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Helicobacter pylori and its effect on the body. Worldwide prevalence of Helicobacter pylori

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Abstract

Helicobacter Pylori is one of the most common bacteria in the world's population, mainly causing chronic gastritis, which can progress to such severe complications as gastric and duodenal ulcers, gastric adenocarcinoma, and gastric MALT lymphoma.

The bacterium Helicobacter Pylori is highly prevalent in a wide variety of countries around the world. Not only the adult population suffers from helicobacteriosis, but also children from birth whose parents are carriers or have symptoms of helicobacter infection. Helicobacter Pylori is a very capricious bacterium in cultivation, which requires a special composition of the nutrient medium, its optimal pH and temperature regime. Helicobacter Pylori produces a wide range of enzymes, urease is one of the many enzymes on which diagnostic methods are based.

Keywords: Helicobacter pylori; Helicobacter infection; chronic gastritis; gastric ulcer; duodenal ulcer.

Recently, much attention has been paid to the study of the features of the spread of Helicobacter pylori in the human body. It has been found that Helicobacter pylori infection (H. pylori) is one of the most common infections on the globe. About 1.5-2 billion people on the planet are infected with Helicobacter pylori (HP), especially in developing countries in Africa, Asia and Latin America, where by the age of 10, 80% of the population have HP colonization of the gastric mucosa. It has now been established that this infection is the cause of 100% of cases of chronic antral non-atrophic gastritis, over 95% of all duodenal ulcers, almost 90% of benign gastric ulcers not associated with taking medications, and 60-70% of cases of gastric cancer, and also provokes the development of polyp-like formations of the gastrointestinal mucosa.

The presence of HP on the gastric mucosa does not always cause chronic non-atrophic gastritis, it can have a hidden (latent) course or the option when the patient can be a carrier of the infection. Carriership of HP in practically healthy people is associated with the presence of weakly virulent strains on the gastric mucosa (SOM) or a decrease in the number of receptors on the surface of the stomach that promote adhesion of the microorganism.

There is no doubt that human SOE contamination with H. pylori has been occurring since ancient times. For example, H. pylori antigens have been detected by polymerase chain reaction in South American mummies in Colombia, which are about 1700 years old. Data from studies of H. pylori infection in Australia, Great Britain, Belgium, the Netherlands, Germany, Denmark, Italy, Israel, Ireland, Peru, Poland, Saudi Arabia, the USA, Taiwan, Ukraine, Finland, France, Sweden, Scotland, Estonia, as well as India, Malaysia and Japan indicate a high prevalence of H. pylori. The lowest incidence was observed in Malaysia, where among healthy individuals antibodies to HP were detected in only 4.6%, in patients with gastrointestinal pathology (GI) this figure was higher than in healthy individuals, but lower than in other countries. In Sweden, for example, antibodies to HP were detected in 48% of people who consider themselves healthy, and in Japan - in 74.7% of those examined. The contamination of "healthy" children ranges from 0 to 27%.

In recent years, the number of children with chronic inflammatory diseases of the upper gastrointestinal tract has been steadily increasing. Even in infants, HP is detected in 5.4%, and by 13-15 years of age, the infection reaches 58-72%. HP infection is detected on the surface of the upper respiratory tract in children, starting from 2 months of age. Studies by many authors have shown that one of the main links in the spread of HP is the family factor, in which the transmission of infection occurs as a result of close contact between family members, most likely, the fecal-oral route of transmission, given the ability of HP to transition to a coccal form under adverse conditions and be able to be excreted from the body with feces. Thus, in particular, HP was detected in all parents and in 70% of siblings in the group of children from 1 year to 14 years old, who were being treated for various diseases of the upper gastrointestinal tract and in whom HP was detected on the mucosal surface, although 46% of relatives did not complain of gastrointestinal diseases. After treatment and eradication of GI in sick children, recurrence of Helicobacter pylori was observed 2 times more often in those families where only the examined children were treated compared to families in which all relatives received therapy. Moreover, in families where there were several children (2 or more), relapse occurred 12% earlier than in families with one child. Evidence of the fecal-oral route of transmission was found in patients who lived and were in prolonged close contact. Also, evidence of this route of transmission was provided by studies of adult groups in closed groups (military units, ship crews, etc.), where for a long time all members of these groups used common cutlery and bathrooms, which led to rapid mass infection. Thus, when conducting research on the rate of infection of GIs, it was found that the rate of infection depends on the space in which the team members are located.

