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Advances and therapeutic strategies in allergy management

Avanços e estratégias terapêuticas no manejo de alergias

Avances y estrategias terapéuticas en el manejo de las alergias

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ABSTRACT

Objective: Analyze advances and therapeutic strategies applied to the management of allergies. **Literature review:** Hypersensitivity reactions, immunological responses triggered after exposure to specific antigens, have been better understood thanks to advances in cellular and molecular biology and in the immunology of allergies. In recent years, the understanding of the immunological mechanisms underlying allergies has advanced significantly, enabling the development of innovative therapeutic approaches. Allergies, characterized by exacerbated responses to generally harmless substances such as pollen, food and dust mites, affect millions of people worldwide, impacting quality of life and overloading health systems. Advances include venom immunotherapy for allergies to insect stings, the development of specific vaccines for food hypersensitivities and future therapeutic strategies. Diagnoses, such as allergic rhinitis, are based on clinical histories related to exposure to the allergen, and biomedical professionals play an essential role in these processes, qualified to perform biological sample collections and specialized diagnostic procedures, as regulated by the Regional Council of Biomedicine. **Final considerations:** Advances in immunology have shown great potential in the treatment of hypersensitivities. In this context, biomedical professionals play a crucial role in the development of research aimed at creating new technologies, promoting the evolution of biomedicine and immunology. This evolution not only broadens the understanding of the mechanisms underlying diseases, but also opens new therapeutic frontiers, directly benefiting patients' quality of life.

Keywords: Hypersensitivity, Allergic reactions, Immunoglobulins, Immunotherapy, Biomedicine, Gene therapy.

RESUMO

Objetivo: Analisar os avanços e estratégias terapêuticas aplicadas ao manejo de alergias. **Revisão bibliográfica:** As reações de hipersensibilidade, respostas imunológicas desencadeadas após a exposição a antígenos específicos, têm sido melhor compreendidas graças aos avanços nas biologias celular e molecular e na imunologia das alergias. Nos últimos anos, a compreensão dos mecanismos imunológicos subjacentes às alergias avançou significativamente, possibilitando o desenvolvimento de abordagens terapêuticas inovadoras. As alergias, caracterizadas por respostas exacerbadas a substâncias geralmente inofensivas, como pólen, alimentos e ácaros, afetam milhões de pessoas em todo o mundo, impactando a qualidade de vida e sobrecarregando os sistemas de saúde. Entre os avanços, destacam-se a imunoterapia com veneno para alergias a picadas de insetos, o desenvolvimento de vacinas específicas para hipersensibilidades alimentares e estratégias terapêuticas futuras. Diagnósticos, como no caso da rinite alérgica, baseiam-se em históricos clínicos relacionados à exposição ao alérgeno, e o biomédico desempenha um papel essencial

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nesses processos, habilitado a realizar coletas de amostras biológicas e procedimentos diagnósticos especializados, conforme regulamentado pelo Conselho Regional de Biomedicina. **Considerações finais:** Os avanços na imunologia têm evidenciado um grande potencial no tratamento de hipersensibilidades. Nesse contexto, o biomédico desempenha um papel crucial no desenvolvimento de pesquisas voltadas para a criação de novas tecnologias, promovendo a evolução da biomedicina e da imunologia. Essa evolução não apenas amplia a compreensão dos mecanismos subjacentes às doenças, como também abre novas fronteiras terapêuticas, beneficiando diretamente a qualidade de vida dos pacientes.

Palavras-chave: Hipersensibilidade, Reações alérgicas, Imunoglobulinas, Imunoterapia, Biomedicina, Terapia genética.

