Premalignant gastric lesions in patients included in National colorectal cancer screening

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Background. Gastric cancer is the fifth most common malignancy in the world with almost one million new cases annually. Helicobacter pylori infection causes 89% of all gastric cancers. Premalignant lesions (atrophy and intestinal metaplasia) develop after several decades of inflammation. Secondary prevention with gastroscopy is possible, but it is costly and has a low compliance rate. Alternative procedures like serology testing for pepsinogen I and II and pepsinogen I/II ratio are available to select patients for surveillance gastroscopies.

Patients and methods. In seven outpatient endoscopic units, 288 patients (154 men; 53.5%), average age 60.68 years, tested positive in National colorectal cancer screening programme SVIT, were included in the study. Gastropanel (BioHit, Finland) was used as a serologic biopsy method.

Results. We found 24 patients (12 men, mean age 63.7 years) with pepsinogen (pepsinogen I/II < 3 and/or pepsinogen I < 30 μg/L). Premalignant changes were found on gastric biopsies in 21 patients (7.3% incidence). Operative Link on Gastric Intestinal Metaplasia Assessment (OLGIM) ≥ 1 was found in 20 patients; Operative Link for Gastritis Assessment (OLGA) ≥ 1 was found in 19 patients. Combined accuracy for preneoplastic lesions in Gastropanel positive patients was 87.5%. H. pylori seropositivity was found in 219 patients (76%). Only 24% of our population had normal results.

Conclusions. Gastropanel test has proven to be a reliable non-invasive test for advanced gastric preneoplastic lesions that can select patients for further gastroscopy. We found high H. pylori seropositivity in older age groups in Slovenia.

Key words: gastropanel; Helicobacter pylori; atrophy; intestinal metaplasia; gastric cancer

Introduction

Gastric cancer (GC) remains the fifth most common malignancy with almost one million new cases annually and is responsible for 9% of all cancer related deaths in the world (third place). In Slovenia, the average incidence of gastric cancer in the period from 2009 to 2013 was 479 new cases of gastric cancer per year. The incidence rate was higher for men (29.1/100,000) than for women (17.8/100,000), with only 28% five-year survival rate.
Helicobacter pylori (H. pylori) is grade I carcinogen and responsible for 89% of all gastric cancers.\textsuperscript{3} Several decades of infection with H. Pylori can cause some preneoplastic changes, atrophy and intestinal metaplasia, in half of the infected patients.\textsuperscript{4} Primary gastric cancer prevention program would be a National screening program for H. pylori infection with eradication of those infected. Secondary gastric cancer prevention program would be possible if we could find patients with severe preneoplastic changes in the stomach and offer them regular upper gastrointestinal endoscopies. Population-based screening by endoscopy for detection of these preneoplastic lesions is not feasible, except in Japan and Korea.\textsuperscript{5,6} In Western countries, regular endoscopic follow-up is offered to patients with endoscopically visible preneoplastic lesions according to MAPS recommendations\textsuperscript{7,8}, but this represents only opportunistic secondary prevention.

Serologic biopsy – measuring pepsinogen I and pepsinogen II (PGI, PGII), Gastrin 17 (G 17) and H. pylori antibodies in the serum can select those patients with preneoplastic gastric lesions. In case of corpus atrophy and intestinal metaplasia, the production of pepsinogen I goes down more than pepsinogen II, which is produced also in antrum. Gastropanel (Biohot Ojy, Finland) has set cut-off for corpus atrophy at PGI/PGII < 3 and/or PGI < 30 μg/L).

If a patient is not on PPI therapy, increased Gastrin 17 can be another marker of low gastric acid secretion and corpus atrophy. Gastrin 17 is lower than normal in case of atrophy in antrum, or in case of gastric hypersecretion.\textsuperscript{9} H. pylori seropositivity is a risk factor for gastric cancer and up to 2.9% of infected patients can develop gastric cancer in their lifetime.\textsuperscript{10}

Serologic biopsy is more accurate in the diagnosis of corpus atrophic gastritis (CAG) than antral atrophic gastritis (AAG) with 70.2% vs. 51.6% pooled sensitivity and 93.9% vs. 84.1% pooled specificity.\textsuperscript{11} The serologic biopsy can be of help in finding those patients in the population who have advanced premalignant gastric lesions. This method is already used in Japan, China and Finland.\textsuperscript{12-15}

In our multicenter prospective study, we wanted to assess the accuracy of serologic biopsy (Gastropanel) in the diagnosis of premalignant gastric lesions (primary objective of the study) as well as the prevalence of H. pylori infection (secondary objective of the study) in a population of patients included in a National colorectal cancer screening program (age 50 to 74 years) who are FIT positive and thus referred to colonoscopy.

