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Медицина є прикладом інтеграції багатьох наук. Наукові дослідження у сучасній медицині на основі досягнень фізики, хімії, біології, інформатики та інших наук відкривають нові можливості для вивчення процесів, які відбуваються в живих організмах, та вимагають якісних змін у підготовці медиків. Науково-практична інтернет-конференція «**Розвиток природничих наук як основа новітніх досягнень у медицині**» покликана змінювати свідомість людей, характер їхньої діяльності та стимулювати зміни у підготовці медичних кадрів. Вміле застосування сучасних природничо-наукових досягнень є запорукою подальшого розвитку медицини як галузі знань.

Конференція присвячена висвітленню нових теоретичних і прикладних результатів у галузі природничих наук та інформаційних технологій, що є важливими для розвитку медицини та стимулювання взаємодії між науковцями природничих та медичних наук.

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У збірнику подані матеріали науково-практичної інтернет-конференції «Розвиток природничих наук як основа новітніх досягнень у медицині». У статтях та тезах представлені результати теоретичних і експериментальних досліджень.

Матеріали подаються в авторській редакції. Відповідальність за достовірність інформації, правильність фактів, цитат та посилань несуть автори.

Для наукових та науково-педагогічних співробітників, викладачів закладів вищої освіти, аспірантів та студентів.

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НОВІТНІ ДОСЯГНЕННЯ У БІОМЕДИЦИНІ ЯК НАСЛІДОК РОЗВИТКУ ПРИРОДНИЧИХ НАУК

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Methods of diagnosis of helicobacter pylori infection in children at the present stage

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Abstract. Comparative evaluation of the results of different methods of infection *H. pylori* is shown. The study involved 120 patients from 7 to 18 years of pathology of the upper gastrointestinal tract. Fibrogastroduodenoscopy was conducted with fence biopsies from the body, antrum and duodenum bulb. Verification of *H. pylori* was performed by the following methods: express methods (industrial sets «CLO-test» the company «Delta» (Australia), «De-Nol-test» firm «Yamanouchi» (Japan)) and laboratory tests («Campy-test» (Russia), «Helikotest» (Russia) and rapid urease test (Russia)), histological investigation, PCR detection ureC, CagA, VacA gene pathogenicity islands microorganism, biological, enzyme-linked immunosorbent assay (ELISA) for the detection of specific immunoglobulin classes M, A and G to CagA *H. pylori* antigen in serum. There was established that all express tests have a high sensitivity and specificity. To improve the accuracy of diagnosis helicobacter infection it is recommended to use at least two, and preferably three, research methods, preferably a combination of express urease test or «De-Nol-test» with histological methods (biopsy of the antrum of the stomach) or PCR (gene detection ureC, CagA and VacA). «Helic test» is recommended as an exact noninvasive method for assessing the effectiveness of eradication therapy, especially by children.

Key words: children, diagnostics, *Helicobacter pylori*.

Introduction. *Helicobacter pylori* infection is one of the most serious problems of gastroenterology due to the fact that the prevalence of infection with *Helicobacter pylori* (*H. pylori*) is progressively increasing, the disease is often detected in young working age and this microorganism is recognized like cancer gene of first order [1]. Thus, the development of algorithms for early and exact diagnostics of *Helicobacter pylori* infection will improve quality of treatment these patients. In addition, more attention is paid to the problem of re-infection, and therefore the necessity clarification

of terms of control tests for *H. pylori* for differentiation reinfection and failure of eradication therapy [3].

During numerous comparative studies found that the results of different methods are not always identical, so to avoid getting a false-negative or false-positive results, more exact diagnostics of the presence of infection must use at least two methods and the result is considered positive or negative in the case of coincidence indices of both methods of investigation [2]. Some authors even recommend the use of three methods in order to talk about absence of infection [4,6].

A comparative analysis of the effectiveness of different methods for diagnostics of *H. pylori* in adult patients with *H. pylori*-associated diseases [1], it was found that according to the rapid urease and breath test and *H. pylori* was detected in 100% of patients, histological examination determined 70%, by polymerase chain reaction (PCR) – 70% of patients. We found that the results of bacteriological methods in 25 % of cases were negative with the positive results of other methods of investigation, due to the complexity of culturing *H. pylori*, therefore, only the data bacteriological method is not recommended to navigate to avoid false negative results [6].

Main aim of the research – to compare different methods of diagnostic of *Helicobacter pylori* in children.

Material and methods. We performed a comparative evaluation of the results of different methods of infection *H. pylori* with further development of optimization algorithm diagnosis of pyloric *Helicobacter* infection.

There were examined 120 patients from 7 to 18 years of pathology of the upper gastrointestinal tract (37% of patients with peptic ulcer disease, 63% – with chronic gastroduodenitis). The study involved the observance of the concept of informed consent on the basis of ethical principles in relation to children who are the subject of research (World Medical Association Declaration of Helsinki 1964, 2000, 2008).

