

# The Association Between Gastric Endoscopic Findings and Histologic Premalignant Lesions in the Iranian Rural Population

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**Abstract:** Atrophic gastritis, intestinal metaplasia, and gastric dysplasia are histologic premalignant lesions (PMLs). Correlation between the gastric endoscopic findings and histologic PMLs is not clear. This study was designed to determine the possible association of endoscopic findings and histologic PMLs.

Over 28 months gastric endoscopic findings of consecutive rural patients with dyspepsia were categorized into 3 groups: 1—normal, 2—ulcerative with or without concurrent abnormality, 3—abnormal non-ulcerative. Biopsies of antrum and body were taken from all included patients and examined for the presence of histologic PMLs. Any mucosal abnormality was also biopsied.

From 7340 evaluated patients, an overall of 1973 patients were included. 55.7% of patients were in group 1; 3.8% in group 2 and 40.5% in group 3. A within sex analysis showed that the majority of male patients were in PMLs subgroup ( $P < 0.001$ ) likewise in groups 2 and 3 ( $P < 0.001$ ). The prevalence of histologic PMLs in groups 2 and 3 was significantly higher than group 1 ( $P < 0.001$ ) but the difference was not significant between groups 2 and 3 ( $P = 0.484$ ). Mean ( $\pm$ SD) age of patient with PMLs was  $50.25 \pm 17.71$  whereas in patients without PMLs was  $41.16 \pm 16.48$  ( $P < 0.001$ ).

This study has showed that abnormal gastric endoscopic findings, male sex and increased age can be considered as risk factors of the formation of histologic PMLs. Until further investigations we propose that any abnormality on gastric mucosa (ulcerative or non-ulcerative) could be biopsied for the evaluation of probable histologic PMLs especially in old men.

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**Abbreviations:** AG = Atrophic gastritis, GD = gastric dysplasia, *H pylori* = *Helicobacter pylori*, IM = intestinal metaplasia, PMLs = premalignant lesions.

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## INTRODUCTION

Gastric cancer is the fifth prevalent cancer and the third cause of cancer-related mortality worldwide.<sup>1</sup> Atrophic gastritis (AG), intestinal metaplasia (IM), and gastric dysplasia (GD) are histologic premalignant lesions (PMLs) which are considered as the multistep cascade precursors of gastric cancer development.<sup>2–5</sup>

The presence and extension of PMLs in the stomach are frequently diagnosed by endoscopic or histologic examinations.<sup>6,7</sup>

Dyspepsia as a common symptom is used for the characterization of epigastric pain or discomfort. Although the functional disorder is a major cause of dyspepsia, organic conditions such as ulcer and gastric cancer can also be present in dyspepsia.<sup>8,9</sup>

Endoscopy is generally used for the diagnosis of the possible causes of dyspepsia. In general practice, different appearances can be found during endoscopy; however, there is no consensus about the association of gastric endoscopic findings and histopathological conditions especially PMLs on which there are only a few published researches, which have described this controversial correlations.<sup>10–25</sup>

Although poor correlation between endoscopic findings and histologic changes was detected in many studies,<sup>22–24,26–30</sup> good correlation was reported only in the severe types of gastritis or normal endoscopy.<sup>25,26,31</sup>

Up to now there is no clear correlation between endoscopic findings of stomach and histologic PMLs, for example, AG, IM, and GD according to few published researches, so we designed this study to investigate this possible association. In this research 3 groups of endoscopic findings were comparatively analyzed for the existence of histologic PMLs in a population of adult patients with dyspepsia.

## MATERIAL AND METHODS

### Population

In order to evaluate the prevalence and association between gastric endoscopic finding and histologic PMLs, consecutive Iranian rural patients with dyspepsia were enrolled. Cases with the following conditions were excluded: (a) previous *Helicobacter pylori* eradication; (b) history of gastric or esophageal surgery; (c) positive history of recent treatment (up to 2 weeks prior to inclusion) with H2-blockers, proton pump inhibitors, and NSAIDs; (d) evidence of malignancy in histopathological examination; (e) patients with poor cooperation.