RESUMEN

Objetivo: Analizar los avances y estrategias terapéuticas aplicadas al manejo de la alergia. **Revisión de la literatura:** Las reacciones de hipersensibilidad, respuestas inmunológicas desencadenadas tras la exposición a antígenos específicos, se han comprendido mejor gracias a los avances en la biología celular y molecular y en la inmunología de las alergias. En los últimos años, la comprensión de los mecanismos inmunológicos subyacentes a las alergias ha avanzado significativamente, lo que ha permitido el desarrollo de enfoques terapéuticos innovadores. Las alergias, caracterizadas por respuestas exacerbadas a sustancias generalmente inofensivas como el polen, los alimentos y los ácaros del polvo, afectan a millones de personas en todo el mundo, repercutiendo en la calidad de vida y suponiendo una carga para los sistemas de salud. Los avances incluyen la inmunoterapia con veneno para las alergias a las picaduras de insectos, el desarrollo de vacunas específicas para las hipersensibilidades alimentarias y futuras estrategias terapéuticas. Los diagnósticos, como en el caso de la rinitis alérgica, se basan en historias clínicas relacionadas con la exposición al alérgeno, y el profesional biomédico juega un papel esencial en estos procesos, capacitado para realizar colectas de muestras biológicas y procedimientos diagnósticos especializados, tal como lo regula el Consejo Regional de Biomedicina. **Consideraciones finales:** Los avances en inmunología han demostrado un gran potencial en el tratamiento de las hipersensibilidades. En este contexto, los científicos biomédicos juegan un papel crucial en el desarrollo de investigaciones orientadas a la creación de nuevas tecnologías, impulsando la evolución de la biomedicina y la inmunología. Esta evolución no sólo amplía nuestra comprensión de los mecanismos subyacentes a las enfermedades, sino que también abre nuevas fronteras terapéuticas, beneficiando directamente la calidad de vida de los pacientes.

Palabras clave: Hipersensibilidad, Reacciones alérgicas, Inmunoglobulinas, Inmunoterapia, Biomedicina, Terapia génica.

INTRODUCTION

Hypersensitivity reactions, commonly known as allergies, consist of an exacerbated immune response triggered after exposure to a specific antigen, called an allergen. According to Correa JMM and Zuliani A (2001), this immune response results in an inflammatory reaction that can vary in intensity and location. In severe cases, such as anaphylaxis, a potentially fatal systemic reaction occurs. In localized forms, the manifestations may be restricted to specific areas, such as the respiratory tract, causing symptoms such as bronchoconstriction and increased mucous secretion. These reactions are subdivided into four main types (I to IV) according to the immune mechanism involved and are essential for the understanding and appropriate clinical management of allergic conditions and associated diseases (DISPENZA MC, 2019).

The authors Correa JMM and Zuliani A (2001) describe IgE-mediated allergic hypersensitivity reactions in response to insect bites, which can cause lymphangitic streaks. These manifestations differ from cellulitis due to their lower intensity and the absence of systemic symptoms. Furthermore, patients with a history of extensive local reactions have a reduced risk of developing severe systemic reactions (SR), less than 10%, and the risk of severe anaphylaxis is even lower, estimated at less than 3%.

In Brazil, anaphylaxis does not represent a significant cause of mortality in proportional terms. However, in the United States, approximately 5% of the population reported episodes of this condition, although less than

1% of cases evolved to death (TURNER PJ, et al., 2017). In countries such as Australia, the death rate attributed to non-food anaphylaxis was 11 per 1000 cases, while in Denmark, mortality from anaphylactic shock within a 30-day period of hospitalization was less than 1%.

Among the most common causes of fatal anaphylaxis in several countries are medications, as pointed out by Solé D, et al. (2018). This scenario emphasizes the need for advances in the clinical and preventive management of anaphylaxis. In this context, advances in molecular and cellular biology have driven the development of innovative therapies. One promising approach is the use of monoclonal antibodies, which offer a more targeted, effective treatment adapted to the individual characteristics of the patient, contributing to the reduction of associated morbidity and mortality rates. Malik B and Ghatol A (2024) argue that monoclonal antibodies (mAbs) are an excellent example of personalized therapeutics made possible by advances in our knowledge of immunology, molecular biology, and biochemistry. The authors highlight that the mechanisms of action related to monoclonal antibodies (mAbs) involve direct cellular toxicity, immune-mediated cellular toxicity, vascular disruption and modulation of the immune system. The evolution of this therapeutic class has positioned mAbs at the forefront of highly individualized interventions for various types of cancer and autoimmune diseases, contributing to a more effective and safe approach by minimizing the adverse systemic effects often associated with conventional treatments.

Advances in immunological practices have opened new perspectives for more effective and personalized treatments. Abrams EM and Golden DBK (2020) demonstrated that Hymenoptera Venom Immunotherapy (VIT) is highly effective, significantly reducing the risk of future systemic reactions in individuals predisposed to anaphylaxis caused by insect bites. In addition, innovative technologies such as gene therapy are gaining prominence. Yang L and Kulis M (2019) described ARA-LAMP-Vax, a single-plasmid, multivalent lysosomal membrane-based (LAMP) DNA vaccine encoding peanut allergenic proteins (Ara h1, h2, h3), representing a promising advance in the treatment of allergic disorders such as peanut hypersensitivity.

