follow-up after Helicobacter pylori eradication. *J Gastroenterol* 2020; **55**: 281-288 [PMID: 31667586 DOI: 10.1007/s00535-019-01639-w]

42 **Maric L**, Castaneda D, Singh H, Bejarano P, Jimenez Cantisano B, Castro FJ. Kimura-Takemoto Classification: A Tool to Predict Gastric Intestinal Metaplasia Progression to Advanced Gastric Neoplasia. *Dig Dis Sci* 2022; **67**: 4092-4099 [PMID: 34406583 DOI: 10.1007/s10620-021-07212-x]

43 **Sekikawa A**, Fukui H, Sada R, Fukuhara M, Marui S, Tanke G, Endo M, Ohara Y, Matsuda F, Nakajima J, Henmi S, Saito S, Tsumura T, Maruo T, Kimura T, Osaki Y. Gastric atrophy and xanthelasma are markers for predicting the development of early gastric cancer. *J Gastroenterol* 2016; **51**: 35-42 [PMID: 25904098 DOI: 10.1007/s00535-015-1081-0]

44 **Toyoshima O**, Nishizawa T, Yoshida S, Aoki T, Nagura F, Sakitani K, Tsuji Y, Nakagawa H, Suzuki H, Koike K. Comparison of endoscopic gastritis based on Kyoto classification between diffuse and intestinal gastric cancer. *World J Gastrointest Endosc* 2021; **13**: 125-136 [PMID: 34046150 DOI: 10.4253/wjge.v13.i5.125]

45 **Kawamura M**, Uedo N, Koike T, Kanesaka T, Hatta W, Ogata Y, Oikawa T, Iwai W, Yokosawa S, Honda J, Asonuma S, Okata H, Ohyauchi M, Ito H, Abe Y, Ara N, Kayaba S, Shinkai H, Shimokawa T. Kyoto classification risk scoring system and endoscopic grading of gastric intestinal metaplasia for gastric cancer: Multicenter observation study in Japan. *Dig Endosc* 2022; **34**: 508-516 [PMID: 34415621 DOI: 10.1111/den.14114]

46 **Sui Z**, Chen J, Li P, Shao L, Ye J, Lu X, Cai J. Risk for gastric cancer in patients with gastric atrophy: a systematic review and meta-analysis. *Transl Cancer Res* 2020; **9**: 1618-1624 [PMID: 35117509 DOI: 10.21037/tcr.2020.01.54]

47 **Xiao S**, Fan Y, Yin Z, Zhou L. Endoscopic grading of gastric atrophy on risk assessment of gastric neoplasia: A systematic review and meta-analysis. *J Gastroenterol Hepatol* 2021; **36**: 55-63 [PMID: 32656803 DOI: 10.1111/jgh.15177]

48 **Shichijo S**, Hirata Y, Niikura R, Hayakawa Y, Yamada A, Koike K. Association between gastric cancer and the Kyoto classification of gastritis. *J Gastroenterol Hepatol* 2017; **32**: 1581-1586 [PMID: 28217843 DOI: 10.1111/jgh.13764]

49 **Shin SY**, Kim JH, Chun J, Yoon YH, Park H. Chronic atrophic gastritis and intestinal metaplasia surrounding diffuse-type gastric cancer: Are they just bystanders in the process of carcinogenesis? *PLoS One* 2019; **14**: e0226427 [PMID: 31851694 DOI: 10.1371/journal.pone.0226427]

50 **Sakitani K**, Nishizawa T, Toyoshima A, Yoshida S, Matsuno T, Yamada T, Irokawa M, Takahashi Y, Nakai Y, Toyoshima O, Koike K. Kyoto classification in patients who developed multiple gastric carcinomas after *Helicobacter pylori* eradication. *World J Gastrointest Endosc* 2020; **12**: 276-284 [PMID: 32994858 DOI: 10.4253/wjge.v12.i9.276]

51 **Watanabe M**, Kato J, Inoue I, Yoshimura N, Yoshida T, Mukoubayashi C, Deguchi H, Enomoto S, Ueda K, Maekita T, Iguchi M, Tamai H, Utsunomiya H, Yamamichi N, Fujishiro M, Iwane M, Tekeshita T, Mohara O, Ushijima T, Ichinose M. Development of gastric cancer in nonatrophic stomach with highly active inflammation identified by serum levels of pepsinogen and Helicobacter pylori antibody together with endoscopic rugal hyperplastic gastritis. *Int J Cancer* 2012; **131**: 2632-2642 [PMID: 22383377 DOI: 10.1002/ijc.27514]

