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Diagnostic Tests of Medical Microbiology

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Editorial Note

Diagnostic tests

Identifying an infectious agent for a minor disease can be as simple as a clinical presentation; such as gastrointestinal diseases and skin infections. To make an informed assessment of which microbe could cause the disease, epidemiological factors must be considered; such as the probability of exposure of the patient to the suspected organism and the presence and prevalence of a microbial strain in a community. Diagnosis of an infectious disease almost always begins with the patient's medical history and a physical exam. More detailed identification techniques include microbial culture, microscopy, biochemical testing and genotyping. Other less common techniques, such as X-rays, CT scans, PET scans, or MRI scans, are used to create images of internal abnormalities that result from the growth of an infectious agent.

Microbial culture

Microbiological culture is the main method of isolating infectious diseases for study in the laboratory. Tissue or fluid samples are analyzed for the presence of a specific pathogen, which is determined by growth on a selective or differential medium.

The three main types of media used for testing are:

Solid culture: A solid surface is created with a mixture of nutrients, salts, and agar. A single microbe on an agar plate can then grow into colonies (clones with identical cells) containing thousands of cells. These are mainly used to grow bacteria and fungi.

Liquid culture: The cells are cultured in a liquid medium. Microbial growth is determined by the time it takes for the liquid to form a colloidal suspension. This technique is used to diagnose parasites and detect mycobacteria.

Cell culture: Human or animal cell cultures are infected with the microbe of interest. These cultures are then observed to determine the effect of the microbe on the cells. This technique is used to identify viruses.

Microscopy

Culture techniques often use microscopic examination to help identify the microbe. Instruments such as compound light microscopes can be used to assess critical aspects of the body. This can be done immediately after the sample is taken from the patient and used in conjunction with biochemical staining techniques to allow resolution of cellular features. Electron microscopes and fluorescence microscopes are also used to take a closer look at microbes for research.

Biochemical tests

Rapid and relatively simple biochemical tests can be used to identify infectious agents. The metabolic or enzymatic properties are widely used to identify bacteria due to their ability to ferment carbohydrates in patterns characteristic of their genus and species. Acids, alcohols, and gases are generally detected in these tests when bacteria grow in selective liquid or solid media, as mentioned above. Automated machines are used to perform these mass tests. These machines run multiple biochemical tests at the same time, using multiple well cards that contain various dehydrated chemicals. The microbe of interest reacts with each chemical in a specific way, helping to identify it.

Polymerase chain reaction

Polymerase Chain Reaction (PCR) assays are the most widely used molecular technique for detecting and studying microbes. Compared to other methods, sequencing and analysis are clear, reliable, accurate, and fast. Quantitative PCR is the main technique in use today, as it provides faster data compared to a standard PCR assay. For example, conventional PCR techniques require the use of gel electrophoresis to visualize amplified DNA molecules after the reaction is complete. Quantitative PCR does not require this, as the detection system uses fluorescence and probes to recognize DNA molecules during amplification. Furthermore, quantitative PCR also eliminates the risk of contamination that can arise with standard PCR methods. Another advantage of using PCR to detect and study microbes is that the DNA sequences of newly discovered infectious microbes or strains can be compared with those already in databases, which in turn helps to better understand which organism is causing the infectious disease and therefore what is possible. Treatment methods are used. This technique is the current standard for detecting viral infections such as AIDS and hepatitis.