Han X, et al. (2020) points out that research into the molecular and cellular foundations of basic and clinical immunology has provided significant advances in the understanding of allergic disorders. These advances have enabled scientists and clinicians to more accurately diagnose and treat conditions such as asthma, allergic and non-allergic rhinitis, as well as food allergies, contributing to more effective and personalized therapies.

Despite significant advances in the field of immunology, substantial challenges remain, such as the need for more effective treatments and the continued implementation of therapeutic innovations. In this sense, the analysis and development of new approaches are essential to overcome these obstacles and offer superior therapeutic solutions for allergic conditions. This review aimed to explore recent advances in immunology and promising therapeutic strategies in the management of allergies. The focus was on the analysis of emerging technologies applied to treatment, highlighting the relevance of immunomodulatory therapies, advances in allergen-specific immunotherapy and the impact of cutting-edge biotechnologies. Innovations analyzed include allergy vaccines, gene editing tools and monoclonal antibody-based therapies, all aimed at increasing the efficacy and safety of treatments offered to allergic patients.

LITERATURE REVIEW

Non-IgE-mediated allergic reactions usually do not manifest immediately and are predominantly characterized as cell-mediated hypersensitivity, according to Solé D, et al. (2018). Although this type of reaction involves the participation of T lymphocytes, many of the underlying mechanisms still require further investigation for a more comprehensive understanding. The same authors highlight different manifestations of cell-mediated food allergies. These manifestations often vary in severity and time of onset, highlighting the need for careful diagnosis and appropriate therapeutic strategies to manage such conditions.

The clinical manifestations of hypersensitivity, according to Solé D, et al. (2018), can be classified based on the underlying immunological mechanisms as IgE-mediated, IgE- and cell-mediated, and non-IgE-mediated. These manifestations affect different organic systems and are present in different ways. In the

cutaneous system, IgE-mediated reactions include urticaria, angioedema, erythema morbilliformis, and bullous lesions. In IgE- and cell-mediated reactions, atopic dermatitis is observed, while in non-IgE-mediated reactions, dermatitis herpetiformis and contact dermatitis occur. In the respiratory system, IgE-mediated reactions include allergic rhinoconjunctivitis and acute bronchospasm. In IgE- and cell-mediated manifestations, asthma stands out, while food-induced hemosiderosis (Heiner syndrome) is associated with non-IgE-mediated reactions. Manifestations in the gastrointestinal system also vary. In IgE-mediated reactions, oral allergy syndrome and acute intestinal spasms have been reported. IgE- and cell-mediated reactions include eosinophilic esophagitis, eosinophilic gastritis, and eosinophilic gastroenteritis. Non-IgE-mediated reactions include food protein-induced enterocolitis syndrome (FPIES), food protein-induced proctocolitis syndrome (FPIPS), and food protein-induced enteropathy. In the cardiovascular system, dizziness and fainting are associated with IgE-mediated reactions. Among the miscellaneous manifestations, IgE-mediated reactions include uterine cramps, contractions, and the sensation of "impending doom." Finally, systemic manifestations include anaphylaxis, exercise-induced anaphylaxis, and food-dependent anaphylaxis, all associated with IgE-mediated reactions. These findings highlight the diversity of immune responses and the need for diagnostic and therapeutic strategies specific to each underlying mechanism.

Food allergy is currently considered a relevant public health problem due to the abnormal immune response triggered after consumption or interaction with certain foods, as pointed out by Solé D, et al. (2018). According to the same authors, food hypersensitivity reactions are classified based on the immunological mechanisms involved, and may be IgE-mediated, non-IgE-mediated, or present a combination of both mechanisms. This differentiation is essential for accurate diagnosis and for the development of effective therapeutic strategies. In 2001, Correa JMM and Zuliani A (2001) highlighted that allergic manifestations can occur in the first 12 months of life. The authors pointed out that episodes during the prenatal period, such as exposure to allergens or other substances, have the potential to cause changes in the development and maturation of the immune system.

In recent years, significant advances in understanding the immunological mechanisms underlying allergies have driven the development of new therapeutic approaches. Allergies, characterized by exacerbated immune responses to normally harmless antigens such as pollen, food and dust mites, affect millions of people globally, negatively impacting quality of life and generating a significant burden on health systems. According to the same authors, recent discoveries in the field of allergy immunology offer a promising basis for the discussion and implementation of current and future therapeutic strategies, including advanced immunotherapies and innovative immunomodulatory interventions (Han X, et al., 2020).