52 **Toyoshima O**, Yoshida S, Nishizawa T, Toyoshima A, Sakitani K, Matsuno T, Yamada T, Matsuo T, Nakagawa H, Koike K. Enlarged folds on endoscopic gastritis as a predictor for submucosal invasion of gastric cancers. *World J Gastrointest Endosc* 2021; **13**: 426-436 [PMID: 34630892 DOI: 10.4253/wjge.v13.i9.426]

53 **Nishikawa I**, Kato J, Terasoma S, Matsutani H, Tamaki H, Tamaki T, Kuwashima F, Nakata H, Tomeki T, Matsunaka H, Ibata Y, Yamashita Y, Maekita T, Higashi K, Ichinose M. Nodular gastritis in association with gastric cancer development before and after *Helicobacter pylori* eradication. *JGH Open* 2018; **2**: 80-86 [PMID: 30483568 DOI: 10.1002/jgh3.12049]

54 **Kamada T**, Tanaka A, Yamanaka Y, Manabe N, Kusunoki H, Miyamoto M, Tanaka S, Hata J, Chayama K, Haruma K. Nodular gastritis with helicobacter pylori infection is strongly associated with diffuse-type gastric cancer in young patients. *Digest Endosc* 2007; **19**: 180-184 [DOI:10.1111/j.1443-1661.2007.00750.x]

55 **Moribata K**, Iguchi JK, Nakachi K, Maeda Y, Shingaki N, Niwa T, Deguchi H, Inoue I, Maekita T, Tamai H, Ichinose M. Endoscopic features associated with development of metachronous gastric cancer in patients who underwent endoscopic resection followed by Helicobacter pylori eradication. *Dig Endosc* 2016; **28**: 434-442 [PMID: 26623565 DOI: 10.1111/den.12581]

56 **Majima A**, Dohi O, Takayama S, Hirose R, Inoue K, Yoshida N, Kamada K, Uchiyama K, Ishikawa T, Takagi T, Handa O, Konishi H, Naito Y, Itoh Y. Linked color imaging identifies important risk factors associated with gastric cancer after successful eradication of Helicobacter pylori. *Gastrointest Endosc* 2019; **90**: 763-769 [PMID: 31299258 DOI: 10.1016/j.gie.2019.06.043]

57 **Yan X**, Hu X, Duan B, Zhang X, Pan J, Fu J, Xu M, Xu Q. Exploration of endoscopic findings and risk factors of early gastric cancer after eradication of *Helicobacter pylori*. *Scand J Gastroenterol* 2021; **56**: 356-362 [PMID: 33410344 DOI: 10.1080/00365521.2020.1868567]

58 **Ohno A**, Miyoshi J, Kato A, Miyamoto N, Yatagai T, Hada Y, Kusuhara M, Jimbo Y, Ida Y, Tokunaga K, Okamoto S, Hisamatsu T. Endoscopic severe mucosal atrophy indicates the presence of gastric cancer after Helicobacter pylori eradication -analysis based on the Kyoto classification. *BMC Gastroenterol* 2020; **20**: 232 [PMID: 32689949 DOI: 10.1186/s12876-020-01375-z]

59 **Hanaoka N**, Uedo N, Shiotani A, Inoue T, Takeuchi Y, Higashino K, Ishihara R, Iishi H, Haruma K, Tatsuta M. Autofluorescence imaging for predicting development of metachronous gastric cancer after Helicobacter pylori eradication. *J Gastroenterol Hepatol* 2010; **25**: 1844-1849 [PMID: 21091995 DOI: 10.1111/j.1440-1746.2010.06442.x]

60 **Sugimoto M**, Ban H, Ichikawa H, Sahara S, Otsuka T, Inatomi O, Bamba S, Furuta T, Andoh A. Efficacy of the Kyoto Classification of Gastritis in Identifying Patients at High Risk for Gastric Cancer. *Intern Med* 2017; **56**: 579-586 [PMID: 28321054 DOI: 10.2169/internalmedicine.56.7775]