Patients underwent fibrogastroduodenoscopy with biopsy from the body and antrum and duodenal bulb (Sydney-Houston System, 1996). Verification of *H. pylori* was performed by the following methods: express methods (industrial sets «CLO-test» the company «Delta» (Australia), «De-Nol-test» firm «Yamanouchi» (Japan)) and laboratory tests («Campy-test» (Russia), «Helikotest» (Russia) and express urease test (Russia)), histological investigation, PCR with detection ureC, CagA, VacA gene pathogenicity islands microorganism, bacteriological, enzyme-linked immunosorbent assay (ELISA) for the detection of specific immunoglobulin classes M, A and G to CagA *H. pylori* antigen in serum by conventional method using diagnostic test-system «HelioBest-antibodies» (series D-3752) and a set of reagents company «BEST Vector» (Novosibirsk,

Russia). Results evaluated with a spectrophotometer by measuring the optical density at a wavelength of 450 nm.

Results. By comparison of the results, it was found that the maximum number of positive results was determined using the express urease test, the minimum amount – when seeding biopsies (Fig.1).

In addition, correlation analysis on match performance of different methods of diagnostics, according to which established a correlation between the results of the urease test and PCR (gene ureC) ($r=0,67$, $p<0,01$), urease test and histological examination (H. pylori in the stomach) ($r=0,59$, $p<0,05$), helic-test and histological examination (H. pylori in the stomach) ($r=0,70$, $p<0,01$). On this basis, it can be argued that the use of combinations of these methods will be the most informative for the diagnostics of infection.

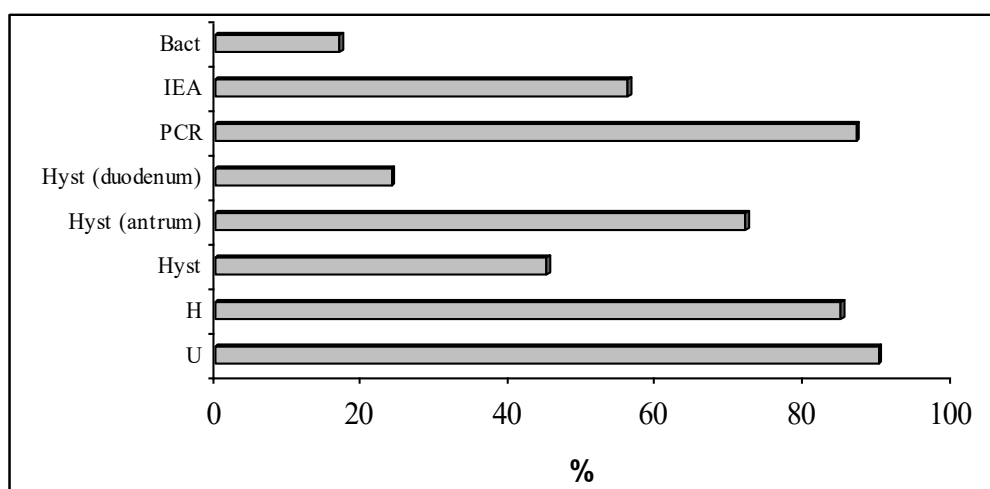


Fig. 1. Comparative description of the results of various diagnostic methods H. pylori (U – urease test, H – helic-test, Hyst – histology, PCR – polymerase chain reaction ureC, IEA – ELISA, Bact – bacteriological study). The vertical axis – research methods, X-axis – the number of positive results, %.

Express-diagnostics of pyloric *Helicobacter pylori* based on the properties of H. pylori in large numbers (compared to other microorganisms) secrete urease that breaks down urea, which is part of a diagnostic test for carbon dioxide and ammonia. As a result, the pH shifted to the alkaline side and recorded by changing the color of diagnosticum. Exposure time of biopsy transfer in environment is different. Thus, by performance «CLO-test» and «Campy-test» results obtained after 24 hours, conducting «Helicotest» allowed to conclude that the presence of H. pylori for 2 hours. The most

«express» tests were «De-Nol-test» and urease quick test, in which the outcome was assessed for 5-20 min. All express tests had different sensitivity and specificity (Table 1).

Table 1

Comparative characteristics of express-methods for diagnostic H. pylori

Express-tests	Sensitivity	Specificity
CLO-test	95,1%	100%
Campy-tesy	92,1%	94,7%
Helico-test	96,3%	100%
De-Nol-test	96,8%	100%
Urease test	96,5%	100%

Rate of change of color express diagnosticums depend on the degree of sowing mucosa by microorganisms, confirmed following histological investigation. The most expressed, this pattern was observed during the De-Nol test and urease test. With a high degree sowing mucosa of pyloric bacteria changing color of these diagnostics do not exceed 5 minutes if the color change occurred within 5-15 minutes, the degree of sowing was mainly middle and low level at sowing came the reaction after 15-30 minutes. If the response time of the test exceeded 30 minutes, the result was considered doubtful [2].

Genotyping of H. pylori in individuals studied by PCR performed with primers specific for locus of genes responsible for the synthesis of CagA and VacA. The results of the study are presented in Table 2.