### Study Design

This study was carried out between November 2011 and March 2014. The study protocol was approved by the Hospital Ethics Committee. Written informed consent was obtained from

each patient or his or her legal guardian in accordance with the Helsinki Declaration.

Dyspepsia was defined as the epigastric pain or discomfort.<sup>8,9</sup>

The high resolution white light endoscopic procedure (PENTAX Video Processor: 300W Xenon lamp-PENTAX Video Gastroscope: EG-290Kp with insertion tube 9.8mm) was performed by an expert gastroenterologist for all included patients.

The gastric endoscopic findings were categorized into 3 groups:

1—normal, 2—ulcerative with or without concurrent abnormality, 3—abnormal non-ulcerative (any evidence of mucosal abnormality except ulcerative lesion).

Two biopsies of antrum and 2 biopsies of body were taken from all of the enrolled cases with normal or abnormal endoscopy. Biopsy of the abnormal lesions was also performed for any mucosal abnormality. The biopsy samples were fixed in 10% formalin and examined by 2 expert pathologists for the presence of histologic PMLs, for example, atrophic gastritis, IM, and dysplasia.

Atrophic gastritis was defined as a severe decrease in typical gastric glands with the presence of inflammation.<sup>32,33</sup> IM was defined as the replacement of the glandular gastric mucosa with epithelium similar to the intestinal type cells.<sup>32,34</sup> Gastric dysplasia was defined as the cellular pleomorphism, nuclear hyperchromatism, and increase in nuclear/cytoplasmic ratio, decreased cytoplasmic mucin, increased mitotic activity, and glandular disarray.<sup>21</sup>

## Statistical Analysis

Comparative analysis of the groups was performed by using chi square test for categorical variables and by *t* test for continuous variables. Odds of histopathological features were analyzed by using logistic regression. The 95% confidence interval for key proportions was calculated using the exact binomial distribution. A *P*-value of 0.05 or less was considered statistically significant. Statistical analysis was performed with SPSS 15.0.

## RESULTS

From 7340 evaluated patients, an overall of 1973 patients (1288 females and 685 males) were enrolled. The mean age (SD) of patients was 42.61 ( $\pm 17.024$ ) years old (Table 1).

On endoscopic examination, 1098 (55.7%) patients showed normal endoscopy (group 1), 76 patients (3.8%) had ulcer with or without concurrent abnormality (group 2) and 799 patients (40.5%) had abnormal non-ulcerative endoscopic findings (group 3) (Table 2).

**TABLE 1.** The Characteristics of the Patients With and Without Histologic Premalignant Lesions (PMLs)

Variable	With PMLs (N = 277)	Without PMLs (N = 1696)	<i>P</i> - Value
SEX; N (%)			
Male	123 (44.4)	562 (33.1)	<0.001
Female	154(55.6)	1134 (66.9)	
Age (years; mean $\pm$ SD)	50.25 $\pm$ 17.71	41.16 $\pm$ 16.48	<0.001

Overall the majority of enrolled patients were female. On histologic examination, 277 patients had an evidence of histologic PMLs while 1696 patients showed no evidence of histologic PMLs. A within sex analysis showed that the majority of male patients were in PMLs subgroup ( $P < 0.001$ ; Chi-square test). (Table 1)

Moreover; 59.2% of female patients showed normal endoscopy (group 1) in contrast of 49.0% of male patients in this group. The within sex analysis in groups 2 ( $P = 0.003$ ) and 3 ( $P < 0.001$ ) in comparison with group 1 showed that the predominance of female gender had normal endoscopy, but there was not any significant difference between groups 2 and 3 ( $P = 0.162$ ).

Abnormal non-ulcerative endoscopic findings of our cases included erosion, erythema, nodularity, atrophic mucosa, and polypoid lesion.

Age of patients with histologic PMLs was significantly higher than patients without histologic PMLs ( $P < 0.001$ ) (Table 1).

Age of patients with abnormal endoscopy (groups 2 and 3) was significantly higher than normal endoscopy ( $P < 0.001$ ; multiple comparisons based on Tukey test).

