



Hypersensitivity Reactions and Their Role in Immune Mediated Disorders

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DESCRIPTION

Hypersensitivity refers to exaggerated or inappropriate immune responses that result in tissue damage or clinical disease. These immune reactions can be triggered by allergens, infectious agents, drugs or autoantigens and are classified into four major types based on immunological mechanisms. Hypersensitivity reactions are implicated in a wide range of disorders, including allergies, autoimmune diseases, transplant rejection and certain chronic inflammatory conditions. This article provides an in-depth overview of hypersensitivity, discussing its classification, mechanisms, clinical manifestations, diagnostic approaches and management strategies, highlighting its relevance in clinical practice and research. Type I hypersensitivity, also known as immediate or (IgE) mediated hypersensitivity, occurs when exposure to an allergen triggers the production of Immunoglobulin E (IgE) binds to mast cells and basophils, leading to the release of histamine and other mediators upon re-exposure to the allergen. Clinical manifestations include urticaria, allergic rhinitis, asthma and anaphylaxis. Type I hypersensitivity is commonly associated with environmental allergens, food, insect venom and certain medications. Prompt recognition and treatment are essential to prevent severe or life-threatening reactions. Pharmacological interventions such as antihistamines, corticosteroids and epinephrine are employed to manage acute episodes, while allergen avoidance and immunotherapy help in long-term control. Type III hypersensitivity, also called immune complex mediated hypersensitivity, occurs when antigen antibody complexes deposit in tissues, activating the complement cascade and inducing inflammation. These reactions can affect the kidneys, joints, blood vessels and skin. Common disorders include systemic lupus erythematosus, post streptococcal glomerulonephritis and rheumatoid arthritis. Symptoms depend on the organ involved and often include joint pain, rash, haematuria or vasculitis lesions. Diagnosis relies on serological tests for immune complexes, complement levels and tissue biopsy. Management involves controlling inflammation with corticosteroids, immunosuppressive medications and addressing the triggering antigen.

Type IV hypersensitivity, also known as delayed type or cell mediated hypersensitivity, is mediated by T lymphocytes rather than antibodies. The reaction typically develops 24 to 72 hours after exposure to the antigen and involves activation of sensitized T cells, recruitment of macrophages and cytokine release, leading to tissue damage. Examples include contact dermatitis, tuberculin skin test reactions and chronic transplant rejection. Diagnosis often relies on patch testing or delayed hypersensitivity skin tests and management includes avoidance of the triggering antigen and anti-inflammatory therapy. In severe cases, immunosuppressive drugs may be required to prevent tissue damage. Hypersensitivity reactions are influenced by genetic predisposition, environmental factors and prior sensitization. The severity and presentation vary depending on the type of reaction, the antigen involved and host factors such as age and immune status. Understanding the underlying immunological mechanisms is important for accurate diagnosis, effective treatment and prevention of complications. Early identification of triggers and targeted therapy can reduce morbidity, improve quality of life and prevent chronic disease progression. Public health measures, including allergen regulation, vaccination programs and education about drug safety, also contribute to reducing the burden of hypersensitivity reactions. Diagnosis of hypersensitivity involves a combination of clinical evaluation, laboratory tests and, in some cases, functional assays. Skin tests, blood tests for specific antibodies, complement assays and biopsy are commonly used to confirm the type of hypersensitivity and identify the causative antigen. Molecular techniques, including flow cytometry and cytokine profiling, provide additional information for complex or atypical cases. Multidisciplinary approaches involving allergists, immunologists, dermatologists and other specialists are often required to optimize diagnosis and management.

In conclusion, hypersensitivity reactions represent a spectrum of immune mediated responses that can lead to significant morbidity and, in some cases, mortality. They are classified into four major types based on their immunological mechanisms, each with distinct clinical features, diagnostic approaches and management strategies. Accurate recognition, early intervention

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Received: 24-Nov-2025, Manuscript No. JAT-25-31064; **Editor assigned:** 26-Nov-2025, Pre QC No. JAT-25-31064 (PQ); **Reviewed:** 10-Dec-2025, QC No JAT-25-31064; **Revised:** 17-Dec-2025, Manuscript No. JAT-25-31064 (R); **Published:** 24-Dec-2025, DOI: 10.35248/2155-6121.25.16.441

Citation: Fernandez L (2025) Hypersensitivity Reactions and Their Role in Immune Mediated Disorders. J Allergy Ther.16:441.

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and targeted therapy are essential to reduce complications and improve patient outcomes. Ongoing research into the molecular mechanisms of hypersensitivity and the development of novel therapeutic agents is likely to enhance understanding and

treatment of these conditions. Hypersensitivity remains a central topic in immunology and clinical medicine, highlighting the balance between protective immune responses and pathological immune activation.