**Patients and methods**

Patients included in the National colorectal cancer screening, tested FIT positive, and scheduled for screening colonoscopy in seven outpatient endoscopic units were invited to participate in the study. Exclusion criteria were use of PPI or H2 blockers in the previous two weeks. Those that fulfilled the criteria and signed the Informed Consent Statement were included.

Fasting serum with EDTA (2 X 5ml) were frozen to -20°C and transported on dry ice to Central laboratory at the Institute for Microbiology and Immunology at the Medical Faculty in Ljubljana, where it was frozen and stored at -80°C. Byohit Elisa test was used for PGI and PGII, G 17, and anti-H. pylori antibodies (IgG-Hp). According to producer data, normal values are: PGI 30–165 μg/L, PGII 3–15μg/L, PGI/PGII 3–20, G 17 < 5 pmol/L, H. pylori antibodies < 30 EIU. If PGI/PGII was < 3 and/or PGI < 30 μg/L, patients were invited to upper gastrointestinal endoscopy.\textsuperscript{16,17}

Five biopsies (two from the lower and upper curvature 3 cm from the pylorus, one from incisura angularis, and two from lower and upper curvature of middle corpus) and two biopsies (from antrum and corpus) for rapid urease test (RUT) were taken. According to updated Sydney protocol and Operative Link for Gastritis Assessment (OLGA) / Operative Link on Gastric Intestinal Metaplasia Assessment (OLGIM) classification, the histopathological analysis was performed by expert gastrointestinal pathologist.\textsuperscript{18-20}

Patients who were H. pylori positive (positive anti-H. pylori antibodies or histology) and have normal pepsinogen levels took the urea breath test; according to national recommendations. If the result was positive, they received a 7-day triple regimen.\textsuperscript{21}

The primary objective of the study was to detect patients with preneoplastic conditions (i.e. atrophic gastritis/intestinal metaplasia) in stomachs of fecal immunochemical test (FIT) positive patients included in National colorectal cancer screening with serologic biopsiy (GastroPanel\textsuperscript{19}, Byohit, Helsinki, Finland).

The secondary objective of the study was to determine the prevalence of H. pylori infection in the age group from 50 to 74 years.
Statistical analysis

The results of the Gastropanel testing (in Excel format) were submitted to Biohit Oyj (Helsinki, Finland) for final analysis using the GastroSoft® (Biohit Oyj) interpretation software. All statistical analyses were performed using the SPSS 23.0.0.2 for Windows (IBM, Armonk, NY, USA) and STATA/SE 14.1 software (StatCorp, College Station, TX, USA). Frequency tables were analyzed using the Chi-square test, with likelihood ratio (LR) or Fischer’s exact test being used to assess the significance levels between the categorical variables. Using the exact method, odds ratios (OR) and their 95% confidence intervals (95% CI) were calculated where appropriate. Differences in the means of continuous variables were analyzed using the non-parametric tests (Mann-Whitney, Kruskal-Wallis), with the mean (95% CI) values being derived from analysis of variance (ANOVA).

Ethics

The study was registered at the National Ethical Committee of the Ministry of Health under number 158/07/13 and was conducted in accordance with the Declaration of Helsinki, consistent with Good Clinical Practices recommendations.

Results

In seven SVIT endoscopic units, 288 patients, 154 men (53.5%) and 134 women (46.6%), average age 60.68 years (from 50–75), were included (Table 1). Results of Gastropanel for different age groups and sex are shown in Tables 2 and 3.

