The aim of this study was the detection of Helicobacter pylori (HP) infection and estimation of the clinical validity and the accuracy of the $^{14}$C-urea breath test in the groups of patients studied. A total of 248 patients with gastric diseases were examined. There were 38 patients with gastric ulcer, 41 with duodenal ulcer, 43 with gastroduodenitis erosiva, 26 with hiatus hernia, 36 with gastric carcinoma and 64 patients with gastritis. There were 103 true positive (TP), 139 true negative (TN), 4 false negative (FN) and 2 false positive (FP) patients. There was no significant difference in the incidence of the HP infection between the groups of patients studied ($p>0.05$). Sensitivity of the method was 96.3%, specificity 98.6%, positive predictive value 98.1%, negative predictive value 97.2% and accuracy 97.6%. Our results point out that the method is very accurate for the detection of HP infection.

Key words: Helicobacter pylori, gastritis, gastric carcinoma, hiatus hernia, gastroenteritis erosiva, duodenal ulcer, gastric ulcer

INTRODUCTION

Helicobacter pylori (H. pylori, HP) is a common bacterial pathogen with an incidence up to 50% in some parts of the world. Development of symptoms after infection depends also to the immune response, physical status and the eating habits of the patient. Long-term consequences can include chronic superficial gastritis (with or without progressive atrophy), duodenal or gastric ulceration, gastric adenocarcinoma and mucosa associated lymphoid tissue lymphoma. Also, the presence of HP can be connected with some non-digestive diseases (ischemic heart disease, autoimmune diseases, late puberty, delayed grow-up etc.).

H. pylori has a unique way of adapting in the stomach environment. It goes through the mucous layer to infect gastric epithelial cells, and produces enzymes that break down substances contained in gastric juice. The most important of these enzymes is urease. Urease converts urea from saliva and gastric juices into bicarbonate and ammonia, which are strong bases and thus protect bacteria from stomach acidity. Carbon dioxide is absorbed into the bloodstream and excreted by the lungs. Urease is found in much higher concentrations in infections from HP than from any other bacteria, thus enabling the HP test. Thus, when an infected patient swallows a dose of urea labeled with a radioactive carbon-14 ($^{14}$C) HP in his gastric mucosa breaks down the labeled urea to ammonia and labeled carbon dioxide, which is being absorbed and exhaled through the lungs. After the collection of a certain amount of $^{14}$CO$_2$, beta counter measures its activity.

The aim of the study is was the detection of helicobacter pylori (HP) infection and estimation of the clinical validity and the accuracy of the $^{14}$C-urea breath test in the groups of patients studied.

PATIENTS AND METHODS

The total of 248 patients with gastric symptoms were studied. HP infection was proved by the $^{14}$C-urea breath test using commercially available kit (37 kBq/dose) produced by the Institute for Nuclear Sciences, Vinca, Serbia, as well as by biopsy. The investigation was carried out under fasting conditions, in patients who had not taken proton pump inhibitors or sucralfates during the last four weeks and were not allowed to take these for another two weeks after treatment. Two samples were measured: one, for the determination of the basic values (X) of radioactivity in the exhaled air, and the other 30 min after ingestion of the $^{14}$C-urea capsule. The fast urease test and pathohistology of gastric mucosa were performed using samples obtained by gastric biopsy.

Descriptive and analytical statistical methods were performed (mean value, standard deviation, T-test and Chi-square test).
RESULTS

T test showed a highly (p<0.01) significant difference in the actual values of the $^{14}$C breath test measured in positive and negative patients. Our results showed high differences between basic and reference values of the patients who were infected with HP (p<0.05), and didn’t prove any difference in the noninfected patients (Table 1).

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Thus, we can conclude that this test has very high accuracy (Table 2).

DISCUSSION

T test showed a highly (p<0.01) significant difference in the actual values of the $^{14}$C breath test measured in positive and negative patients. Our results showed high differences between basic and reference values of the patients who were infected with HP (p<0.05), and didn’t prove any difference in the noninfected patients (Table 1). Sensitivity of the method was 96.3%, specificity 98.6%, positive predictive value 98.1%, negative predictive value 97.2% and accuracy 97.6%. There was no significant difference in the incidence of the HP infection between the groups of patients studied (p>0.05). Thus, we can conclude that this test has very high accuracy (Table 2).

Our results are in accordance with the results of other authors. So, Kaul3 obtained very significant rise of the radioactivity in the collected samples in Helicobacter positive persons (p<0.001). Jensen7 proved that sensitivity and specificity of the method is 100% in comparison to the fast urease test, while in comparison to pathohistology 100% and 89% respectively. The results of other authors point out2 that sensitivity and specificity of these investigations were 90-98% and 87-100% in comparison with histology and the culture of biopsy specimen.

Studies have shown that the labeled urea breath test is both sensitive and specific for H. pylori; it detects only urease-producing organisms and reflects total gastric urease activity (the labeled urea reaches a large area of the stomach), and test results can be reproduced. It tells whether a patient is actively infected, and it can be used for follow-up to determine if treatment has been effective. However, it is necessary to perform the investigation at least 4 weeks after the end of the antibiotic therapy and two weeks after the therapy with sucralfates or proton pump inhibitors in order to avoid false negative finding10. Also, caution is needed in the interpretation of the findings in the patients with gastric resection that can be false negative because of the fast elimination of the capsule or false positive because of achlorhydria or colonization with Helicobacter like bacteria, that can also break up urea. The investigation must be done at least 6 hours after the last meal. Some authors conclude that radiation dose absorbed by patient can be compared to the one received from the natural radiation sources during one day5,11,12, while the most pessimistic criteria claim1 that the dose absorbed by this way can be compared to the one absorbed during radiography of the teeth (up to 20 µSv). Caution is necessary in implementation of the method in pregnant and nursing women while it can be performed without necessity in implementation of the method in pregnant and nursing women while it can be performed without risk in children. Recent studies show that these method has been still very widely used for clinical work as well as for investigation, even in pediatric population because of the high reliability and accuracy13-19.