Fundamentals of immunology related to allergies

IgE-dependent hypersensitivity to allergens, according to Kucuksezer UC, et al. (2020), begins when an allergen is captured by antigen-presenting cells (APCs) present in tissues such as the skin, respiratory tract, or gastrointestinal mucosa. After capture, the allergen is processed into peptides by APCs during their migration to the lymph nodes. In the lymph nodes, these peptides are presented to CD4+ T cells, promoting the activation of a Th2 profile. This process is characterized by the predominance of IL-4, which is essential for the differentiation of T cells into Th2 cells, and the subsequent production of cytokines associated with IgE-mediated allergic reactions.

According to the mechanism of immunological hypersensitivity immunological reactions are classified into four groups, with type 1 being known as an anaphylactic reaction. These reactions occur rapidly, usually between 2 and 30 minutes after re-exposure to the same antigen. They are characterized by their systemic nature, which can result in severe manifestations, such as anaphylactic shock and dyspnea. These conditions represent a medical emergency because, if not treated quickly, they can be fatal (MOGA A, 2020).

Type 1 hypersensitivity reactions include examples such as local reactions that cause skin erythema and allergic asthma, characterized by a rapid IgE-mediated response. Type 2 hypersensitivity reactions (cytotoxic reactions), as described by Moga A (2020), involve the activation of the complement system triggered by the interaction of the antigen-antibody complex on the surface of target cells. This activation results in the

destruction of these cells, mediated not only by the complement system, but also by immune cells such as macrophages, lymphocytes and T cells, which can contribute to cell lysis or phagocytosis. According to the authors, examples of hypersensitivity reactions include reactions to blood transfusions and rejection of transplanted tissues. In addition, type III reactions (immune complex reactions) involve antibodies that react against antigens circulating in the serum. This interaction results in the formation of antigen-antibody complexes, predominantly composed of IgG immunoglobulins. These complexes can be deposited in different tissues of the body, activating the complement system. This process can lead to the destruction of antigen-antibody complexes, but it can also cause damage to surrounding tissues due to inflammation and recruitment of immune cells (MOGA A, 2020).

Alkhatib EH, et al. (2023) investigated cases of insulin hypersensitivity reactions in young individuals diagnosed with type 1 diabetes (T1D). The study concluded that these reactions include types I, III, and IV hypersensitivity, presenting varied clinical manifestations. Symptoms observed include localized urticaria, erythematous nodules, eczematous plaques, and, in more severe cases, anaphylaxis accompanied by respiratory distress. These reactions highlight the immunological complexity associated with the therapeutic management of T1D and the need for appropriate monitoring and treatment strategies. Although rare, insulin hypersensitivity reactions negatively affect glycemic control and quality of life.

Usman N and Annamaraju P (2024) state that a hypersensitivity reaction is an inappropriate or exaggerated immune response to an antigen, resulting in undesirable effects. Symptoms usually arise in individuals who have previously been exposed to the antigen. The main characteristic that distinguishes type III reactions from other hypersensitivity reactions is that, in type III reactions, antigen-antibody complexes are performed in the circulation before being deposited in the tissues, which can lead to localized damage and activation of the complement system, promoting inflammation and tissue injury.

Epidemiology of allergies

The studies by Feng H, et al. (2023) on the prevalence of food allergy (FA) between 2011 and 2021 revealed relevant data on the global distribution of the condition. According to the pooled effect estimates and their confidence value, the prevalence of food allergy varied between continents, being 4.3% in Asia, 3.2% in the Americas, 4.8% in Europe, 1.6% in Africa and 7.5% in Oceania. Among the foods most associated with allergic reactions, milk and eggs stood out. These results highlight the importance of awareness and prevention of food allergies, especially considering the variability of prevalence rates in different regions of the world.

