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Identification Methods of Helicobacter Pylori Bacteria

Metode Identifikasi Bakteri Helicobacter Pylori

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Abstract

Background: *Helicobacter pylori* is a well-known carcinogenic pathogen associated with gastrointestinal diseases, often infecting individuals during childhood and persisting asymptomatically for years. **Specific Background:** The failure to diagnose *H. pylori* early can result in severe health consequences, making timely and accurate diagnosis critical to preventing its spread. **Knowledge Gap:** Diagnostic methods' effectiveness depends on patient age, economic status, and operator skill, with some tests being expensive and influenced by protocol adherence. **Aims:** The study evaluates the efficacy of various diagnostic methods for *H. pylori*, focusing on the accuracy, reliability, and practicality of invasive and non-invasive techniques. **Results:** Invasive methods like histology, endoscopy, culture, rapid urease test, and polymerase chain reaction (PCR) provide direct detection of the bacterium, while non-invasive methods such as the urea breath test, stool antigen assay, and serology offer indirect detection without requiring endoscopy. PCR, when conducted with appropriate primers and gene targets, remains the most accurate diagnostic tool. **Novelty:** The study emphasizes the superior diagnostic value of PCR due to its precision, despite challenges related to operator skill and procedural compliance. **Implications:** The study emphasizes the significance of selecting suitable diagnostic methods based on patient-specific factors and the need for skilled execution for accurate results in managing and treating *H. pylori* infections.

Highlights:

PCR Accuracy: Most reliable *H. pylori* test with correct primers and targets.
Operator Skill: Diagnosis depends on skilled execution and procedural adherence.
Test Selection: Choose based on patient age, economic status, and method availability.

Keywords: *Helicobacter pylori*, diagnosis, gastrointestinal diseases, PCR, invasive tests

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Introduction

Helicobacter pylori is a Gram-negative, spiral-shaped, anaerobic, and a fastidious bacterium that only grows under certain conditions (1,2), however, the spread of infection with this bacterium is very widespread(3) . When it infects a person, it colonizes within the gastric mucosa (4). The occurrence of some gastrointestinal diseases such as gastritis, gastric ulcers and gastric cancer often leads to suspicion of the presence of this bacterium (5). In addition to other indicators that may indicate or be associated with infection with this bacterium which are iron deficiency anemia, immune red spots, vitamin B12 deficiency, diabetes, cardiovascular disease, and some neurological disorders (6).

It must be noted that infection with this bacteria may occur in children naturally without being detected (7), as there are no symptoms suggesting this infection (8)

There are many different factors that lead to infection with *Helicobacter pylori*, which may be health, social, economic, or ethnic factors (9), where one example of these factors is excessive salt intake, which contributes to creating suitable conditions for this bacterium (10).

Methods

There are several methods to diagnose this bacterium, but the choice of method depends on different factors as the patient's age and economic status where some methods are expensive. *Helicobacter pylori* is detected either directly by histological evaluation, culture, rapid urease test, or polymerase chain reaction which are performed on tissues obtained during endoscopy; or indirectly using urea breath test, serology, or stool antigen test are performed without the need for endoscopy (11).

In addition to treatment, optimal and rapid diagnosis is one of the things that helps prevent the spread of this bacterium, however, reaching an accurate diagnosis requires knowledge of many related factors (6).

Result and Discussion

Identification of *Helicobacter pylori*

There are many methods for identifying this bacterium, some of which require endoscopy and some of which do not, Note that the choice of any of them depends on several factors, including the individual's historical condition (12).

Each method has its advantages and disadvantages, as histology on which the endoscopic tests are based (invasive test) depend on several requirements or restrictions, including the high price, the long period of time required to know the result, the accuracy of the result depends on the skills of the workers, and the correct evaluation depends on the experience of the operator, which varies from one operator to another, and the percentage of bacteria in the site from which the biopsy was taken, as the density of bacteria varies from one site to another, and the necessity of preventing the intake of some inhibitors that affect the tissue and thus the result, but the tests based on invasive techniques are the most accurate (13).

While non-invasive tests do not require a long time to get the result and are inexpensive, urea breath test, which relies on non-invasive techniques, is a powerful test. However, real time-PCR based on invasive techniques is the most accurate and reliable (14).

A-Invasive techniques

1-Histology

Helicobacter pylori bacteria in gastric biopsies are diagnosed using a number of relevant stains (15). Changes in gastric tissue help to assess the inflammatory process in the gastric mucosa. However, the uneven distribution of bacteria in the gastric mucosa necessitates taking more than several biopsies from different sites because relying on only one biopsy from one site may mislead the truth (16).

2- Endoscopy

It is a precise examination to give a clear figure of the gastric mucosa, and it is the procedure on which subsequent procedures depend (17). However, this procedure requires highly experienced personnel in addition to the long time required to perform such a technique (18).

3- Culture

Helicobacter pylori bacteria are grown on media containing antibiotics to protect them from competing bacteria (19), as these bacteria require specific conditions for their growth (20).

4- Rapid Urease Test

This test is rapid, inexpensive, accurate and available (21). The change in the color of the medium from yellow to red is considered evidence of the presence of *Helicobacter pylori* bacteria in the biopsy that are placed in the medium that is containing urea. This change occurs due to the urease enzyme produced by the bacteria, which converts urea into ammonia and bicarbonate. In other words, the color change indicates the presence of these bacteria (22).

5- Polymerase Chain Reaction

Accurate diagnosis of bacterial species is generally achieved by molecular methods (23). Polymerase chain reaction is one of the preferred molecular methods for detecting bacteria (24). Where it is a method that does not require much time and is relatively inexpensive and can give a correct and accurate result even when obtaining of the perfect sample is not possible (25).

However, the accuracy of the result obtained from PCR depends on the selection of the appropriate primers as well as the gene that serves the purpose (26).

B-Non-invasive techniques

1-Urea breath Test

This test is the most common, to perform this test, the patient is given a solution containing either ¹³C-urea-labeled or ¹⁴C-urea-labeled isotopes, as the formation of isotopic carbon dioxide in the patient's breath within a few minutes is evidence of infection with the bacteria (27).

This method is sensitive and accurate, but the reliability of its result is affected by several factors, including prior treatment with antimicrobial drugs, however its use is not recommended in children (28).

2- Stool Antigen Assay

It is the latest non-invasive method and is particularly useful for children who are difficult to control for testing, as this test only requires taking their stool. This test is based on detecting antigens secreted by these bacteria in the stool using the enzyme-linked immunosorbent assay. Stool antigen assay has sensitivity with 94% and specificity with 97%, however, this test may give false negative results (29).

3- Serology

Infection with *Helicobacter pylori* leads to a humoral immune response and thus the production of IgM, IgG, and IgA antibodies specific to this bacterium, but tests based on IgG antibodies are more accurate than tests based on IgA antibodies (30).

Antibodies specific to these bacteria can be detected in serum, saliva, or urine, but these tests are time-consuming and some antibodies do not appear until a long period after infection, and some of them remain even after recovery from the infection (31).

Conclusion

Early accurate diagnosis of the pathogen causing the disease is the basic step to get rid of it and recover quickly without any major side effects. Accurate diagnosis is the key to recovery. The reliability of the diagnosis, even if it is accurate, sensitive and qualitative, remains dependent on a number of things, including the skill and experience of the operators and their accuracy in work, and the implementation of the instructions are stipulated by each method when using it, whether those instructions are related to the patient or the related materials to performing that method. However, the molecular method represented by the polymerase chain reaction is the most accurate and reliable for diagnosis.

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