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Allergic Management Strategies: An Update of the Literature

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Abstract **Review Article**

An overt immune response to normally occurring, often harmless substances found in the environment is what defines an allergic reaction. From a medical perspective, allergies and hypersensitivities affect a large number of people worldwide. A wide range of clinical symptoms appear in those who are impacted. This literature review's main goal is to highlight recent advancements in the realm of allergies and the management strategies that go along with them. The authors assessed the most well-known search engines, such as Google Scholar, PubMed, Science Direct, and others. The results of this study showed that allergies are becoming more common, which may be related to changes in lifestyle and environmental factors. This study looked at five different types of allergies and their therapeutic approaches.

Keywords: Allergy, hypersensitivity, allergen, antigen, management strategies.

1. INTRODUCTION

Allergic reactions are distinguished by an excessive immune response to compounds that are typically innocuous and found in the surroundings. Angioedema, distinguished by enlargement of the airway, tongue, and lips, is a common symptom. Additional symptoms include abdominal cramping, prickling, erythema, rash, urticaria, nausea, and vomiting. Bronchospasm, wheezing, and dyspnea are also present. Stridor, syncope, or collapse may also be experienced. This instructional activity underscores the importance of healthcare professionals in providing knowledge and overseeing patients regarding allergies, while also clarifying their etiology, pathophysiology, classification, and clinical presentations (Dougherty *et al.*, 2023).

2. Types of Allergies:

There are five main types of hypersensitivities labeled as type I through type V, respectively. Type I hypersensitivity is characterized by repeated exposure to antigens, also known as allergens. Type II hypersensitivity, which usually involves IgG and IgM antibodies, is categorized as antibody-dependent hypersensitivity. Cell-mediated reactions is a synonym for type IV hypersensitivity. Type V hypersensitivity is a kind of type 2 hypersensitivity when antibodies attach to cell surface receptors instead of cell surfaces. This interferes with cell signaling by mimicking the effects of the ligand or inhibiting the intended ligand from attaching to the receptor (Alkhatib, 2022a).

According to Godwin and Crane (2020), type 1 hypersensitivity is an allergic reaction that occurs after repeated exposure to a particular antigen. These responses may be either local or systemic. Type I hypersensitivity has symptoms that vary from mild discomfort to anaphylactic shock. (Valenta *et al.*, 2018) raise concern. Treatment options consist of epinephrine, corticosteroids, and antihistamines (Dona and Suphioglu, 2020). Antigens can enter the body in type 1 hypersensitivity through inhalation, ingestion, direct touch, or injection (Inomata *et al.*, 2018). After being exposed to the antigen, inexperienced B lymphocytes undergo a priming process in which they gain recognition of the antigen. Following this, the lymphocytes undergo differentiation into cells that secrete IgE antibodies (Vaillant *et al.*, 2020). The main distinction between type 1 hypersensitivity response and a regular immune response is the secretion of IgE-class immunoglobulins from plasma cells in type 1 hypersensitivity, while IgG or IgM is secreted in a regular response (Saunders *et al.*, 2019). IgE can specifically attach to Fc receptors on tissue mast cells and blood basophils. Mast cells and basophils coated with IgE have increased sensitivity. Sensitized cells release prostaglandins, histamine, and leukotrienes when exposed to the same allergen repeatedly, affecting nearby tissues (Gasser *et al.*, 2020). Hedqvist *et al.*, (2000) assert

that the main impacts of these substances are vasodilation and smooth muscle contraction. Several cases of type 1 hypersensitivity have been recognized, such as allergic asthma, allergic rhinitis (hay fever), and allergic conjunctivitis (Theoharis *et al.,* 2019).