61 **Lin J**, Su H, Zhou Q, Pan J, Zhou L. Predictive value of nomogram based on Kyoto classification of gastritis to diagnosis of gastric cancer. *Scand J Gastroenterol* 2022; **57**: 574-580 [PMID: 34994675 DOI: 10.1080/00365521.2021.2023626]

62 **Cho JH**, Jeon SR, Jin SY, Park S. Standard *vs* magnifying narrow-band imaging endoscopy for diagnosis of *Helicobacter pylori* infection and gastric precancerous conditions. *World J Gastroenterol* 2021; **27**: 2238-2250 [PMID: 34025076 DOI: 10.3748/wjg.v27.i18.2238]

63 **Shibukawa N**, Ouchi S, Wakamatsu S, Wakahara Y, Kaneko A. Gastric Xanthoma Is a Predictive Marker for Early Gastric Cancer Detected after Helicobacter pylori Eradication. *Intern Med* 2019; **58**: 779-784 [PMID: 30449773 DOI: 10.2169/internalmedicine.0925-18]

64 **Yamashita K**, Suzuki R, Kubo T, Onodera K, Iida T, Saito M, Arimura Y, Endo T, Nojima M, Nakase H. Gastric Xanthomas and Fundic Gland Polyps as Endoscopic Risk Indicators of Gastric Cancer. *Gut Liver* 2019; **13**: 409-414 [PMID: 30600671 DOI: 10.5009/gnl17136]

65 **Hu H**, Zhang Q, Chen G, Pritchard DM, Zhang S. Risk factors and clinical correlates of neoplastic transformation in gastric hyperplastic polyps in Chinese patients. *Sci Rep* 2020; **10**: 2582 [PMID: 32054871 DOI: 10.1038/s41598-020-58900-z]

66 **Li D**, Zhang J, Yao WZ, Zhang DL, Feng CC, He Q, Lv HH, Cao YP, Wang J, Qi Y, Wu SR, Wang N, Zhao J, Shi YQ. The relationship between gastric cancer, its precancerous lesions and bile reflux: A retrospective study. *J Dig Dis* 2020; **21**: 222-229 [PMID: 32187838 DOI: 10.1111/1751-2980.12858]

67 **Tanaka F**, Tominaga K, Fujikawa Y, Morisaki T, Otani K, Hosomi S, Nagami Y, Kamata N, Taira K, Nakano A, Kimura T, Yamagami H, Tanigawa T, Morikawa H, Fukumoto S, Watanabe T, Kawada N, Hirata K, Fujiwara Y. Association between Functional Dyspepsia and Gastric Depressive Erosions in Japanese Subjects. *Intern Med* 2019; **58**: 321-328 [PMID: 30210122 DOI: 10.2169/internalmedicine.1325-18]

68 **Garcés-Durán R**, Galdín-Ferreyra M, Delgado-Guillena PG, Cuatrecasas M, Córdova H, García-Rodríguez A, Rodrigo-Calvo MT, Jimeno-Ramiro M, Araujo IK, Ginès A, Llach J, Fernandez-Esparrach G. Diagnosis of Helicobacter pylori Infection by the Arrangement of Collecting Venules Using White Light Endoscopy: Evaluation of Interobserver Agreement. *Dig Dis* 2022; **40**: 376-384 [PMID: 34348294 DOI: 10.1159/000518100]

69 **Lenti MV**, Rugge M, Lahner E, Miceli E, Toh BH, Genta RM, De Block C, Hershko C, Di Sabatino A. Autoimmune gastritis. *Nat Rev Dis Primers* 2020; **6**: 56 [PMID: 32647173 DOI: 10.1038/s41572-020-0187-8]

70 **Kishikawa H**, Nakamura K, Ojiro K, Katayama T, Arahata K, Takarabe S, Sasaki A, Miura S, Hayashi Y, Hoshi H, Kanai T, Nishida J. Relevance of pepsinogen, gastrin, and endoscopic atrophy in the diagnosis of autoimmune gastritis. *Sci Rep* 2022; **12**: 4202 [PMID: 35273265 DOI: 10.1038/s41598-022-07947-1]

71 **Dilaghi E**, Esposito G, Pivetta G, Galli G, Pilozzi E, Annibale B, Lahner E. Endoscopic diagnosis of gastric intestinal metaplasia in patients with autoimmune gastritis using narrow-band imaging: does pseudopyloric metaplasia muddy the waters? *Endosc Int Open* 2022; **10**: E434-E440 [PMID: 35433221 DOI: 10.1055/a-1776-7628]