H. pylori disrupt normal mucosal defense and repair, making the mucosa more susceptible to acid, thus predisposing gastric diseases. According to our results, there was no significant difference in the incidence of the HP infection between the groups of patients studied (p>0.05), which is in accordance to the results of other authors.

### Table 1

<table>
<thead>
<tr>
<th>Disease</th>
<th>Basic values of HP- (c/min)</th>
<th>Reference values for HP- (c/min)</th>
<th>Significance</th>
<th>Basic values for HP+ (c/min)</th>
<th>Reference values for HP+ (c/min)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastric ulcer</td>
<td>69.6±15.1</td>
<td>70.1±14.9</td>
<td>p&gt;0.05</td>
<td>70.0±16.2</td>
<td>152±27.2</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Duodenal ulcer</td>
<td>72.6±16.9</td>
<td>73.8±17.1</td>
<td>p&gt;0.05</td>
<td>73.4±17.0</td>
<td>207±35.6</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Gastroduodenitis erosiva</td>
<td>75.6±17.1</td>
<td>75.8±17.0</td>
<td>p&gt;0.05</td>
<td>74.5±16.9</td>
<td>171±29.1</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Hiatus hernia</td>
<td>72.8±18.1</td>
<td>73.9±18.3</td>
<td>p&gt;0.05</td>
<td>79.6±17.1</td>
<td>198±28.2</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Gastric carcinoma</td>
<td>71.4±17.2</td>
<td>73.5±17.5</td>
<td>p&gt;0.05</td>
<td>80.1±21.2</td>
<td>183±33.7</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Gastritis</td>
<td>78.6±19.1</td>
<td>79.8±19.2</td>
<td>p&gt;0.05</td>
<td>76.8±19.2</td>
<td>168±26.2</td>
<td>p&gt;0.05</td>
</tr>
</tbody>
</table>
Thus, HP infection is present in 50 to 70% of patients with duodenal ulcers and 30 to 50% of patients with gastric ulcers. Incidence of HP in chronic active gastritis was found to be 50.4%. Similarly, 47% of patients with erosive gastritis have a positive H. pylori status. The presence of hiatal hernia and corpus gastritis are closely related to the development of reflux oesophagitis after H. pylori eradication therapy. The results of other authors prove similar incidence of HP infection in the patients with gastric carcinoma.

**CONCLUSION**

Thus, we can conclude that in adults, there is no difference between the HP infection present among the groups of patients studied. 14C-urea breath test is precise, available, cheap method for the assessment of the presence of helicobacter pylori infection. It is particularly recommended for the follow up of the therapy.

**SUMMARY**

Cilj rada je otkrivanje infekcije bakterijom helikobakter pilori (HP) i procena kliničke vrednosti metode izdisajnog testa pomoću 14C-ureje u ispitivanim grupama bolesnika. Ukupno je ispitano 248 bolesnika sa digestivnim poremećajima.

Njih 38 imalo je ulkus želuca, 41 ulkus duodenuma, 43 erozivni gastroduodenitis, 26 hiatus herniju, 36 karcinom želuca i 64 pacijenta gastritis. Bila su 103 stvarno pozitivna nalaza (SP), 139 stvarno negativna (SN), 4 lažno negativna (LN) i 2 lažno pozitivna (LP).

Nije postojala značajna razlika u incidenci HP infekcije između ispitivanih grupa bolesnika (p=0.05). Sensitive metode je bila 96.3%, specificitet 98.6%, pozitivn prediktivna vrednost 98.1%, negativn prediktivna vrednost 97.2% i tačnost 97.6%.

Naši rezultati ukazuju da je metoda veoma precizna za otkrivanje HP infekcije.

**REFERENCES**


**TABLE 2**

<table>
<thead>
<tr>
<th>Disease</th>
<th>TP</th>
<th>TN</th>
<th>FP</th>
<th>FN</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Ppv</th>
<th>Npv</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastric ulcer</td>
<td>17</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Duodenal ulcer</td>
<td>18</td>
<td>22</td>
<td>0</td>
<td>1</td>
<td>94.7%</td>
<td>100%</td>
<td>100%</td>
<td>95.7%</td>
<td>97.6%</td>
</tr>
<tr>
<td>Gastroduodenitis erosiva</td>
<td>18</td>
<td>24</td>
<td>1</td>
<td>0</td>
<td>100%</td>
<td>96.0%</td>
<td>94.7%</td>
<td>100%</td>
<td>97.7%</td>
</tr>
<tr>
<td>Hiatus hernia</td>
<td>11</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Gastric carcinoma</td>
<td>15</td>
<td>19</td>
<td>1</td>
<td>1</td>
<td>93.7%</td>
<td>95.0%</td>
<td>93.7%</td>
<td>95.0%</td>
<td>91.9%</td>
</tr>
<tr>
<td>Gastritis</td>
<td>24</td>
<td>38</td>
<td>0</td>
<td>2</td>
<td>92.3%</td>
<td>100%</td>
<td>100%</td>
<td>95.0%</td>
<td>96.9%</td>
</tr>
</tbody>
</table>

Total: 103 139 2 4 96.3% 98.6% 98.1% 97.2% 97.6%

Ključne reči: Helicobacter pylori, gastritis, karcinom želuca, hiatus hernia, erozivni gastroenteritis, ulkus duodenuma, ulkus želuca