Type 2 hypersensitivity involves the production of antibodies, typically IgG and IgM, that bind with antigens found on the individual's cell components (Roan *et al.,* 2019; Alkhatib, 2022b). Antigens can be intrinsic, self-antigenic, or extrinsic because of exposure to foreign antigens, according to bio.libretexts.org (2020). IgG and IgM antibodies form immunological complexes with antigens, triggering the traditional pathways of the complement system to eliminate cells identified as foreign antigen-presenting cells (Vaillant *et al.,* 2020). The buildup of mediators at the region of acute inflammation enhances the complexes' capacity to specifically attach to membranes, resulting in cell death (Vries *et al.,* 2017). Cells expressing Fc receptors are involved in phagocytosis. Complement receptors recognize the protein complement bonded to the surface, while Fc receptors identify the antibody bound to the surface. The cells can be identified by dendritic cells or macrophages, together with the previously described features. Active cells present antigens, triggering a B-cell response that produces antibodies to attack the foreign antigen. Penicillin's reaction serves as a clear example because the antibiotic can adhere to red blood cells and stimulate their differentiation. The medicine will stimulate the production of antibodies and enhance the growth of B-cells. ADCC, also known as antibody-dependent cytotoxicity, is another term for type 2 hypersensitivity. In this scenario, IgG or IgM antibodies identify cells that display unfamiliar antigens. Antibodies (IgG or IgM) are used here to detect cells that display the foreign antigen. The tagged cells are eliminated by natural killer (NK) and macrophage cells, which identify them through IgG bound to the cell surface receptor CD16 (FcγRIII). Examples of such disorders include erythroblastosis fetal, Goodpasture syndrome, and autoimmune hemolytic anemia (Uribe-Querol and Rosales, 2020).

Type III hypersensitivity: Immunological complex. Various tissues, such as the epidermis, kidneys, and joints, experience type 3 hypersensitivity reactions caused by the buildup of insoluble immune complexes composed of IgG and IgM antigens and antibodies in the bloodstream (Fan *et al.,* 2020; Alkhatib, 2022c). The traditional supplement's activation process involves the deposition of antibodies to trigger an immune response aimed at destroying cells containing foreign antigens (Hsiao *et al.,* 2014). Antigen binding takes place between IgG and IgM antibodies in the early stage of complex formation. Later, the complexes combine to form larger structures that can be released from the organism (Rojko *et al.,* 2014). Usman and Annamaraju (2020) suggest that the antibody and antigen complex spreads during the initial phase of its development, making removal unachievable at that stage. The reaction's development may take from hours to days (Fan *et al.,* 2020). Tissue injury occurs at the location of the immune complex due to the infiltration of phagocytes and granulocytes, together with the production of inflammatory mediators (Usman and Annamaraju, 2020). Examples are as follows: Complicated immunological glomerulosis Rheumatoid arthritis is a type of arthritis that affects the joints. Symptoms and signs of subacute malaria, bacterial endocarditis, and serum-induced nausea SLE stands for systemic lupus erythematosus, a type of lupus that affects the entire body.

Type IV hypersensitivity reaction, known as Contact Dermatitis, is a cell-mediated response that can be triggered by specific diagnostic procedures (such as the tuberculin skin test) or exposure to allergens. Avoiding the consumption of allergens that trigger this disease is crucial. This exercise stresses evaluating and controlling type 4 hypersensitivity reactions and highlights the importance of a multidisciplinary team in delivering high-quality care to patients with this illness (Marwa and Kondamudi, 2020). Type IV hypersensitivity reaction occurs when T cells initiate an inflammatory response due to external or internal triggers. Various cell types, such as monocytes, neutrophils, and eosinophils, may be involved in certain circumstances. Leukocytes are drawn to the area where the immune and inflammatory response is first initiated due to exposure to an antigen. Macrophages and monocytes present the ingested antigen to T cells, leading to their activation and sensitization. The cytokines and chemokines generated by these cells can cause tissue damage and lead to illness. Type IV hypersensitivity reactions can lead to medication hypersensitivity and contact dermatitis (Alkhatib, 2022a, b).

Type IV reactions are classified into subtypes IVa, IVb, IVc, and IVd based on the specific cytokines/chemokines released and the involvement of CD4 T helper type 1 and type 2 cells (Marwa and Kondamudi, 2020).

Delay-induced hypersensitivity is a necessary physiological reaction to fight intracellular infections such as mycobacteria and fungi. Moreover, they play a crucial role in tumor immunity and transplant rejection (Alkhatib, 2022d).

Individuals with AIDS have a weakened type 4 hypersensitivity response because of a gradual decline in their CD4 cell levels (Justiz *et al.,* 2020; Usman and Annamaraju, 2020). Type 4 hypersensitivity is common among sensitive individuals. The estimated prevalence of contact hypersensitivity ranges from 1% to 6% of the population. Drug allergy is a type 4 hypersensitivity reaction that falls within a moderate subset. Drug allergies make up about 14% of all pharmacological adverse effects but are frequently considered distinct

medical disorders. Approximately 2% to 3% of patients admitted to hospitals experience dermatological allergies on average (Alkhatib, 2022a).