72 **Rodríguez-Carrasco M**, Esposito G, Libânio D, Pimentel-Nunes P, Dinis-Ribeiro M. Image-enhanced endoscopy for gastric preneoplastic conditions and neoplastic lesions: a systematic review and meta-analysis. *Endoscopy* 2020; **52**: 1048-1065 [PMID: 32663879 DOI: 10.1055/a-1205-0570]

73 **Desai M**, Boregowda U, Srinivasan S, Kohli DR, Al Awadhi S, Murino A, Yu LHK, Dinis-Ribeiro DM, Sharma P. Narrow band imaging for detection of gastric intestinal metaplasia and dysplasia: A systematic review and meta-analysis. *J Gastroenterol Hepatol* 2021; **36**: 2038-2046 [PMID: 34090306 DOI: 10.1111/jgh.15564]

74 **Buxbaum JL**, Hormozdi D, Dinis-Ribeiro M, Lane C, Dias-Silva D, Sahakian A, Jayaram P, Pimentel-Nunes P, Shue D, Pepper M, Cho D, Laine L. Narrow-band imaging versus white light versus mapping biopsy for gastric intestinal metaplasia: a prospective blinded trial. *Gastrointest Endosc* 2017; **86**: 857-865 [PMID: 28366441 DOI: 10.1016/j.gie.2017.03.1528]

75 **Chen H**, Liu Y, Lu Y, Lin X, Wu Q, Sun J, Li C. Ability of blue laser imaging with magnifying endoscopy for the diagnosis of gastric intestinal metaplasia. *Lasers Med Sci* 2018; **33**: 1757-1762 [PMID: 29777405 DOI: 10.1007/s10103-018-2536-3]

76 **Min M**, Dong TH, Liu Y, Bi YL, Ma CY. Novel endoscopic findings as visualized by non-magnification endoscopy with linked color imaging are indicative of gastric intestinal metaplasia. *Chin Med J (Engl)* 2019; **132**: 782-788 [PMID: 30896610 DOI: 10.1097/CM9.0000000000000172]

77 **Matsumura S**, Dohi O, Yamada N, Harusato A, Yasuda T, Yoshida T, Ishida T, Azuma Y, Kitae H, Doi T, Hirose R, Inoue K, Yoshida N, Kamada K, Uchiyama K, Takagi T, Ishikawa T, Konishi H, Morinaga Y, Kishimoto M, Yagi N, Naito Y, Itoh Y. Improved Visibility of Early Gastric Cancer after Successful *Helicobacter pylori* Eradication with Image-Enhanced Endoscopy: A Multi-Institutional Study Using Video Clips. *J Clin Med* 2021; **10** [PMID: 34441946 DOI: 10.3390/jcm10163649]

78 **Ishikawa T**, Matsumura T, Okimoto K, Nagashima A, Shiratori W, Kaneko T, Oura H, Tokunaga M, Akizue N, Ohta Y, Saito K, Arai M, Kato J, Kato N. Efficacy of Texture and Color Enhancement Imaging in visualizing gastric mucosal atrophy and gastric neoplasms. *Sci Rep* 2021; **11**: 6910 [PMID: 33767278 DOI: 10.1038/s41598-021-86296-x]

79 **Abe S**, Yamazaki T, Hisada IT, Makiguchi ME, Yoshinaga S, Sato T, Nonaka S, Suzuki H, Oda I, Saito Y. Visibility of early gastric cancer in texture and color enhancement imaging. *DEN Open* 2022; **2**: e46 [PMID: 35310718 DOI: 10.1002/deo2.46]

80 **Kimura K**, Takemoto T. An endoscopic recognition of the atrophic border and its significance in chronic gastritis. *Endoscopy* 1969; **3**: 87-97 [DOI: 10.1055/S-0028-1098086]

81 **Nishibayashi H**, Kanayama S, Kiyohara T, Yamamoto K, Miyazaki Y, Yasunaga Y, Shinomura Y, Takeshita T, Takeuchi T, Morimoto K, Matsuzawa Y. Helicobacter pylori-induced enlarged-fold gastritis is associated with increased mutagenicity of gastric juice, increased oxidative DNA damage, and an increased risk of gastric carcinoma. *J Gastroenterol Hepatol* 2003; **18**: 1384-1391 [PMID: 14675267 DOI: 10.1046/j.1440-1746.2003.03192.x]