The prevalence of histologic PMLs in patients with ulcer (group 2) was significantly higher than that of normal endoscopy group (group 1). The prevalence of histologic PMLs in patients with abnormal non-ulcerative endoscopic findings (group 3) was also significantly higher than normal endoscopy group (group 1). Furthermore, the prevalence of histologic PMLs showed no significant difference between groups 2 and 3 ( $P = 0.484$ ) (Table 3).

## DISCUSSION

There are a few published researches about the correlation between endoscopic findings and histologic PMLs. As far as we know this study is the first report of Iranian adult population with dyspepsia in which a range of histologic PMLs were comparatively analyzed between the 3 groups of gastric endoscopic findings.

Association between GD as a histologic PML and gastric endoscopic findings is not also clear according to previous studies. A variety of endoscopic findings including ulceration, atrophic mucosa, polyps, erosions, plaques, and scars have been associated with GD. GD can also be associated with a normal endoscopy.<sup>16–18,21</sup> Lansdown et al<sup>17</sup> evaluated patients with GD. On review, only 20 of the 40 patients had true dysplasia. The endoscopic findings of these cases included ulcer (9/20), raised tumor or polyp (6/20), plaque (1/20), atrophic mucosa (2/20), irregular mucosa at a gastroenterostomy (1/20), deformity of the pyloric canal (1/20). In another study, Aste et al showed that 29 of 694 patients with endoscopic localized gastric lesions (ulcers, erosions, enlarged or irregular folds, tumors and polyps) had GD but only 1 of 123 patients with normal endoscopy had GD. They concluded that GD is significantly associated with prominent or depressed lesions on endoscopy.<sup>35</sup>

Although some endoscopic criteria for AG have been described, a few reports have showed that the diagnosis of AG by conventional endoscopy often correlates poorly with histology.<sup>7,36</sup> Lin et al in a prospective study had evaluated the accuracy of the diagnosis of IM by endoscopy and the correlation of endoscopic diagnosis with histology. They showed that the specificity, sensitivity, and accuracy of the endoscopic diagnosis was 68.1%, 75%, and 71.3%, respectively.<sup>28</sup> Association between nodular gastritis as an endoscopic finding and

**TABLE 2.** The Characteristics of the Gastric Endoscopic Findings

Endoscopic Findings	Age (Years; Mean ± SD)	Prevalence of PMLs* <sup>‡</sup> ; N (%)	Total (N = 1973)
Group 1 (normal mucosa)	38.24 ± 16.52	75 (6.8)	1098
Group 2 (ulcerative with or without concurrent abnormality)	53.70 ± 18.58	20 (26.3)	76
Group 3 (abnormal non-ulcerative mucosa)	46.27 ± 17.52	182 (22.8)	799

\* Premalignant lesions.

histologic premalignant or malignant lesions is not also clear.<sup>10–15</sup>

Some studies have showed that there is a poor correlation between endoscopic findings and histological diagnosis of gastritis.<sup>22,24,37,38</sup> Kaur et al<sup>39</sup> in a study for evaluation of the correlation between endoscopic findings and histological gastritis showed that there was a poor correlation between them. They concluded that endoscopic finding is an unreliable predictor of histological gastritis. A study by Fung et al<sup>24</sup> showed that in dyspeptic patients endoscopic diagnosis is relatively inaccurate in specific types of gastritis. They showed that among 33 dyspeptic patients endoscopically diagnosed gastritis, histological confirmation was detected in 3/9, 10/14, and 0/6 cases of chronic atrophic gastritis, chronic (superficial) gastritis, and acute gastritis, respectively. A study by Redéen et al<sup>27</sup> on 488 adult individuals selected from a general population showed that except for the absence of visible vessels and rugae in the gastric corpus, endoscopic findings had very limited value in the evaluation of histological gastritis. Their endoscopic findings were erythema, erosions, presence of visible vessels, and absence of rugae in the gastric corpus. Calabrese et al<sup>38</sup> in a prospective study for the evaluation of the correlation of endoscopic findings with histologic changes and *H pylori* infection showed that the correlation between endoscopic findings and histological diagnosis of gastritis is poor. They concluded that biopsies are mandatory in all patients. A study by Jönsson et al<sup>23</sup> showed that in 210 dyspeptic patients endoscopic diagnosis correlates significantly with the histologic changes in the bulb of duodenum but not in the stomach.