After data (in Excel) have been processed by using the GastroSoft® (Biohit Oyj) interpretation software, 4 different phenotypes of gastric histology by serologic biopsies (Gastropanel) have been found (normal Gastropanel, H. pylori gastritis, Corpus atrophic gastritis, Antrum atrophic gastritis) (Table 4).

Only 24% of our population had a normal Gastropanel test (no premalignant lesions and...

| Patients       | Number | Percentage |
|----------------|--------|------------|
| Men            | 154    | 53.5%      |
| Women          | 134    | 46.5%      |
| Total          | 288    | 100%       |
| 50–60 years    | 134    | 46.5       |
| 61–70 years    | 120    | 41.7       |
| 70+            | 34     | 11.8       |

TABLE 2. Gastropanel data for different age groups

| Age range       | N     | Mean         | Std. Deviation | Std. Error |
|-----------------|-------|--------------|----------------|------------|
| G 17 basal (pmol/L) |       |              |                |            |
| 50–59 years     | 105   | 7.1860       | 8.6474         | 0.8439     |
| 60–69 years     | 99    | 17.8350      | 99.0131        | 9.9512     |
| 70+ years       | 32    | 8.9800       | 10.7870        | 1.9069     |
| Total           | 236   | 11.8970      | 64.5188        | 4.1998     |
| PGI (μg/L)      |       |              |                |            |
| 50–59 years     | 134   | 95.9870      | 42.1806        | 3.6438     |
| 60–69 years     | 120   | 97.9820      | 42.5086        | 3.8805     |
| 70+ years       | 34    | 87.4010      | 53.5034        | 9.1804     |
| Total           | 288   | 95.8050      | 43.7446        | 2.5777     |
| PGII (μg/L)     |       |              |                |            |
| 50–59 years     | 134   | 11.7030      | 10.3706        | 0.8959     |
| 60–69 years     | 120   | 12.1780      | 9.4390         | 0.8617     |
| 70+ years       | 34    | 12.9740      | 9.4896         | 1.6275     |
| Total           | 288   | 12.0480      | 9.8640         | 0.0581     |
| PGI/PGII ratio  |       |              |                |            |
| 50–59 years     | 134   | 10.0840      | 4.4246         | 0.3822     |
| 60–69 years     | 120   | 9.6950       | 4.6364         | 0.4232     |
| 70+ years       | 34    | 7.6100       | 3.7772         | 0.6478     |
| Total           | 288   | 9.6300       | 4.4953         | 0.2849     |
| Helicobacter pylori Ab titre (EIU) |       |              |                |            |
| 50–59 years     | 134   | 72.9270      | 46.5802        | 4.0239     |
| 60–69 years     | 120   | 80.8910      | 42.3679        | 3.8676     |
| 70+ years       | 34    | 91.2500      | 51.0485        | 8.7547     |
| Total           | 288   | 78.4090      | 45.6677        | 2.2610     |
no H. pylori infection). The vast majority of them (70.5%) had H. pylori gastritis without premalignant lesions and they were all asymptomatic. According to GastroSoft®, only 5.2% of the population had corpus atrophic gastritis (CAG) and 0.3% had antral atrophic gastritis (AAG).

Differences among age groups or sex were not statistically significant. Only PGI/PGII (p = 0.016) as well as PGI (p = 0.019) was significantly lower in older age group. PGI/PGII as well as PGI was lower in higher OLIM stage (Figure 1).

H. pylori seropositivity was found in 219 patients (76%; Table 5). Patients in younger age groups have lower seropositivity for H. pylori (70.1%) than older age groups. The oldest age group has the highest H. pylori seropositivity (85.3%); the differences between groups were statistically significant (P = 0.005).

Gastropanel test found only 24 patients (12 women, 12 men, mean age 63.5; from 50 – 75 years) with PGI/PGII < 3 and/or PGI < 30 μg/L. Those patients were examined by upper gastrointestinal endoscopy.

Premalignant changes (intestinal metaplasia/atrophy) was found in 21 patients. In 5 of those 21 patients no H. pylori infection could be found. Atrophic gastritis - OLIM ≥ 1 was found in 20 patients; OLGA ≥ 1 was found in 19 patients.