**Footnotes**

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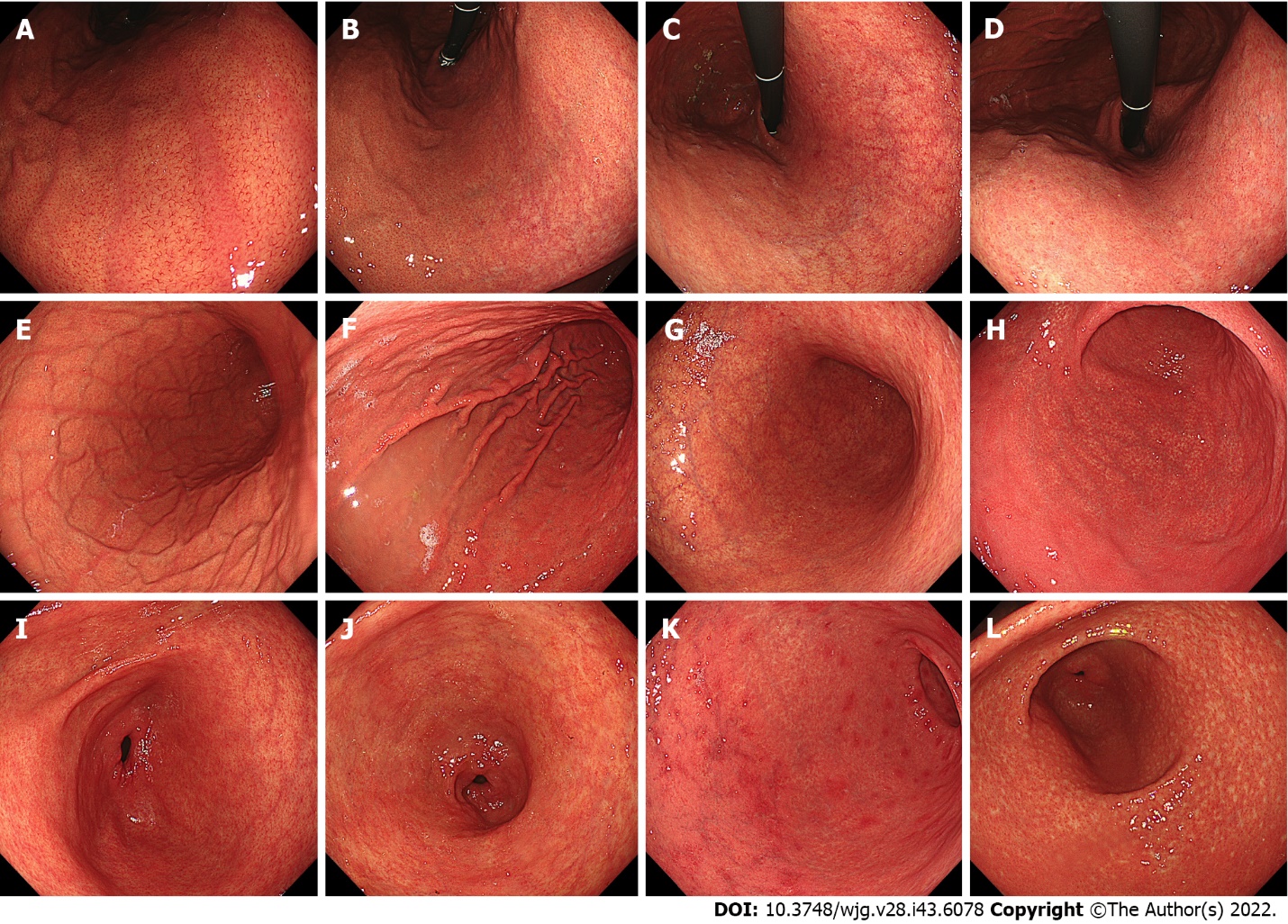
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