Abnormal endoscopic findings were also seen in an asymptomatic population. In a prospective study by Akdamar et al<sup>40</sup> on 355 asymptomatic adult individuals showed that 86 (24%) of them had abnormal endoscopic findings in the stomach. In a case control study Toukan et al<sup>25</sup> showed that normal endoscopy was more likely associated with a histologic normal neutrophil count. However there was no correlation between abnormal endoscopic finding and increased histologic normal neutrophil count.

In our report the prevalence of histologic PMLs in patients with ulcer was significantly higher than normal endoscopy.

Histologic PMLs in patients with abnormal non-ulcerative endoscopy were also significantly higher than that of normal endoscopy ( $P = 0.000$ ) (Table 3). However, the prevalence of histologic PMLs was not significantly different between endoscopic ulcerative group and abnormal non-ulcerative group ( $P = 0.484$ ) (Table 3). These results have showed that abnormal endoscopic findings (ulcerative or non-ulcerative) can be considered as risk factors for the formation of histologic PMLs.

In this study, abnormal endoscopic findings (ulcerative and/or non-ulcerative) in comparison with normal endoscopy were significantly higher in male sex. Patients' sex with histologic PMLs rather than cases without histologic PMLs was also significantly in favour of male gender. Similar to some studies, our result showed that male gender can be considered as a risk factor for the formation of histologic PMLs and/or abnormal gastric endoscopic findings.<sup>21</sup>

Age of our patients with histologic PMLs was significantly higher than patients without histologic PMLs ( $P < 0.001$ ) (Table 1) that was similar to many previous studies.<sup>21,41–43</sup> Age of patients with abnormal endoscopy (groups 2 and 3) was also significantly higher than those with normal endoscopy ( $P < 0.001$ ). These results have showed that increased age can be considered as a risk factor for the formation of histologic PMLs and/or abnormal gastric endoscopic findings as well.

Among patients with normal gastric endoscopy, 6.8% had histologic PMLs. This result has showed that histologic PMLs can also be seen in cases with normal gastric mucosa. Similar result was seen by Di Gregorio et al.<sup>18</sup> They evaluated 99 patients with the diagnosis of GD, out of which 7 had normal endoscopy. Abnormal endoscopic findings of their cases included ulcer, polypoid, erosion, atrophy, and scar.

Our study had some limitations. First, only white light endoscopy without new advanced endoscopic procedure such as narrow band imaging or chromoendoscopy was used. Second, biopsy of fundus of stomach with endoscopic normal mucosa was not taken. Third, only symptomatic rural patients in a single-center study were evaluated.

Based on our results it is recommended that more studies should be carried out to clarify the different types of abnormal gastric endoscopic findings as the possible causes of histologic

**TABLE 3.** Association Between Gastric Endoscopic Findings and Histologic Premalignant Lesions

Prevalence of Histologic PMLs*	Odd Ratio	95% Confidence Interval	P Value
Ulcerative vs. normal endoscopy	3.309	1.850–5.918	0.000
Abnormal non-ulcerative vs. normal endoscopy	3.364	2.508–4.513	0.000
Ulcerative vs. abnormal non-ulcerative	–	–	0.484

\* Premalignant lesions.

PMLs. Until further investigations we propose that any abnormality on gastric mucosa (ulcerative or non-ulcerative) could be biopsied in all patients for the evaluation of possible histologic PMLs in addition to detection of helicobacter infection. Furthermore, although histologic PMLs were significantly higher in patients with abnormal endoscopy, normal mucosa in endoscopy cannot exclude the existence of histologic PMLs especially in a high risk population. Therefore until future researches we propose that in dyspeptic old age men, even with normal gastric mucosa in conventional endoscopy, random sampling can be considered for the detection of possible histologic PMLs.