Table 2

Results of genotyping of Helicobacter pylori

Strain of Helicobacter pylori									
H. pylori (tox+), n=86								H. pylori (tox -), n=34	
CagA+VacA+		CagA+VacA-		CagA-VacA+		Total		CagA-VacA-	
Abs.	%	Abs.	%	Abs.	%	Abs.	%	Abs.	%
46	53,4	24	27,9	16	18,6	86	71,7	34	28,3

The gravity of all strains with the presence of gene toxicity (tox +) is 71,7% of all strains of H. pylori. Spectrum of gene toxicity pylori was distributed as follows: CagA (+) identified in 70

persons (81,3%), VacA (+) – 62 children (72,1%). Thus among strains of *H. pylori* detected heterogeneity with natural increase biochemical activity of bacteria in the presence of these gene CagA.

When comparing the results of cytosopic investigation smears-matrix and DNA typing of genes toxicity *H. pylori* found that the smears-matrix helicobacter-like microflora in mucosa of antrum was found in 86 of 120 persons with helicobacter infection, diagnosed by PCR, therefore sensitivity amounted to 71,7%. Helicobacter microflora in the mucosa of stomach body was detected in 49 (40,8%) patients, whereas in 34 duodenal biopsies of examined children, only 11 (32,3%) found *H. pylori* (Table 3).

Table 3

Frequent of revealing Helicobacter microflora by cytosopic method and polymerase chain reaction

Biopsy sampling location	Cytoscopic method, (%)	Polymerase chain reaction method, (%)
Antrum, n=120	71,7*	100
Body of the stomach, n=120	40,8*	100
Duodenum, n=34	32,3*	100

Mark. * – difference is reliable ($p < 0,01$).

Thus, most often *H. pylori* is detected in the antrum (71,7%), the least – in duodenal bulb (32,3%). The difference between the frequencies of detection *H. pylori* in different parts of the gastroduodenal region is reliable ($n=120, p < 0,01$).

All express tests have a fairly high level of sensitivity and specificity. For express diagnostics for the presence of *Helicobacter pylori* bacteria can use any of these, however, the advantage, in our opinion, should be given to «De-nol test» or urease test, which allows not only to carry out a qualitative response, but also to assess the degree of sowing mucous membrane of these bacteria [4].

However, we performed express-tests is quite informative, but they are qualitative reactions, recording only the waste products of *H. pylori*. Positive results were obtained in the course of urease and helic-test with negative results obtained by histological methods or PCR, can not explain false-positive results, and the fact that during the urease test and helic-test determined the waste products of *H. pylori*, rather than the microorganism that can not get into the biopsies studied using histological methods or PCR [3].

Conclusions. To improve the accuracy of diagnosis helicobacter pylori infection it is recommended to use at least two, and preferably three research methods, preferably a combination of express urease test or «De-nol-test» with histological methods (biopsy of the antrum of the stomach) or PCR (gene detection ureC, CagA and VacA). For express-diagnostics for the presence of Helicobacter pylori bacteria it can be used any of them. «Helic-test» is recommended as an exact noninvasive method for assessing the effectiveness of eradication therapy, especially by children.

References

1. Best LM, Takwoingi Y, Siddique S, Selladurai A, Gandhi A, Low B, Yaghoobi M, Gurusamy KS. Non-invasive diagnostic tests for Helicobacter pylori infection. *Cochrane Database Syst Rev.* 2018 Mar 15;3:CD012080.
2. Kalach N, Bontems P, Raymond J. Helicobacter pylori infection in children. *Helicobacter.* 2017 Sep;22 Suppl 1: 278-292.
3. Moran-Lev H, Lubetzky R, Mandel D, Yerushalmy-Feler A, Cohen S. Inverse Correlation between Helicobacter pylori Colonization and Pediatric Overweight: A Preliminary Study. *Child Obes.* 2017 Aug;13(4):267-271.
4. Sabbagh P, Javanian M, Koppolu V, Vasigala VR, Ebrahimpour S. Helicobacter pylori infection in children: an overview of diagnostic methods. *Eur J Clin Microbiol Infect Dis.* 2019 Jun;38(6):1035-1045.
5. Seo JH, Park JS, Rhee KH, Youn HS. Limitations of urease test in diagnosis of pediatric Helicobacter pylori infection. *World J Clin Pediatr.* 2015 Nov 8;4(4):143-7.
6. Sustmann A, Okuda M, Koletzko S. Helicobacter pylori in children. *Helicobacter.* 2016 Sep;21 Suppl 1:49-54.

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Advances in optical devices for biomedical applications

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The recent advances in optical devices have opened up new opportunities for sensing and biomedical imaging techniques. It is interesting to note that the main advantage of optical devices is to obtain more detailed information about the subject of the study. This paper introduces potential applications of optical parameters of α -Hg₃S₂Br₂ in the creation of optical transducers for medical devices, demonstrates proof of principle, discusses potential clinical applications. α -Hg₃S₂Br₂ polymorph is a potential nanomaterial for design of optical transducers, multifunctional elements and imaging system operating in optical spectra. Nanomaterials based on α -Hg₃S₂Br₂ crystals have tremendous potential in addressing the two major issues faced by our society: the searching for new energy sources and improving healthcare. These crystals can be efficiently used for enhancement of the optical processes in biomolecules by nanostructured surfaces on their basis. Obtained data suggest