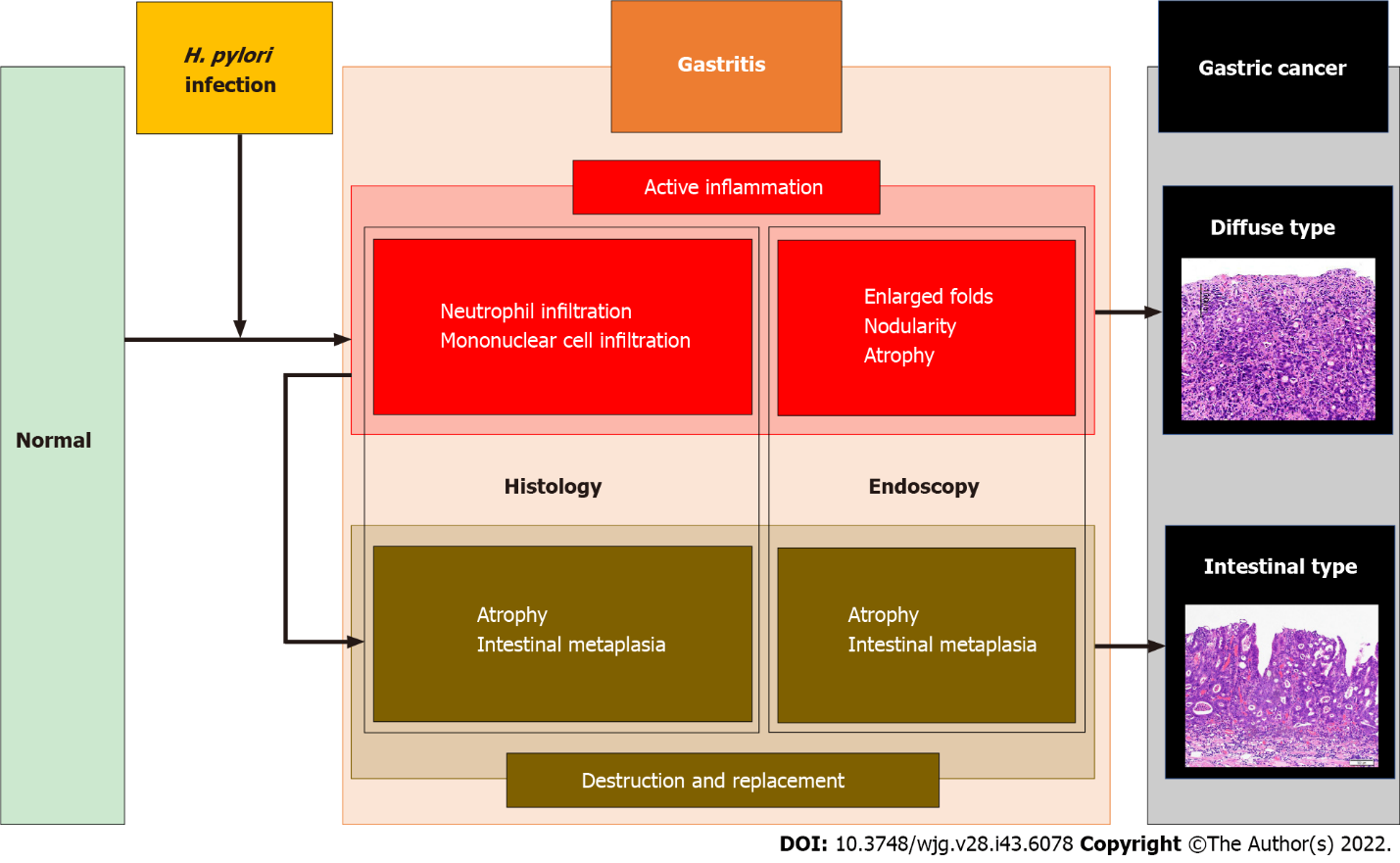
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**Figure Legends**