Helicobacter Pylori is one of the most common infections in the world, which is the main cause of gastrointestinal diseases such as chronic gastritis, gastric ulcer (GUD) and duodenal ulcer (DUO), MALT lymphoma and gastric cancer.

Helicobacter Pylori is a gram-negative, non-spore-forming, spiral-shaped bacterium 2.2-5.0 μm long and 0.5-1 μm in diameter with rounded ends. The microorganism moves due to the presence of 2 to 6 flagella at one of the poles. The flagella are surrounded by a membrane-like case that protects them from depolarization when the pH of the stomach decreases. The unipolarity of the flagella of the bacterium provides the necessary mobility for movement in the viscous environment of the stomach.

Studies have shown that HP exist in three morphological forms: S-, C- and U-coccus-like forms. In vivo and under optimal cultivation conditions in vitro HP exists in the form of an S-shaped bent bacterium with 1-3 whorls and a bundle of 5-7 flagella. Under adverse conditions (temperature, pH, lack of nutrients, the action of antibiotics), microorganisms can transform into coccus-like forms. Saito N. et al. (2003) identified 3 types of coccus-like forms: non-viable, viable cultivated and uncultivated. C- and U-shaped forms are intermediate forms in the transformation of the microorganism into an inactive (dormant) phase under adverse conditions. Morphological changes are accompanied by a decrease in metabolic activity, in particular urease activity, but the genes encoding its synthesis continue to be detected. These data indicate that the process of morphological and biochemical transformation is phenotypic in nature and does not involve the genotype. Reversion of inactive forms to vegetative ones is also possible.

The cultural properties of HP are that they are microaerophiles (optimal oxygen concentration – 3-15%) and capnophiles (optimal carbon dioxide concentration – 10-15%). Xia H. et al. (1994) obtained a culture of HP bacteria that grew under aerobic conditions, but differed in smaller colony size and low frequency of microbial cell division.

The HP bacterium is demanding on the nutrient medium, which must contain blood or serum. On blood agar, small (1-2 mm in diameter), moist, transparent colonies are observed to grow after 2-5 days. Some strains exhibit hemolytic activity (a-hemolysis). The optimal growth temperature is 37 °C, but some strains grow at + 30 °C - + 42 °C. The optimal pH value is neutral, closer to a slightly alkaline (8.5) environment.

Cultivation of HP cannot occur without the use of amino acids such as arginine, histidine, isoleucine, leucine, methionine, phenylalanine, valine and serine, which act as growth and reproduction factors and are necessary not only for protein synthesis, but also are the main source of energy. Cultivation of HP can be carried out on dense and liquid media, but due to the difficulties of isolating these bacteria on liquid media, agar is used in practice. For the cultivation of HP, media can be conditionally divided into selective and non-selective.

Mandatory components are base agar, and for selective ones - an inhibitor of the growth of concomitant microflora (vancomycin to inhibit the growth of gram-positive cocci; polymyxin, nalidixic acid, colistin, trimethoprim, cefsulodin to inhibit the growth of gram-negative bacteria; nystatin, amphotericin B to inhibit the growth of fungi). HP is a very capricious microorganism that requires additional factors (vitamins, trace elements) that enhance its growth. One of the mandatory components of the medium for growing bacteria should be the addition of 5-10% blood or serum of animals (horse, sheep). The use of human blood is limited by the presence in most adults of protective antibodies that can inhibit the growth of HP. In this case, erythrocytes are lysed so that growth factors can be used more quickly, which is achieved by using "chocolate agar" (lysis of erythrocytes occurs when blood is heated, due to which it acquires a chocolate color). It is also possible to use other growth supplements such as: egg yolk, charcoal, starch, bovine serum albumin, cyclodextrin. Cellini L. et al. (1992) developed a medium with the addition of 2% isovitalex and hemin (10 mg/l).

