Progress in the Application of Molecular Biology Testing Techniques in Medical Testing

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Summary: Molecular biology testing technology is an important means of medical testing. Since 2003, this technology has entered various fields of medical testing and has been widely and frequently applied, bringing new support to medical testing. Relying on the advantages of high sensitivity, low misjudgment rate, and high specificity of molecular biology testing technology, the efficiency of medical testing has been greatly improved, and it has become an irreplaceable presence in medical testing. The article focuses on the main technologies in molecular biology testing and provides a detailed discussion on the application of some technologies in medical testing.

Keywords: Molecular biology technology; Medical laboratory; application

Molecular biology is currently receiving great attention, and with the continuous emergence of new technologies, the pattern of medical testing has been reshaped. Specifically, molecular biology is dedicated to the study of biological macromolecules such as nucleic acids and proteins. The development of molecular biology technology is based on nucleic acid sublimation and has been widely applied in medical testing. It mainly conducts rapid testing of trace biomolecules, trace biological samples, and small changes, becoming an important means of disease risk analysis and early diagnosis, So understanding the current application progress of molecular biology testing technology in medical testing has practical significance.

1. The main technologies applied in molecular biology testing

The core of molecular biology technology is polymerase Chain reaction (PCR), which is characterized by the realization of amplification in a short time and the derivation of many technologies, including in situ PCR, LCR, TAS, which has greatly improved the level of testing and has shown extraordinary significance in clinical diagnosis and treatment. The main techniques applied in inspection can be summarized as follows:

One is Polymerase chain reaction (PCR). Also known as polymerase Chain reaction, it is a method of synthesizing specific DNA fragments outside the cells of organisms through enzyme catalysis. The application advantages of this technology are very significant, breaking the deadlock of obtaining rich sample DNA sequences in past scientific research and diagnostic testing. Currently, it is widely used in various fields such as oncology, microbiology, genetics, food testing, etc. In the process of applying this technology, other technologies have also been derived, such as allele specific PCR technology, for genotype identification; PCR - Single-strand conformation polymorphism technology is used to reveal the polymorphism within the product sequence; There are also PCR restriction fragment polymorphism analysis methods to detect mutations at specific enzyme digestion sites, and there are many other such techniques, which greatly enrich the test content.

The second is biochip technology, which is a high-throughput intensive technology. It mainly uses various chips fixed on the chip to complete the detection of a large number of biomolecules. The chip type includes tissue chip, gene chip, etc. The detection includes polymorphism analysis, hybridization sequencing, Gene expression profiling, etc. In reality, it is mainly used for clinical disease diagnosis, epidemic screening and discipline research.

The third is molecular biosensor technology. That is, molecular biosensors that are sensitive to Biogenic substance and convert their concentrations into electrical signals are used for inspection. The identification elements are fixed biomolecules, and the analysis system is composed of signal amplifier devices and appropriate physical and chemical transducers. This device can detect biological macromolecules and small molecules in human body fluids, better diagnose diseases and detect occupational environments, and provide reliable and accurate data. By analyzing the data, specific situations can be understood.

Fourth, DNA sequencing technology. This technology mainly tests clinical disease molecules to obtain more accurate data and determine diseases. This technology has gone through three generations in its development process: the first generation of sequencing focuses on the double deoxygenation end termination method, but its disadvantages are slow speed and high cost; The second generation relies on three major technologies: synthetic sequencing, chip sequencing and Pyrosequencing, which have significant advantages, including low cost, large scale and high throughput; The third-generation sequencing focuses on real-time single-molecule sequencing, with a significant breakthrough in speed.

The fifth is the combination of protein separation and purification technology with genome sequencing technology. It is possible to better develop proteomics and provide precise gene sequence coding frameworks. Research on proteomics mainly focuses on its applications, discovering biomarkers for early diagnosis and detection, deepening understanding of diseases, and promoting the process of drug development. The technology mainly includes antibody engineering, chromatography technology, and protein engineering.

2. The specific application of molecular biology testing technology in medical testing

2.1 Specific Applications of Molecular Biosensors

Molecular biosensors use biotechnology or chemical technology to fix biological recognition elements onto transducers. These elements include animal and plant tissues, receptors, enzymes, cells, microorganisms, etc. After a specific reaction occurs between the tested substance and the biological recognition element, the transducer can convert the generated results into optical signals, electrical signals, etc. These signals can be output and received for detection, completing quantitative and qualitative analysis of the tested substance, The detection task can be easily completed.

Molecular biosensors are widely used, involving the detection of various substances such as small molecule organic compounds and nucleic acids, which can serve as important basis for clinical diagnosis of diseases. Real time monitoring of biosensors in the body will bring more important assistance to surgical patients and intensive care patients.

Skladal et al. used piezoelectric sensors modified with oligonucleotide probes to detect hepatitis C virus (HCV) in serum, and also conducted real-time monitoring of DNA structure transcription and Polymerase chain reaction (PCR) amplification. The monitoring task can be completed in only 10 minutes, and the device can be used for many times.

In the reports of Dro sten and others, the enzyme telegraphy of neurotransmitters is mainly detected. The detection method is that the electrode is placed near the Neuromuscular junction to monitor and record the neurotransmitter glutamate released by the adjacent neurons after Depolarization.

2.2 Specific Applications of Biochip Technology

Biochip technology refers to the analysis of a large number of probes fixed on a support material, usually a point on the support material representing a molecular probe, hybridizing or reacting with labeled samples, and using automated instruments to detect the strength of hybridization or reaction signals, thus obtaining information on the number of target molecules in the sample. This technology is mainly used for disease diagnosis, with the advantages of being fast, accurate, and comprehensive.