Combined accuracy for preneoplastic lesions in Gastropanel positive patients was 87.5%.

Incidence rate of OLIM/OLGA ≥ 1 as criteria for atrophic gastritis in our study population was 7.3% (6.9% for OLIM and 6.6% for OLGA). We found 3 patients with CAG, 1 patient with AAG, and 17 patients with chronic atrophic pangastritis.

**Discussion**

In countries with high incidence rate of gastric cancer, national programs for secondary prevention and early gastric cancer detection have been put in place. In Japan, they use barium double-contrast radiography combined with endoscopy from 1960, or direct gastroscopy in recent years. A total of 3,000 to 6,000 gastric cancer cases are detected annually. Among these cases, EGC (early gastric cancer) accounts for approximately 50% to 70%. An estimated 50% of patients undergo resection or delamination of the gastric mucosa through endoscopy. In Korea, the direct upper gastrointestinal series, or endoscopic detection (or a combination) was adopted above the age of 40 as a way of gastric cancer screening and takes place every two years. Owing to the early diagnosis and treatment of gastric cancer, the 5-year survival rate of gastric cancer in Korea gradually increased from 40% during the 1990s to more than 60% at the beginning of this century.

To improve the compliance and to reduce the costs, serologic biopsy has been introduced in Asia. It allows selection of patients with higher risk for preneoplastic gastric changes and reduces the endoscopic workload and costs. Since the 1990s, the detection of serum PG combined with endoscopy has been conducted in Japan to screen for gastric cancer. Miki et al. reported that among 101,892 Japanese, 125 cases of gastric cancer were detected using serum PG and endoscopy, with a detection rate for cancer of 0.12%. Among these cases, EGC accounted for 80% (25). This combined approach is now in place also in some regions of China.

Gastric cancer incidence is the most prevalent in certain countries of East Asia, but Eastern and Central parts of Europe are on the second place regarding incidence of gastric cancer. In Slovenia, average gastric cancer incidence is 23.4/100,000 with -0.3% change in incidence per year in the last 10 years.

H. pylori is the main carcinogen in gastric carcinogenesis responsible for 89% of all gastric cancers. Slovenian Association for Gastroenterology...
and Hepatology Recommendations for H. pylori diagnosis and treatment clearly stated that we should start with primary prevention in a way of screen and treat for H. pylori in population between 20 and 30 years before preneoplastic conditions develop. At the moment, we practice opportunistic prevention for our elderly population according to MAPS (Management of precancerous conditions and lesions in the stomach) recommendations.

The prevalence of preneoplastic changes in the stomach is 2%–5% in the developed world, but it is much higher in the developing world. The prevalence of preneoplastic lesions in St Petersburg study was 10.8%, while in our study it was 7.3%. The real prevalence is probably slightly higher, because we know that sensitivity of Gastropanel is 70.2% for CAG. Gastropanel missed some, especially early preneoplastic stages, so absolute numbers of preneoplastic changes in the population are higher. In some well conducted European studies, the sensitivity and specificity of the serologic biopsy to diagnose normal stomach mucosa in the population-based sample of the 1,000 subjects were 89% (95% CI 86–92%) and 92% (90–95%), respectively.

Gastropanel software analysis found one patient with AAG and 15 patients with CAG. According to definite histopathologic analysis, 1 patient had AAG, 3 CAG, and all the other Chronic atrophic gastritis. In our opinion, accuracy of Gastropanel for any Chronic atrophic gastritis is good, but this test is not very accurate in distinguishing between fenotipic chronic atrophic gastritis subtypes. The problem partially lies in specificity of G 17 as a marker of antrum atrophy. G 17 can be low in patients with antral atrophy, but also in case of high gastric acid output. On the other hand, high G 17 is present in patients with corpus atrophy as well as in patients on PPIs.

Our study was not designed in a way to be able to calculate sensitivity and specificity of Gastropanel for chronic atrophic changes in the stomach. On the other hand, the majority of patients tested positive for preneoplastic conditions in the stomach by gastropanel were also positive with histology. In our study, the accuracy of Gastropanel for detection of preneoplastic condition in the stomach was 87.5%. This makes Gastropanel a suitable first step test in secondary prevention of gastric cancer; positive patients can then be sent to endoscopy.