**Figure 1 Representative images of the Kyoto classification.** A: Normal with regular arrangement of collecting venules; B: Atrophy score 1; C: Atrophy score 2; D: Intestinal metaplasia score 2; E: Normal; F: Enlarged folds score 1; G: Diffuse redness score 1; H: Diffuse redness score 2; I: Normal; J: Intestinal metaplasia score 1; K: Map-like redness; L: Nodularity score 1. A-D: Corpus lesser curvature; E-H: Corpus greater curvature; I-L: Antrum.



**Figure 2 Pathogenesis of diffuse-type and intestinal-type gastric cancers.** *H. pylori*: *Helicobacter pylori*.

**Table 1 Kyoto classification score**

|  |  |  |  |
| --- | --- | --- | --- |
| **Endoscopic findings** | **Kyoto score** | | |
| **0** | **1** | **2** |
| Atrophy1 | None, C1 | C2, C3 | O1-O3 |
| Intestinal metaplasia | None | Antrum | Corpus and antrum |
| Enlarged folds | Absence | Presence | - |
| Nodularity | Absence | Presence | - |
| Diffuse redness | None | Mild with RAC | Severe without RAC |

1According to the Kimura-Takemoto classification[80].

RAC: Regular arrangement of collecting venules.

**Table 2 Diagnostic performance of Kyoto classification for** ***Helicobacter pylori* infection**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Ref.** | **Country** | **No. of patients** | **Sensitivity** | **Specificity** | **Accuracy** |
| Non-infection | | | | | | |
| RAC | Garcés-Durán *et al*[22], 2019 | Spain | 140 | 100 | 49.0 | 65.0 |
| Yoshii *et al*[17], 2020 | Japan | 485 | 89.1 | 79.8 | 85.6 |
| Zhao *et al*[19], 2020 | China | 583 | 62.4 | 73.7 | 69.3 |
| Ebigbo *et al*[23], 2021 | Germany | 200 | 80.8 | 57.4 | - |
| Fiuza *et al*[20], 2021 | Brazil | 187 | 70.7 | 87.2 | 74.9 |
| Glover *et al*[24], 2021 | UK | 153 | 78.4 | 64.3 | 75.8 |
| Yuan *et al*[21], 2021 | China | 165 | 51.4 | 96.7 | 76.4 |
| Hirai *et al*[18], 2021 | Japan | 1761 | 93.2 | 83.2 | 90.6 |
| Current infection | | | | | | |
| Atrophy | Toyoshima *et al*[27], 2018 | Japan | 136 | 82.6 | 85.8 | 85.3 |
| Zhao *et al*[19], 2020 | China | 583 | 54.9 | 61.1 | 58.5 |
| Ebigbo *et al*[23], 2021 | Germany | 200 | 80.4 | 69.7 | - |
| Intestinal metaplasia | Toyoshima *et al*[27], 2018 | Japan | 136 | 39.1 | 95.6 | 86.0 |
| Enlarged folds | Toyoshima *et al*[27], 2018 | Japan | 136 | 17.4 | 99.1 | 85.3 |
| Yoshii *et al*[17], 2020 | Japan | 494 | 23.1 | 96.6 | 85.0 |
| Nodularity | Toyoshima *et al*[27], 2018 | Japan | 136 | 8.7 | 100 | 84.6 |
| Yoshii *et al*[17], 2020 | Japan | 494 | 6.4 | 98.3 | 83.8 |
| Toyoshima *et al*[28], 2020 | Japan | 265 | 33.3 | 99.6 | 89.1 |
| Fiuza *et al*[20], 2021 | Brazil | 187 | 10.6 | 98.6 | 76.5 |
| Diffuse redness | Toyoshima *et al*[27], 2018 | Japan | 136 | 52.2 | 93.8 | 86.8 |
| Yoshii *et al*[17], 2020 | Japan | 485 | 60.0 | 94.7 | 89.7 |
| Zhao *et al*[19], 2020 | China | 583 | 20.3 | 97.6 | 65.0 |
| Fiuza *et al*[20], 2021 | Brazil | 187 | 80.9 | 73.6 | 75.4 |
| Total Kyoto score | Toyoshima *et al*[27], 20181 | Japan | 136 | 78.3 | 92.0 | 89.7 |
| Sumi *et al*[30], 20222 | Japan | 561 | 98.7 | 98.4 | 98.6 |

1The total Kyoto score ≥ 2 is defined as current infection.

2The total Kyoto score ≥ 1 is defined as current infection.

RAC: Regular arrangement of collecting venules.