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### REFERENCES

- Fock KM. Review article: the epidemiology and prevention of gastric cancer. *Aliment Pharmacol Ther.* 2014;40:250–260.
- Correa P. A human model of gastric carcinogenesis. *Cancer Res.* 1988;48:3554–3560.
- Kapadia CR. Gastric atrophy, metaplasia, and dysplasia: a clinical perspective. *J Clin Gastroenterol.* 2003;36(Suppl. 5):S29–S36.
- Genta RM. Review article: gastric atrophy and atrophic gastritis – nebulous concepts in search of a definition. *Aliment Pharmacol Ther.* 1998;12(Suppl 1):17–23.
- Dinis-Ribeiro M, Areia M, de Vries AC, et al. Management of precancerous conditions and lesions in the stomach (MAPS): guideline from the European Society of Gastrointestinal Endoscopy (ESGE), European Helicobacter Study Group (EHS), European Society of Pathology (ESP), and the Sociedade Portuguesa de Endoscopia Digestiva (SPED). *Endoscopy.* 2012;44:74–94.
- Kimura K, Takemoto T. An endoscopic recognition of the atrophic border and its significance in chronic gastritis. *Endoscopy.* 1969;3:87–97.
- de Vries AC, Haringsma J, Kuipers EJ. The detection, surveillance and treatment of premalignant gastric lesions related to *Helicobacter pylori* infection. *Helicobacter.* 2007;12:1–15.
- Brun R, Kuo B. Functional dyspepsia. *Ther Adv Gastroenterol.* 2010;3:145–164.
- Miwa H, Ghoshal UC, Gonlachanvit S, et al. Asian consensus report on functional dyspepsia. *J Neurogastroenterol Motil.* 2012;18:150–168.
- Miyamoto M, Haruma K, Yoshihara M, et al. Nodular gastritis in adults is caused by *Helicobacter pylori* infection. *Dig Dis Sci.* 2003;48:968–975.
- Miyamoto M, Haruma K, Yoshihara M, et al. Five cases of nodular gastritis and gastric cancer: a possible association between nodular gastritis and gastric cancer. *Dig Liver Dis.* 2002;34:819–820.
- Sokmensuer C, Onal IK, Yeniova O, et al. What are the clinical implications of nodular gastritis? Clues from histopathology. *Dig Dis Sci.* 2009;54:2150–2154.
- Hong SN, Jo S, Jang JH, et al. Clinical characteristics and the expression profiles of inflammatory cytokines/cytokine regulatory factors in asymptomatic patients with nodular gastritis. *Dig Dis Sci.* 2012;57:1486–1495.
- Al-Enezi SA, Alsurayei SA, Aly NY, et al. Endoscopic nodular gastritis in dyspeptic adults: prevalence and association with *Helicobacter pylori* infection. *Med Princ Pract.* 2010;19:40–45.
- Dwivedi M, Misra SP, Misra V. Nodular gastritis in adults: clinical features, endoscopic appearance, histopathological features, and response to therapy. *J Gastroenterol Hepatol.* 2008;23:943–947.
- Farinati F, Rugge M, Di Mario F, et al. Early and advanced gastric cancer in the follow-up of moderate and severe gastric dysplasia patients. A prospective study. I.G.G.E.D. – Interdisciplinary Group on Gastric Epithelial Dysplasia. *Endoscopy.* 1993;25:261–264.
- Lansdown M, Quirke P, Dixon MF, et al. High grade dysplasia of the gastric mucosa: a marker for gastric carcinoma. *Gut.* 1990;31:977–983.
- Di Gregorio C, Morandi P, Fante R, De Gaetani C. Gastric dysplasia. A follow-up study. *Am J Gastroenterol.* 1993;88:1714–1719.
- Fertitta AM, Comin U, Terruzzi V, et al. Clinical significance of gastric dysplasia: a multicenter follow-up study. Gastrointestinal Endoscopic Pathology Study Group. *Endoscopy.* 1993;25:265–268.
- Rugge M, Farinati F, Baffa R, et al. Gastric epithelial dysplasia in the natural history of gastric cancer: a multicenter prospective follow-up study. Interdisciplinary Group on Gastric Epithelial Dysplasia. *Gastroenterology.* 1994;107:1288–1296.
- Lauwers GY1, Riddell RH. Gastric epithelial dysplasia. *Gut.* 1999;45:784–790.
- Kreuning J, Bosman FT, Kuiper G, et al. Gastric and duodenal mucosa in 'healthy' individuals. An endoscopic and histopathological study of 50 volunteers. *J Clin Pathol.* 1978;31:69–77.
- Jönsson KA, Gotthard R, Bodemar G, Brodin U. The clinical relevance of endoscopic and histologic inflammation of gastroduodenal mucosa in dyspepsia of unknown origin. *Scand J Gastroenterol.* 1989;24:385–395.
- Fung WP, Papadimitriou JM, Matz LR. Endoscopic, histological and ultrastructural correlations in chronic gastritis. *Am J Gastroenterol.* 1979;71:269–279.
- Toukan AU, Kamal MF, Amr SS, et al. Gastroduodenal inflammation in patients with non-ulcer dyspepsia. A controlled endoscopic and morphometric study. *Dig Dis Sci.* 1985;30:313–320.
- Atkins L, Benedict EB. Correlation of gross gastroscopic findings with gastroscopic biopsy in gastritis. *N Engl J Med.* 1956;254:641–644.
- Redén S, Petersson F, Jönsson KA, Borch K. Relationship of gastroscopic features to histological findings in gastritis and *Helicobacter pylori* infection in a general population sample. *Endoscopy.* 2003;35:946–950.
- Lin BR, Shun CT, Wang TH, Lin JT. Endoscopic diagnosis of intestinal metaplasia of stomach – accuracy judged by histology. *Hepatogastroenterology.* 1999;46:162–166.
- Lassen A, Hallas J, de Muckadell OB. The risk of missed gastroesophageal cancer diagnoses in users and nonusers of anti-secretory medication. *Gastroenterology.* 2005;129:1179–1186.
- Xirouchakis E, Laoudi F, Tsartsali L, et al. Screening for gastric premalignant lesions with narrow band imaging, white light and updated Sydney protocol or both? *Dig Dis Sci.* 2013;58:1084–1090.
- Eshmuratov A, Nah JC, Kim N, et al. The correlation of endoscopic and histological diagnosis of gastric atrophy. *Dig Dis Sci.* 2010;55:1364–1375.
- Leung WK, Sung JJ. Review article: intestinal metaplasia and gastric carcinogenesis. *Aliment Pharmacol Ther.* 2002;16:1209–1216.
- Genta RM, Rugge M. Gastric precancerous lesions: heading for an international consensus. *Gut.* 1999;45(Suppl. 1):15–18.
- Correa P, Piazzuelo MB, Wilson KT. Pathology of gastric intestinal metaplasia: clinical implications. *Am J Gastroenterol.* 2010;105:493–498.