Another additive 2, 3, 5 - triphenyltetrazoline chloride contributes to the rapid identification of HP colonies. As a result of the metabolic use of this substance by the bacteria, it is converted into insoluble formazan, and HP colonies are stained golden. Jiang X. et al. (2000) proposed the use of ferrous sulfate, sodium pyruvate and porcine mucin as growth additives. Differential diagnostic media containing urea and an indicator have been proposed for the isolation of HP.

Similar to dense media composition (bases, growth and selective additives), the conditions for cultivating HP are also used in liquid media, however, this process is quite laborious and has not found wide application in laboratories. But the method of cultivating HP on liquid nutrient media is indispensable for scientific purposes for studying physiology, metabolism, expression of genes encoding pathogenicity factors. It is used to obtain large amounts of microbial mass during subculturing for studying enzymes, exo- and endotoxins. Various bases of liquid media have been proposed: Brucella broth, heart-brain broth, soy broth with growth additives (whey, yeast extract, cyclodextrin, etc.) and antimicrobial drugs (vancomycin, nalidixic acid, amphotericin B). A medium with a constant composition of vitamins and trace elements without the addition of serum has also been proposed - serum-free Ham's F-12. When grown on liquid nutrient media, bacteria are motile and biochemically active, have a typical sinuous shape, and have full antigenic properties.

Helicobacter Pylori produces catalase and oxidase, but catalase-negative species have also been described. It secretes urease in large quantities, decomposes carbohydrates. Tests for the formation of H2S, the reduction of nitrates to nitrites are variable. The bacteria also secrete alkaline phosphatase, gamma-glutamyl transpeptidase, and leucine aminopeptidase. To differentiate from bacteria of the Campylobacteriaceae family, tests are used to determine the ability of HP to grow in the presence of 2, 3, 5 - triphenyltetrazoline chloride (0.4 and 1 mg/l), sodium selenite (0.1%), glycine (1%); lack of growth in 8% glucose solution and 3.5% sodium chloride; sensitivity to cephalothin and resistance to nalidixic acid.

This bacterium also produces a wide range of enzymes: urease, cytochrome oxidase, catalase, alkaline phosphatase, alcohol dehydrogenase, lipase, y-glutamyl transpeptidase, leucine aminopeptidase, protease and lipase, but does not secrete saccharolytic enzymes. The metabolism of HP is provided with energy during the metabolism of tricarboxylic acids and amino acids. In the course of evolution, it also acquired properties that allow it to survive in adverse environmental conditions, it is able to change the conditions of its microenvironment. In acidic conditions, a powerful attraction system is “turned on” - a large amount of urease is produced, but at pH = 8 the bacteria die, therefore, in neutral conditions, HP “turns on” the system of oxidase enzymes, which, when oxidizing the substrate, lead to the release of hydrogen ions, which shifts the pH to the acidic side. Oxidative enzymes not only acidify the microenvironment, but also produce active oxygen species that damage the tissues of the mucous membranes. Thus, in an acid-base environment of less than 6, urease exhibits a toxic effect, and when the pH changes to the alkaline side (which often occurs against the background of the use of antisecretory drugs), oxidases have a harmful effect.

One of the important factors of pathogenicity of HP is its ability to colonize the epithelium of the stomach and the changed epithelium of the duodenum. The spiral shape and the presence of flagella at one pole allow the microorganism to move quickly in the thickness of the mucus and penetrate through intercellular contacts. The role of motility as a factor of colonization was demonstrated in 1992 by Eaton K. et al.

Conclusions: Analyzing the above material, we can say that:

1. The bacterium Helicobacter Pylori is highly prevalent among a wide variety of countries around the world. Not only the adult population, but also children from birth whose parents are carriers or have symptoms of Helicobacter infection suffer from Helicobacter pylori.

2. Helicobacter Pylori is a very capricious bacterium in cultivation, requiring a special composition of the nutrient medium, its optimal pH and temperature regime.

3. Helicobacter Pylori produces a wide range of enzymes, urease is one of the many enzymes, the detection of which is based on diagnostic methods.

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