Research conducted by authors Gutowska-Ślesik J, et al. (2023) showed a significant increase in the prevalence of allergic rhinitis in industrialized countries over the past decades. The prevalence increased from 0.29% in 1966 to 3.44% in 2001 and reached 5.19% in 2017. This substantial increase can be attributed to several factors, such as urbanization, changes in environmental patterns, and exposure to pollutants and allergens in indoor and outdoor environments. This data highlights the growing importance of prevention and treatment strategies to control respiratory allergies, especially in more industrialized societies. In the studies of the same authors also revealed a notable increase in the rates of atopic dermatitis in men, with an increase from 0.15% in 1926 to 2.90% in 2017. Although this condition is typically associated with childhood, it can persist into adulthood in some cases, being diagnosed in older individuals. In addition, according to the authors Frei R, et al. (2022), the environment in which a child grows up plays an important role in the development of allergies and asthma. Children who grow up in rural environments are less likely to develop these conditions, probably due to earlier exposure to various environmental factors. This early exposure, together with adequate nutrition, influences the development of the intestinal microbiome, which in turn can regulate immune homeostasis and protect against the formation of allergic responses. These findings reinforce the importance of environment and diet in the development of allergic diseases.

Susceptibility to allergies is, in fact, mediated by epigenetic mechanisms, such as DNA methylation and histone alterations. These mechanisms play a crucial role in the regulation of gene expression, affecting the function of immune cells, such as T lymphocytes and specific effector cells, which are responsible for the allergic response. DNA methylation can silence or activate certain genes, while histone alterations can modify

the chromatin structure, making genes accessible for transcription. According to Potaczek DP, et al. (2021), these regulatory processes are fundamental for the modulation of the immune response in specific allergy sites, such as the respiratory tract, skin and gastrointestinal tract, influencing the development and severity of allergic reactions.

Advances in molecular and cellular understanding

Allergen-specific therapies face several limitations, such as high costs, long treatment periods, and the possibility of not achieving persistent desensitization. To overcome these restrictions, Han X, et al. (2020) proposed the use of monoclonal antibodies, which offer effective alternatives for the treatment of food allergies. Among these, Dupilumab (Dupixent®) stands out, a monoclonal antibody that acts by blocking interleukins 4 (IL-4) and 13 (IL-13) by binding to the IL-4Rα receptor.

When these interleukins bind to the receptor, they trigger cellular signals that lead to gene-mediated inflammatory processes, causing allergic symptoms such as asthma and atopic dermatitis. Dupilumab prevents this binding, interrupting the signaling cascade responsible for inflammation. In this way, the drug reduces the allergic response and symptoms, offering an innovative and targeted approach to the management of allergic and inflammatory conditions (HAN X, et al., 2020).

Biomarkers play a key role in detecting the presence and severity of diseases, as well as assessing their responses to treatments. In allergic rhinitis (AR), several mediators can act as promising biomarkers. For example, increased expression of periostin, a protein associated with inflammation, has been investigated as a possible biomarker in development for allergic diseases, given its relationship with inflammatory processes (BREITENEDER H, et al., 2020).

In addition, studies demonstrate that epigenetic mechanisms, such as changes in the nasal epigenome, can also identify individuals with AR. The literature suggests that the nasal epigenome associated with asthma can be used as a biomarker not only for asthma, but also for other airway allergies. This epigenetic approach offers an innovative perspective for the diagnosis and monitoring of these conditions, enabling significant advances in personalized medicine (BREITENEDER H, et al., 2020).

Diagnosis of allergies and the role of the biomedical professional

The diagnosis of allergic diseases, such as allergic rhinitis, is based on a detailed clinical history of symptoms, often associated with exposure to the causative allergen. In addition, laboratory tests and specific diagnostic procedures are important tools for confirming the presence of sensitization and allergies.

As established by the Regional Council of Biomedicine through Resolution CFBM No. 78/02 (CFBM, 2002), biomedical professionals are competent to work in activities involving diagnostic support procedures, including collecting biological samples for various tests. Among the qualifications of biomedical professionals, immunology stands out, enabling them to contribute significantly to the diagnosis of allergic diseases through immunological tests, such as specific IgE dosages, skin tests and molecular analyses, increasing the accuracy and efficiency in identifying allergic conditions.

Skin prick testing (SPT) is widely used to identify specific allergies (GURECZNY T, et al., 2023). This procedure involves applying different allergens, along with positive (histamine drop) and negative (glycerin drop) controls, to the surface of the arm or upper back. The skin is lightly punctured with a lancet to allow penetration of the allergen. An allergic reaction to the tested allergen manifests as redness and elevation in the area of application, the size of which can be used to assess the patient's degree of sensitivity. Although SPT is a useful tool in the diagnosis of allergies, studies, such as that of Klangkalya N, et al. (2023), reveal that up to 40% of patients with positive results do not present allergic symptoms to the allergen tested, indicating the need for clinical correlation for an accurate diagnosis. According to CFM Resolution No. 2,145/2016 (CFBM, 2016), the SPT must be performed by doctors qualified in allergology, who are able to adequately interpret the results and consider other complementary approaches in the diagnosis of allergic diseases.