35. Aste H, Sciallero S, Pugliese V, Gennaro M. The clinical significance of gastric epithelial dysplasia. *Endoscopy*. 1986;18:174–176.
36. Meshkinpour H, Orlando RA, Arguello JF, DeMicco MP. Significance of endoscopically visible blood vessels as an index of atrophic gastritis. *Am J Gastroenterol*. 1979;71:376–379.
37. Owen DA. The morphology of gastritis. *Yale J Biol Med*. 1996;69:51–60.
38. Calabrese C, Di Febo G, Brandi G, et al. Correlation between endoscopic features of gastric antrum, histology and *Helicobacter pylori* infection in adults. *Ital J Gastroenterol Hepatol*. 1999;31:359–365.
39. Kaur G, Raj SM. A study of the concordance between endoscopic gastritis and histological gastritis in an area with a low background prevalence of *Helicobacter pylori* infection. *Singapore Med J*. 2002;43:090–92.
40. Akdamar K, Ertan A, Agrawal NM, et al. Upper gastrointestinal endoscopy in normal asymptomatic volunteers. *Gastrointest Endosc*. 1986;32:78–80.
41. Badmos KB, Ojo OS, Olasode BJ, Arigbabu AO. Gastric precancerous lesions among Nigerians with chronic gastritis. *Niger Postgrad Med J*. 2012;19:92–96.
42. Choi S, Lim YJ, Park SK. Risk factor analysis for metaplastic gastritis in Koreans. *World J Gastroenterol*. 2006;12:2584–2587.
43. Fennerty MB, Emerson JC, Sampliner RE, et al. Gastric intestinal metaplasia in ethnic groups in the southwestern United States. *Cancer Epidemiol Biomarkers Prev*. 1992;1:293–296.