A link was found in Western European epidemiological studies between atopy and the pure protein derivative (PPD) response in healthy individuals. A comprehensive cross-sectional study in Sweden found that patients with atopy have a slightly greater incidence of PPD reactions over 3 millimeters compared to the general population (15.1% vs. 14.7%).

Studies have shown that 1.4% of healthy newborns and 1.2% of children with allergies had PPD reactions larger than 10 millimeters (Grüber and Paul, 2002; Pichler, 2003; Czarnobilska *et al.,* 2007). Type V hypersensitivity reactions are frequently utilized to differentiate Type 2 diabetes, particularly in the UK (Rajan, 2003). Antibodies connect to cell surface receptors instead of adhering to cell surfaces. This action either hinders the intended ligand from binding to the receptor or imitates the effects of the ligand, disrupting cell signaling (Alkhatib, 2022c).

3. Management Strategies for Allergies

Allergies are managed with a combination of pharmaceutical treatments, avoidance techniques, and immunotherapy in certain cases (Maestrelli *et al.*, 2004; Akdis, 2011; Viswanathan and Busse, 2012). The following measures are essential for treating allergies:

Identification of Allergens: The first step in managing allergens is identifying the individual allergens that caused the reaction. This typically includes using allergy testing, where skin or blood samples are used to identify allergic sensitivity (Chruszcz *et al.*, 2018; Nilsson *et al.*, 2018). Avoidance: After identifying allergies, the next step is to reduce or eliminate any potential exposure to them (Chruszcz *et al.*, 2018). This may include the following:

Environmental control strategies including using air purifiers, cleaning surfaces regularly, keeping windows closed during high pollen seasons, and using dust mites and pollen as airborne allergens (Portnoy *et al.*, 2013).

Dietary adjustments: To prevent allergic responses related to food allergies, it is important to avoid certain foods and thoroughly examine ingredient labels. Pet owners with dander allergies can reduce their pet's exposure by using air filters or limiting their access to certain rooms (Scott *et al.*, 2012). Medication Administration: Antihistamines reduce allergy symptoms such as runny nose, sneezing, and itching by blocking the effects of histamine. Decongestants can relieve allergy-related nasal congestion by constricting blood vessels and reducing swelling in the nasal passages (Izquierdo *et al.*, 2024). Nasal corticosteroids diminish inflammation in the nasal canal and relieve nasal congestion, runny nose, and sneezing (Tosca *et al.*, 2024). It is crucial to have an epinephrine autoinjector, like an EpiPen, on hand to provide emergency treatment for severe allergic responses (anaphylaxis) in persons with major food or insect allergies (Okaiyeto *et al.*, 2024). If medication management and avoidance methods are not effective, allergen immunotherapy, commonly known as allergy injections, may be suggested as an alternate treatment (Arshad *et al.*, 2024). Gradually desensitizing the immune system includes exposing the individual to higher amounts of the allergen. This could result in decreased medication use and relief from allergy symptoms (Ma and Zhu, 2024). Emergency protocol for those with severe allergies must have a well-defined action plan in place. This plan should clearly outline the specific steps to take in the event of an allergic response, including when to seek immediate medical treatment and administer epinephrine (Deschildre *et al.*, 2014; Pouessel *et al.*, 2017). Regular follow-up appointments are crucial for patients with allergies to monitor symptoms, address concerns, and modify medication dosages (Muraro *et al.*, 2014). Implementing these measures can enhance a person's quality of life by decreasing the frequency and intensity of allergy reactions and allowing them to regain more control over their allergies. It is crucial to form a strong working connection with a healthcare provider to create a personalized allergy treatment plan that considers the unique demands and situations of each person (Grabenhenrich *et al.*, 2018).

4. CONCLUSIONS

Allergies comprise a wide range of clinical presentations and are becoming more and more widespread worldwide. Asbestos or hypersensitivities are categorized into five primary classifications, each of which is supported by a unique set of underlying mechanisms. The formulation of management regimens necessitates the consideration of numerous elements, including the identification of allergens and the execution of strategies to reduce their exposure. It may be necessary to incorporate immunotherapies into the treatment regimen to alleviate the intensity of allergy symptoms.

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