Specific IgE measurement, often performed in clinical laboratories by professionals such as biomedical scientists, is an essential method for diagnosing allergies. The detection of specific IgE for allergens associated

with conditions such as allergic rhinitis, asthma, and atopic dermatitis was performed using the ImmunoCAP test, a widely recognized diagnostic system. The results were interpreted based on a cutoff point; specific IgE levels greater than 0.35 kUa/L were considered positive, confirming the individual's hypersensitivity to the allergen tested. This method provides high sensitivity and specificity, aiding in the identification of specific allergens and in the personalized management of patients with allergies (KLANGKALYA N, et al., 2023).

Molecular allergology has introduced significant advances in diagnostic methodologies, including the development of chip-based microarray assays to measure specific IgE (DRAMBURG S, et al., 2023). A notable example is the ISAC (Immuno Solid-phase Allergen Chip) test, which uses a microarray composed of 112 allergen components. This method has been evaluated in patients with nut hypersensitivity, providing insights into the individual allergen profile. However, in terms of efficiency, the ImmunoCAP test has demonstrated greater accuracy in identifying allergic individuals when compared to ISAC and skin prick tests. Chip-based tests such as ISAC have limitations, including lower sensitivity compared to singleplex automated analyzers (biological markers for specific IgE) and semi-quantitative results. In addition, these tests have fixed allergen panels, which restricts their ability to include the full range of allergens relevant for a comprehensive diagnosis. These characteristics make ISAC less versatile for certain clinical scenarios (HAMILTON RG, et al., 2020).

Future perspectives in immunology and allergy treatment

Genetic engineering has emerged as a promising tool for modulating gene expression in a variety of clinical settings. According to Sharma G, et al. (2021), CRISPR-associated protein 9 (Cas9)-based technology represents a significant advance in genome editing. This technique uses an RNA-guided endonuclease (sgRNA), which is derived from the natural immune system of microorganisms, allowing precise genome editing. The method is known for its low cost and flexibility of application at different scales, thanks to its adaptability. The interaction between the sgRNA and the Cas9 protein forms a ribonucleoprotein complex that binds to the target DNA. After this binding, the Cas9 enzyme performs double-stranded nicks at the designated DNA site. This process allows the introduction of alterations such as insertions, deletions, or inversions, which are subsequently repaired by the patient's own DNA repair system.

This innovative approach demonstrates considerable potential in the treatment of human diseases, including allergies. The ability to delete allergen-specific genes opens new perspectives for the management of conditions such as allergic rhinitis and food allergies. Although still an early-stage therapy, the potential of CRISPR-Cas9 technology to transform current therapeutic approaches is undeniable, offering a highly targeted and effective alternative to address allergic reactions and other immunological conditions (BRACKETT NF, et al., 2022).

FINAL CONSIDERATIONS

Emerging gene therapy technologies have the potential to revolutionize medicine, offering new perspectives for the treatment of genetic and acquired diseases. This study, based on a comprehensive review of the scientific literature, highlighted gene therapy as an innovative approach in the field of health, capable of correcting or replacing defective genes, bringing significant benefits to society. In the field of gene editing, advances such as CRISPR-Cas9 technology, together with therapies based on monoclonal antibodies, have paved promising paths for the management of allergic conditions, providing more effective and personalized treatments. These strategies have the potential to transform paradigms in disease care, promoting precision therapeutic approaches. In this context, biomedical professionals play a crucial role, not only by offering advice that ensures the safety and efficacy of these new approaches, but also by leading research for the implementation and improvement of these technologies. Interdisciplinary collaboration between biomedical professionals and other health professionals is essential for the ethical and efficient application of these innovations. Furthermore, it is imperative to ensure the dissemination of accessible and high-quality scientific information, to enable the scientific community and health professionals to use these advances responsibly and effectively, contributing to the continuous evolution of medicine.

