Research on Computer Aided Vaccine Design in the Field of Biomedical Engineering

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Abstract: With the rapid development of modern technology and information technology, the society has fully entered the era of science and technology, which has also made biomedical engineering more and more attention, and in the continuous development process, biomedical engineering is also active Explored a new field, that is, computer-aided vaccine design. The use of computer technology to assist the development of vaccine design can not only further improve the overall efficiency and quality of vaccine design, but also play a vital role in the development of biomedical engineering. effect. Therefore, the article first clarifies the specific background of computer-aided vaccine design; secondly, conducts an in-depth analysis of the research content and methods of computer-aided vaccine design; and finally, describes in detail the significance of computer-aided vaccine design research.

1. Introduction

Biomedical engineering is mainly a frontier subject field that effectively combines biomedicine and modern science and technology. It uses various advanced science and technology and mechanical equipment to optimize the content and scientific research level of biomedical practice, effectively promoting the progress of biomedicine. . At the same time, in the process of biomedical research, we can continue to explore new principles of engineering data information processing to help the development of corresponding scientific and technological fields. It can be seen that the development of biomedical engineering has extremely significant practical significance. Especially in the development process in recent years, computer-aided vaccine design, as a bridge between information engineering and immunology, has become a new development field of biomedical engineering.

2. The Specific Background of Computer-Aided Vaccine Design

As early as 2000, Hamann had put forward the basic concept of using computer technology to assist vaccine design. This concept quickly attracted wide attention within the industry. From a practical point of view, before the concept of “computer-aided vaccine design” was put forward, the research on epitope prediction through computer technology had been going on for more than 20 years, and this period of time was also in biomedicine and modern information technology. A critical period of rapid development. With the continuous in-depth research on molecular immunology and the development and optimization of bioinformatics, the combination and penetration between the two have a greater impact on vaccine research and development. First of all, it has changed from a traditional preventive vaccine to a therapeutic vaccine, and the scope of application of the vaccine has further transitioned from the original infectious disease to the prevention and treatment of allergic diseases, immune diseases and organ transplant diseases; secondly, vaccines From traditional inactivated pathogenic microbial vaccines, it has gradually developed into genetic recombinant vaccines or even epitope vaccines. This also makes vaccine design from the molecular, cellular, or epitope level perspective, and optimization research has become antigen engineering. A brand-new discipline of. Finally, with the improvement of human

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gene technology, it has also made it possible to clarify the basic epitope group of pathogenic proteins and to map the corresponding epitope has also become a key research content. In this social background, computer-assisted vaccines Design has naturally become a new field in biomedical engineering [1].

3. Research Contents and Methods of Computer-Aided Vaccine Design

The core content of current computer-aided vaccine design is epitope theoretical evaluation and theoretical prediction. The epitopes mentioned mainly refer to those conformational structures or linear fragments in the antigen that can be specifically recognized by immune cells, and they are also the most basic unit for triggering an immune response. For example, epitopes are equivalent to words and sentences in an article, which are essential elements that constitute an article. According to the specific degree of epitope specific immune response, the epitopes existing in the antigen can be further divided into recessive epitopes, immunodominant epitopes, and subdominant epitopes. From the perspective of the impact of epitopes on the body From the above point of view, it can be divided into pathogenic epitopes, tolerance epitopes, and protective epitopes; if divided according to the degree of recognition of immune cells, they can be divided into B cell epitopes, helper T cell epitopes, and Toxic T cell epitopes, etc. In the actual process of current computer-aided vaccine design, the focus is on the basic principles and practical applications of B cell epitope and Tc epitope prediction and evaluation.

Most of the prediction methods of B cell epitopes usually use phenomenological theory as the basis, and use the secondary structure and physicochemical properties of protein subsequences to use B cell epitopes to perform calculations. The connectivity between the two is fully predicted. As for the local secondary structure and physical and chemical properties of protein sequences, the specific theoretical calculation results are mostly based on attribute scales, which can be obtained through statistical analysis or experiments. The current computer evaluation and prediction of epitopes have been used in the development and design of epitope vaccines. For the research and development process of some vaccines, it is difficult to fully clone or isolate the complete antigens in the vaccines, and they are complete. The pathogenic microorganisms also have relatively large side effects. Therefore, it is possible to develop subunit vaccines or epitope vaccines, and use epitope prediction to find out the antigen specificity and immune protection as soon as possible, and there are no side effects. Antigen fragments. According to statistical analysis in recent years, among biotechnology drugs, antibody drugs are in the first place, and among the biotechnology that is allowed to enter clinical trials, the first is therapeutic vaccines, and most of these are experienced. Through the process of computer-aided design [2].

4. Significance of Computer Aided Vaccine Design Research

The use of computer technology to assist vaccine design not only has extremely significant scientific significance, but also has critical social and economic significance. For example, in the process of basic research, it should be further determined whether the traditional method used for epitopes is acid elution or overlapping peptide method. The former requires high-performance liquid chromatography and other methods to carry out efficient separation and identification; The main sequence of the antigen can effectively synthesize a large number of overlapping polypeptides, which can be used to carry out more excellent in vivo and in vitro screening and identification. After in-depth research, it can be seen that through the aid of computer technology, the discovery efficiency of new epitopes can be effectively improved, and it can even be increased by about 20 times, and the experimental workload can be reduced by about 90%. To a certain extent, the efficiency of epitope discovery is improved. In the current social environment, human beings are still facing more serious public health problems, which further highlights the importance of computer-assisted vaccine design, which can not only effectively solve various public health problems, but also enhance the problem-solving and overcoming Difficult determination has extremely significant social significance. At the same time, computer-aided vaccine design has also

imperceptibly promoted the rapid development of the biotechnology industry and biomedical engineering, making various commercial activities in the field of computer-aided vaccine design more and more frequent. Many companies have been listed on the market. These all represent Computer-aided vaccine design has great economic significance. Moreover, among traditional vaccines, there are relatively large internal biological safety problems, which will also pose a great threat to the surrounding natural environment. First of all, most traditional vaccines will use some kind of disease-inactivated pathogenic source, which is very likely It will also cause problems such as the spread of diseases. For example, in 1936, the United States injected BCG vaccine into 56 children, but after the injection was completed, most of the children died. This is the Lubeka incident that shocked the world; secondly, part of the traditional vaccine preparation process The medium used can also cause the spread of some diseases. The new vaccines developed through computer-assisted vaccines, which are epitope nucleic acid vaccines or epitope peptide vaccines, can be directly synthesized artificially, which not only avoids the original cultivation process, but also does not contain various pathogens. It will replace the sales and production of traditional vaccines and reduce potential threats to the surrounding environment [3].

5. Conclusion

As a new field of Biomedical Engineering, computer-aided vaccine design has been the focus of the community. It can not only reduce the hidden hazards of traditional vaccines, but also greatly improve the efficiency and quality of vaccine development and design. Therefore, it is necessary to pay more attention to computer-aided vaccine design, so as to lay a solid foundation for the development of biomedical engineering.

References

[1] Biomedical Engineering: creating future in cross[J]. Study, no. 18, pp. 56-57, 2021.

[2] LIU Xin, LIU Xinxin, CHEN Hongxiang. Design and development of vaccine[J].Bulletin of Dermatology, vol. 37, no.04, pp. 340-345+2, 2020.

[3] XIA Han, XIA Tian, ZHANG Cheng, LIU Jiechen, FU Chen. Design and function realization of vaccine traceability management information system[J]. Chinese Journal of health information management, vol. 16, no 05, pp.542-546, 2019.