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EDITORIAL

Advances by Scientists in Health: Monoclonal Antibodies

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Dear readers:

Monoclonal antibodies (mAbs) constitute one of the most important advances in modern biotechnological medicine, allowing specific and personalized therapies for complex diseases, particularly in oncology, autoimmune, and infectious diseases. Since their discovery in the 1970s by Köhler and Milstein, their evolution has been meteoric, integrating innovations in molecular engineering, bioprocesses, and clinical applications.

These, monoclonal antibodies (mAbs), are proteins produced in the laboratory that mimic the ability of the immune system to recognize and bind specifically to a single antigen, which can be a molecule on the surface of a cell, such as cancer cells. They were first developed in 1975 using the hybridoma technique, which involves fusing antibody-producing B cells with myeloma cells to obtain immortal cell clones that produce identical antibodies.

The therapeutic use of mAbs is based on their high specificity for target antigens, reducing adverse effects and increasing clinical efficacy. The development of recombinant techniques and industrial-scale production have boosted their global access.

Their importance lies in the high specificity and affinity they present, which differentiates them from polyclonal antibodies and allows the design of targeted therapies with minimal systemic side effects. Monoclonal antibodies have revolutionized the treatment of various diseases, especially cancer, autoimmune diseases, and infections, with examples such as trastuzumab (HER2 in breast cancer) or rituximab (CD20 in lymphomas).(1)

In Cuba, biotechnology has been a strategic pillar, consolidating itself as a priority sector in the national scientific-health system. The Center for Immunology and Biological Products (CIPB) of the University of Medical Sciences of Camagüey stands out, which since the 1990s has led the research and production of monoclonal antibodies, translating science into public health.(2)

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In our country, the production and development of monoclonal antibodies is a strategic priority and an achievement of technological sovereignty in medical biotechnology. The Center for Immunology and Biological Products, together with other institutions, have developed humanized antibodies of recognized efficacy and safety. Nimotuzumab is a Cuban humanized monoclonal antibody that targets the epidermal growth factor receptor (EGFR) and is used in therapeutic protocols for various solid tumors, with positive results and less toxicity compared to international alternatives.

Among the most notable Cuban mAbs is nimotuzumab, a humanized antibody directed against the epidermal growth factor receptor (EGFR). Nimotuzumab has been incorporated into the standard treatment in Cuba for various neoplasms, including pediatric gliomas and advanced head and neck carcinomas, demonstrating clinical efficacy and a favorable safety profile in combination with radiotherapy. This development has positioned Cuba as a benchmark in Latin America for pharmaceutical autonomy and therapeutic equity in biomedicine.[3]

The advantages inherent to mAbs include their high specificity and selectivity, which reduces systemic toxicity and improves quality of life. In addition, advanced engineering has enabled bispecific antibodies and antibody-drug conjugates (ADCs), which expand therapeutic indications.

Another of its benefits lies in its ability to modulate the immunological response, mark cells for destruction, block tumor proliferation signals, or activate innate and adaptive mechanisms. Emerging technologies such as bispecific antibodies and antibody-drug conjugates (ADCs) expand their applications and efficacy.

Regarding future perspectives, exponential growth is expected with more than a thousand candidates in clinical development and improvements in production, stability, and delivery. Nanotechnology, artificial intelligence, and synthetic biology will be key to designing more potent and personalized antibodies.[4]

According to the Global Market Insights report, in 2022 in the global market, work with monoclonal antibodies was valued at 186.6 billion dollars, projecting that by 2032 it will reach 609 billion, with a compound annual growth rate of 12,5 %. In turn, nanotechnology and artificial intelligence are called upon to enhance strategies to improve the delivery, stability, and immunological function of mAbs, opening new therapeutic frontiers.[5]

Regarding Cuba, recent advances include the consolidation of the monoclonal antibody production plant in Camagüey, with a production capacity multiplied 10 times and support for the continuous development of innovative therapies. Its integration into health protocols and international cooperation broaden access to these technologies in resource-limited environments, reaffirming its universal public health model.

Monoclonal antibodies represent a fundamental pillar in modern medicine, with Cuba positioning itself as a benchmark in its production and clinical application, which strengthens public health and biosanitary innovation in the region. For the Cuban and Latin American medical community, these achievements represent a milestone of scientific progress and a commitment to equitable health, highlighting the importance of maintaining basic and applied research, specialized training, and technological development.

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