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REFERENCES

1. ABRAMS EM, GOLDEN DB.K. Approach to Patients with Stinging Insect Allergy. Medical Clinics of North America, 2020; 104(1): 129-143.
2. ALKHATIB EH, et al. Case Report: Insulin hypersensitivity in youth with type 1 diabetes. Frontiers in Endocrinology, 2023; 14.
3. BRACKETT NF, et al. New Frontiers: Precise Editing of Allergen Genes Using CRISPR. Frontiers in Allergy, 2022; 2.
4. BREITENEDER H, et al. Biomarkers for diagnosis and prediction of therapy responses in allergic diseases and asthma. Allergy, 2020; 75(12): 3039-3068.
5. CFBM. RESOLUÇÃO do CFBM Nº 78/2002, 2002. Disponível em: https://cfbm.gov.br/wp-content/uploads/2021/12/RESOLUCAO-CFBM-No-78-DE-29-DE-ABRIL-DE-2002.pdf. Acessado em: 19 de dezembro de 2024.
6. CFBM. RESOLUÇÃO do CFBM Nº 2.145/2016, 2016. Disponível em: https://portal.cfm.org.br/wp-content/uploads/2020/09/2145_2016.pdf. Acessado em: 19 de dezembro de 2024.
7. CORREA JMM, ZULIANI A. Imunidade relacionada à resposta alérgica no início da vida. Jornal de Pediatria, 2001; 77(6).
8. DISPENZA MC. Classification of hypersensitivity reactions. Allergy and Asthma Proceedings, 2019; 40(6): 470-473.
9. DRAMBURG S, et al. Molecular Allergology User's Guide 2.0. Pediatric Allergy and Immunology, 2023; 34(S28).
10. FENG H, et al. Prevalence and Influencing Factors of Food Allergy in Global Context: A Meta-Analysis. International Archives of Allergy and Immunology, 2023; 184(4): 320-352.
11. FREI R, et al. Environmental influences on childhood allergies and asthma — The Farm effect. Pediatric Allergy and Immunology, 2022; 33(6).
12. GURECZNY T, et al. Allergy screening with extract-based skin prick tests demonstrates higher sensitivity over in vitro molecular allergy testing. Clinical and Translational Allergy, 2023; 13(2).
13. GUTOWSKA-ŚLESIK J, et al. The increase in allergic conditions based on a review of literature. Advances in Dermatology and Allergology, 2023; 40(1): 1-7.
14. HAMILTON RG, et al. Advances in IgE Testing for Diagnosis of Allergic Disease. The Journal of Allergy and Clinical Immunology: In Practice, 2020; 8(8): 2495-2504.
15. HAN X, et al. Advances and novel developments in mechanisms of allergic inflammation. Allergy, 2020; 75(12): 3100-3111.
16. KLANGKALYA N, et al. Skin prick test and serum specific IgE in predicting dust mite-induced allergic rhinitis diagnosed from nasal provocation test in chronic rhinitis children. Asian Pacific journal of allergy and immunology, 2023.
17. KUCUKSEZER UC, Mechanisms of allergen-specific immunotherapy and allergen tolerance. Allergology International, 2020; 69(4): 549-560.
18. MALIK B, GHATOL A. Understanding How Monoclonal Antibodies Work, 2024.
19. MOGA A. The Reaction and Type of Hypersensitivity. Journal Wetenskap Health, 2020. 1(1):21-25.
20. POTACZEK DP. et al. Epigenetic Mechanisms in Allergy Development and Prevention. 2021:331-357.
21. SHARMA G, et al. CRISPR-Cas9: A Preclinical and Clinical Perspective for the Treatment of Human Diseases. Molecular Therapy, 2021; 29(2): 571-586.
22. SOLÉ D, et al. Consenso Brasileiro sobre Alergia Alimentar: 2018 - Parte 1 - Etiopatogenia, clínica e diagnóstico. Documento conjunto elaborado pela Sociedade Brasileira de Pediatria e Associação Brasileira de Alergia e Imunologia. Arquivos de Asma, Alergia e Imunologia, 2018; 2,(1).
23. TURNER PJ, et al. Fatal Anaphylaxis: Mortality Rate and Risk Factors. The Journal of Allergy and Clinical Immunology: In Practice, 2017; 5(5): 1169-1178.
24. USMAN N, ANNAMARAJU P. Type III Hypersensitivity Reaction. 20224.
25. YANG L, KULIS M. Hypoallergenic Proteins for the Treatment of Food Allergy. Current Allergy and Asthma Reports, 2019; 19(2):15. 19634.