In the process of using biochip technology to detect pathogenic bacteria, as most bacterial and viral genomes have been sequenced, a chip will be made representing the specific genes of each microorganism. Reverse transcription detection can be used to detect the specific expression of pathogen genes in the sample, which can infer the patient's infection pathogen, infection process, host response, etc. In addition, P53 tumor suppressor gene mutations occur in most tumors, making it an important tumor diagnostic target gene.

In the study of hepatitis C virus typing in serum samples using biochips, Nam et al. mainly used synthetic oligonucleotide chips. Van Helden et al. facilitated the combination of chemiluminescence immunoassay technology with antibody linked nano magnetic microspheres for the detection of human immunodeficiency virus type I and type II antibodies in serum, and the detection work was successfully completed.

2.3 Specific Applications of Molecular Proteomics

At present, major breakthroughs have been made in the research of molecular proteomics, but some of the existing conclusions are controversial. Some typical tumor markers cannot be reflected in the Proteomics technology represented by SELDI-TOF-MS technology. There may be three reasons: first, the technology itself has limitations, including repeatability and sensitivity. The limitations are also reflected in the equipment's confirmation of each peak protein; Secondly, the experimental design and control group selection were inappropriate, and there is no consensus on whether a certain proteome pattern reflects inflammatory response, tumor specificity, or other factors; Thirdly, it is impossible to explore the comparability of experimental results and differences in sample processing. The above mentioned issues can only be effectively resolved to ensure that SELDI-TOF-MS technology can "expand its capabilities" in the field of medical testing.

2.4 The specific application of technology in clinical practice

Firstly, biological testing of pathogens. This type of testing work mainly utilizes two technologies, PCR and biochip. Compared to traditional technologies such as immunoassay and culture identification, it highlights three advantages: high sensitivity, short duration, and wide application. During the application of PCR technology, specific primers are added to the reaction tube and single or multiple pathogens are identified simultaneously. Even if a large number of dead bacteria have appeared during the testing process, the testing work can still continue without affecting the accuracy of the data and will not be affected by the growth time of mixed samples and microorganisms. The sensitivity and efficiency of biochip technology are outstanding, which can simultaneously detect hundreds of pathogenic microorganisms and quickly identify drug resistance genes in samples, providing important support for doctors to select drugs and patients to receive effective treatment.

Secondly, diagnosis of tumors and genetic diseases. Research has found that both tumors and genetic diseases have certain genetic defects. As long as the binding points between tumors and genes in the human body are found, precise understanding can be obtained through gene level diagnosis. With the help of gene chip, the mutation of the target gene P53 tumor suppressor gene can be determined. Through biosensors, flow cytometry, and molecular Proteomics, tumor specific markers can be diagnosed to determine whether the tested person has cancer. In the field of genetic diseases, molecular biotechnology is used to identify specific polymorphisms of diseased family genes. The applied technologies include Single-strand conformation polymorphism analysis, Fluorescence in situ hybridization chromosome analysis, etc.

Thirdly, diagnosis of immune system diseases. The key point of such diagnosis is to grasp the regulation and expression at the gene level. Taking the detection of HIV as an example, the antibody based molecular biology nanotechnology will use Immunoassay and magnetic modification to detect immune substances. The fluorescent agent, isotope and enzyme will fix the magnetic nanoparticles and antibody antigen to detect the antibodies of human immunodeficiency virus type I and II, which are also mentioned above, Bringing important support

to prevent viral diseases.

3. The Development Prospects of Modern Molecular Biotechnology in Medical Testing

Molecular biological testing is an emerging discipline that has not been applied in medical testing for a long time, and is still the focus of research and a hot topic of exploration. Although molecular biological testing technology is not yet widely known, it has greatly promoted the level of medical testing, which is an undeniable fact. In terms of pure molecular biotechnology, great achievements have been made in two fields, namely, the localization and cloning of pathogenic genes in genetic diseases. The earliest gene cloning can be traced back to 1998, when genetic cloning of hereditary hearing loss was completed; During the outbreak of SARS in 2003, a gene chip for diagnosing the disease emerged, making outstanding contributions to more efficient diagnosis and containment of disease spread; In 2004, multiplex PCR was used to diagnose neonatal Phenylketonuria, Thalassemia and other diseases. In recent years, molecular biological testing technology is more advanced, and it is used in combination with Genetic marker technology. It continues to play an important role in the production of genetic map and Genetic testing of related diseases, and has become an important driving force for the continuous improvement of medical testing level.

It is undeniable that the current molecular biology testing technology still has its shortcomings and operational methods need to be improved, which means that there is still a lot of room for upgrading this technology and there is still a long way to go in terms of promotion. In the future, a large number of theoretical and clinical trials are still needed to continuously improve the standardization, effectiveness, and safety of technology applications, provide richer, more realistic, and more accurate data support for clinical physicians, and become the mainstream technology driving the high-end, intelligent, and automated development of medical testing.

Based on existing theoretical research, modern biological technology has shown two major development trends in the field of medical testing: quantitative PCR and fully automated quantitative PCR. In the future, in vitro gene amplification technologies other than PCR are expected to enter the clinical trial stage, such as transcription amplification system technology and self sequence amplification system technology.

Conclusion

In summary, the application of molecular biology testing technology in medical testing is widely recognized, due to its multiple advantages, including low cost, easy operation, and high accuracy, which can meet the different diagnostic needs of different populations and provide reliable support for clinical physicians in diagnosing and treating diseases. In the future, molecular biology testing technology will continue to be a key focus of attention and development, with the hope of further improving sensitivity, specificity, and accuracy. It has good development prospects and is believed to help continuously improve the level of medical testing.

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