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Short Communication

Role of Glycoengineered Therapeutic Antibodies in Modern Medicine

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DESCRIPTION

Glycoengineering involves the deliberate alteration or customization of glycan structures, whether on proteins, lipids, or other molecules, to achieve desired functions or properties. Glycoengineering is vital because glycans play significant roles in many biological processes, from cell signaling and recognition to immune responses. By modifying these glycans, scientists and engineers can fine-tune biological interactions and create solutions for various applications in medicine, biotechnology, and beyond. One example of glycoengineering is the development of therapeutic antibodies with optimized glycan profiles [1].

Applications of glycoengineering

Therapeutics: Glycoengineering is critical in the development of glycan-based therapeutics, including monoclonal antibodies and vaccines. By modifying the glycan profiles of these molecules, researchers can enhance their efficacy and reduce side effects [2].

Vaccine development: It plays a role in designing glycan-based vaccines that target specific pathogens or cancer cells.

Diagnostics: Glycoengineering is used in the development of glycan-based diagnostic tools, such as lectins and glycan arrays, for the detection of diseases or biomarkers [3].

Glycoengineered therapeutic antibodies

Monoclonal Antibodies (mAbs) are widely used in the treatment of various diseases, including cancer and autoimmune disorders. The glycan structures attached to the Fc region of these antibodies play a crucial role in their effector functions, such as Antibody-Dependent Cellular Cytotoxicity (ADCC) and Complement-Dependent Cytotoxicity (CDC). By modifying the glycan structures on the Fc region, scientists can enhance the therapeutic effects of these antibodies [4].

For instance, glycoengineering can be used to create antibodies with glycan structures that increase their binding affinity to Fc receptors on immune cells, thus improving their ability to recruit immune responses against cancer cells [5]. Alternatively, modifying the glycans can reduce the potential for undesired immune responses, improving the safety profile of the therapeutic antibody. Through glycoengineering, researchers can fine-tune the glycan profiles of therapeutic antibodies to optimize their efficacy, pharmacokinetics, and safety, ultimately leading to more effective treatments for a range of diseases [6].

Clinical significance of monoclonal antibodies

Cancer therapy: mAbs have revolutionized cancer treatment. Therapeutic mAbs can target cancer cells directly, block signaling pathways that promote tumor growth, and stimulate immune responses against cancer [7]. Examples include trastuzumab (Herceptin) for HER2-positive breast cancer and rituximab (Rituxan) for certain lymphomas.

Autoimmune diseases: mAbs are used to treat autoimmune disorders like rheumatoid arthritis, Crohn's disease, and multiple sclerosis. These antibodies can suppress the immune response and reduce inflammation. Infliximab (Remicade) is an example used in rheumatoid arthritis and inflammatory bowel disease [8].

Infectious diseases: Monoclonal antibodies can be developed to target infectious agents such as viruses or bacteria.

Immunotherapies: Immune checkpoint inhibitors, which are a type of mAb, have transformed the treatment of certain cancers like melanoma, lung cancer, and kidney cancer [9]. Pembrolizumab (Keytruda) and nivolumab (Opdivo) are examples of immune checkpoint inhibitors.

Transplantation: mAbs are used to prevent organ rejection in transplant recipients. Agents like basiliximab (Simulect) and rituximab help suppress the immune response, reducing the risk of graft rejection [10].

CONCLUSION

In summary, glycoengineering is an interdisciplinary field that harnesses the power of glycobiology to manipulate and customize glycans for a wide range of applications, from drug development to regenerative medicine. It has the potential to revolutionize the way we diagnose, treat, and engineer biological systems. Monoclonal antibodies are versatile tools that are

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integral to various aspects of glycobiology. They are used for glycoprotein characterization, glycan profiling, glycan modification studies, and have a significant impact on therapeutic development and diagnostics in the field of glycobiology. The development and ongoing research in monoclonal antibodies continue to expand their clinical utility, for treating various diseases and improving patient outcomes.

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