Worldwide, the age-specific incidence of gastric cancer of intestinal type is approximately twice as high in males as in females. We did not find statistically significant difference in H. pylori infection rate in our study, neither in preneoplastic changes of stomach mucosa between men and women. There are evidences that this difference in gastric cancer incidence can be caused by hormonal influences.

The incidence of gastric cancer increases exponentially with age. However, in multivariate analyses, age is not an independent risk factor for gastric cancer, it is only a surrogate marker for H. pylori infection rate which is a birth cohort effect. We found lower PGI and PGI/PGII ratio in older age groups. We also found that values of PGI and the PGI/PGII ratio were lower in the higher stage of OLGIM, what has also been previously reported.

The secondary objective of the study was to determine the prevalence of H. pylori infection in the age group from 50 to 74 years. Gubina et al. published H. pylori epidemiologic study in 2005. The average prevalence of H. pylori infection in Slovenia was 25.1%, while the highest prevalence rate was 54% in the age group > 60 years. We were surprised that in our study H. pylori seropositivity was 76% and significantly increasing with age. In our epidemiologic study, number of patients

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**TABLE 4.** Histologic phenotypes of gastric mucosa according to Gastropanel results

| Frequency | Percent | Valid percent | Cumulative percent |
|-----------|---------|---------------|--------------------|
| Normal panel | 73.00 | 25.30 | 25.30 | 25.30 |
| HP gastritis | 199.00 | 69.10 | 69.10 | 94.40 |
| AGA | 1.00 | 0.30 | 0.30 | 94.80 |
| AGC | 15.00 | 5.20 | 5.20 | 100.00 |
| Total | 288 | 100 | 100 |

AGA = Atrophic gastritis of antrum; AGC = Atrophic gastritis of corpus

**TABLE 5.** Age Group H. pylori positive vs. negative

| Age Group | Hp positive vs negative | Total |
|-----------|-------------------------|-------|
| 50-59 | Count 94 | 40 | 134 |
| % within Age Group | 70.1% | 29.9% | 100.0% |
| 60-69 | Count 96 | 24 | 120 |
| % within Age Group | 80.0% | 20.0% | 100.0% |
| 70+ | Count 29 | 5 | 34 |
| % within Age Group | 85.3% | 14.7% | 100.0% |
| Total | Count 219 | 69 | 288 |
| % within Age Group | 76.0% | 24.0% | 100.0% |
older than 60 years was low (76 participants), what can represent a selection bias to the study and partially explain lower H. pylori seropositivity in older population.

In five of those patients with preneoplastic lesions, H. pylori was negative. This was found also in other studies.\(^{17,25}\) When preneoplastic changes are diffused, H. pylori could not persist in the stomach anymore, but this does not prove that those patients were not infected previously in their lives.

This high H. pylori prevalence in our study population is comparable to the prevalence of H. pylori in St Petersburg study (76.7\%) and in Astana study (76.5\%)\(^{19}\), albeit their population was younger than in our study. The high prevalence of H. pylori in Slovenia goes in parallel with medium high gastric cancer prevalence rate and with predictions that our prevalence of gastric cancer will stay high in the future.\(^2\) This prediction speaks for itself that a program for secondary gastric cancer should be put in place in Slovenia. The most feasible program would be a two-step program with serologic gastric biopsy and gastroscopy for those tested positive.

**Conclusions**

Gastropanel test has proved to be a reliable non-invasive test for advanced gastric preneoplastic lesions that can select patients for further gastroscopy and biopsy in a National secondary gastric cancer prevention program. H. pylori prevalence rate in the age group 50–74 is with 76\% still very high.

**Acknowledgments**

Authors would like to thank prof Kari Syrjänen, Department of Clinical Research, Biohit Oyj, Helsinki, Finland for his support in the analysis of our results using the GastroSoft\(^\text{®}\) (Biohit Oyj) interpretation software and statistical analysis.

Grants received from Biohit Oyj, Helsinki, Finland; Slovenian Association for Gastroenterology and Hepatology.

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