**Table 3 Gastric cancer incidence based on endoscopic atrophy**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Ref.** | **Population** | **No. of subjects** | **No. of cancers** | **Duration, yr** | **Gastric cancer incidence, %/yr** | | |
| **Atrophy (mild)** | **Atrophy (moderate)** | **Atrophy (severe)** |
| Shichijo *et al*[39], 20161,2 | Post eradication | 573 | 21 | 6.2 ± 4.8 | 0.07 | 0.34 | 1.60 |
| Kaji et al[40], 20193 | Screening | 12941 | 63 | 3.7 ± 0.8 | 0.10 | 0.16 | 0.31 |
| Post eradication | 2571 | 20 | 3.7 ± 0.8 | 0.06 | 0.12 | 0.42 |
| Take et al[41], 20201 | Post eradication | 2737 | 68 | 7.1 ± 5.4 | 0.15 | 0.29 | 0.67 |

1Mild, moderate, and severe atrophy represent Kimura-Takemoto’s C1-2, C3-O1, and O2-3, respectively.

2Incidence was divided the incidence per 10 years by 10.

3Mild, moderate, and severe atrophy represent Kyoto atrophy scores 0, 1, and 2, respectively.

**Table 4 Odds ratio for histological subtype of gastric cancer based on the Kyoto classification.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Ref.** | ***H. pylori* status** | **No. of subjects** | **No. of GC** | **No. of diffuse-type GC** | **No. of intestinal-type GC** | **OR for GC** | **OR for diffuse-type GC** | **OR for intestinal-type GC** |
| **Atrophy** | Sekikawa *et al*[43], 2016 | Current, past, and no infection | 1823 | 29 | 3 | 26 | 7.41 |  |  |
| Toyoshima *et al*[44], 2021 | Current infection | 499 | 132 | 39 | 93 | 2.8 | 2.3 | 6.2 |
| Kawamura *et al*[45], 2022 | Current, past, and no infection | 380 | 115 | 19 | 96 | 2.51 |  |  |
| **Intestinal metaplasia** | Shichijo *et al*[48], 2017 | Current, past, and no infection | 3392 | 107 | 22 | 85 |  | 0.22 |  |
| Toyoshima *et al*[44], 2021 | Current infection | 499 | 132 | 39 | 93 | 1.6 |  | 1.7 |
| **Enlarged folds** | Nishibayashi *et al*[81], 2003 | Current infection | 276 | 135 | 69 | 66 | 5.0 |  |  |
| Toyoshima *et al*[44], 2021 | Current infection | 499 | 132 | 39 | 93 |  |  | 0.5 |
| **Nodularity** | Nishikawa *et al*[53], 2018 | Current infection | 674 | 25 | 9 | 16 |  | 10.0 |  |
| Toyoshima *et al*[44], 2021 | Current infection | 499 | 132 | 39 | 93 | 0.5 |  | 0.3 |
| **RAC** | Kawamura *et al*[45], 2022 | Current, past, and no infection | 380 | 115 | 19 | 96 | 0.23 |  |  |
| **Total Kyoto score** | Toyoshima *et al*[44], 2021 | Current infection | 499 | 132 | 39 | 93 | 1.6 | 1.3 | 1.7 |
| Lin *et al*[61], 2022 | Current, past, and no infection | 1848 | 37 | - | - | 1.5 |  |  |

1Odds ratio for Kyoto score 2 *vs* Kyoto scores 0 + 1.

2Odds ratio for Kyoto scores 1 + 2 *vs* Kyoto score 0.

3Odds ratio for regular arrangement of collecting venules presence *vs* absence.

Odds ratios were calculated per 1 rank of Kyoto score. *H. pylori*: *Helicobacter pylori*; GC: Gastric cancer; OR: Odds ratio; RAC: Regular arrangement of collecting venules.

**Table 5 Odds ratio of gastric cancer after *Helicobacter pylori* eradication based on the Kyoto classification**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Ref.** | **No. of subjects** | **No. of GC** | **Odds ratio** |
| **Atrophy** | Yan *et al*[57], 2021 | 1961 | 132 | 8.11 |
| **Map-like redness** | Moribata *et al*[55], 2016 | 1222 | 223 | 5.3 |
| Majima *et al*[56], 2019 | 194 | 109 | 2.1 |
| Yan *et al*[57], 2021 | 1961 | 132 | 1.8 |
| **RAC** | Majima *et al*[56], 2019 | 194 | 109 | 0.4 |
| Ohno *et al*[58], 2020 | 162 | 43 | 0.3 |

1 Odds ratio for Kyoto atrophy score 2.

2 Patients after endoscopic resection of gastric cancer.

3 Metachronous gastric cancer.

GC: Gastric cancer; RAC: Regular arrangement of collecting venules.



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