



**Immunology
Hypersensitivity (A)
2025-2026**

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Aims: To Know the

1. Definition of hypersensitivity.
2. Types of hypersensitivity reactions.
3. Components of each reaction
4. Mediators
5. Clinical presentation
6. Treatment

Some Definitions and Concepts

Hypersensitivity:

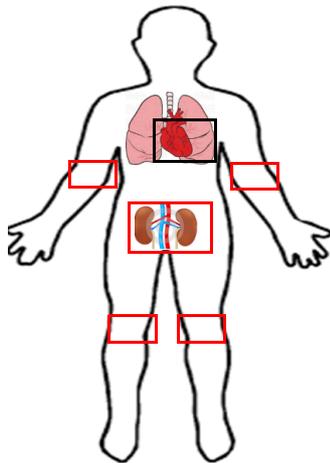
- Heightened unwanted immune response

- Is a set of undesirable reactions produced by the normal immune system, including allergies and autoimmunity.

- These reactions may be damaging, uncomfortable, or occasionally fatal.

Phylaxis: Protection

Anaphylaxis: Opposite of Protection; Damaging



**Bad side
of the immune
response**

**Immune
response**



**Good side
Of the immune
response**



Bacteri



**Viruse
s**

Hypersensitivity reactions= Policeman and the thief



Type 1
hypersensitivity



Type 2
hypersensitivity

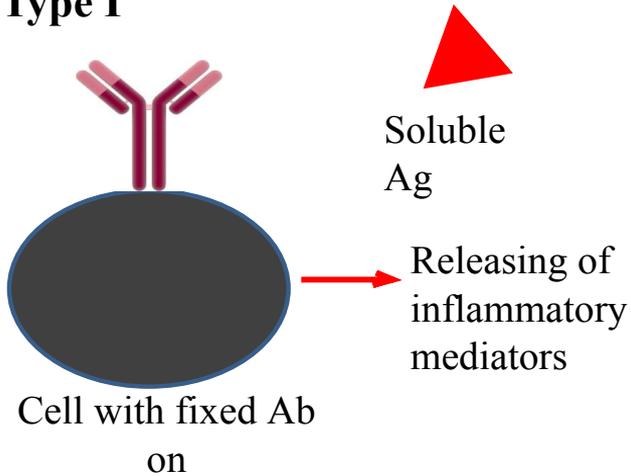


Type 3
hypersensitivity

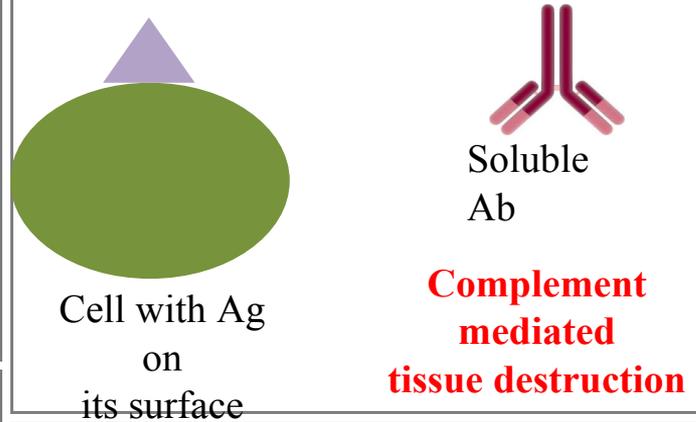


Classification

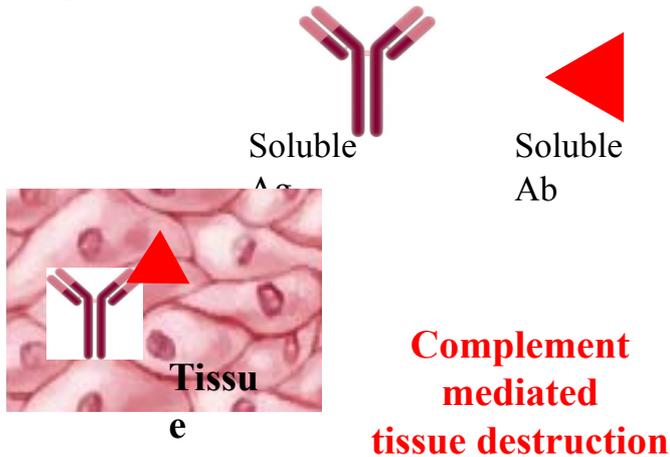
Type I



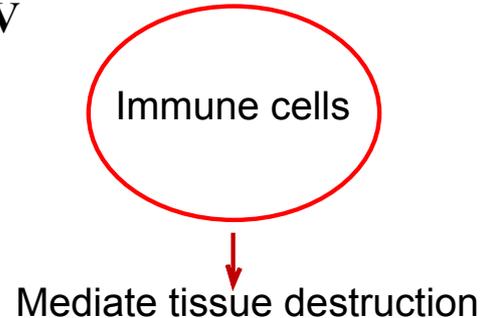
Type II



Type III



Type IV



Type I Hypersensitivity

- Type 1 hypersensitivity is an immediate allergic reaction that occurs when the immune system overreacts to a harmless substance (allergen), such as pollen or peanuts. It is an immunoglobulin E (IgE)-mediated response
- Happens in two stages:
 - A. First, a sensitization phase
 - B. Second, subsequent exposure phase.

why do some people develop hypersensitivity reaction and others no?

Some people develop hypersensitivity reactions due to a combination of genetic predisposition and environmental factors, which cause their immune systems to overreact to certain substances. Others do not have this combination, and therefore their immune systems don't mount an extreme response to those same substances.

Genetic predisposition

- **Atopy:** Genetic misregulation of IgE response (or) an inherited tendency to respond to naturally occurring inhaled and ingested allergens with continued production of IgE.
- **Family history:** Allergies often run in families, suggesting a strong genetic component as the presence of specific HLA-DR2, DR4, and DR7
- **Immune system variation:** Genetic factors influence how the immune system develops and responds to antigens, leading to different immune cell responses in different individuals.

Environmental factors

- **Repeated exposure:** Repeated exposure to certain substances (allergens) is a key factor in triggering an allergic response in sensitized individuals.
- **Diet:** Certain foods can increase the risk of developing allergies (milk, eggs, peanuts, tree nuts, soy, wheat, fish, shellfish, and sesame).
- **Pollutants:** Environmental pollutants like tobacco smoke and exhaust fumes can increase the risk of developing allergies.
- **Initial sensitization:** The first exposure to an allergen can trigger the immune system to become "sensitized," meaning it will overreact to subsequent exposures.

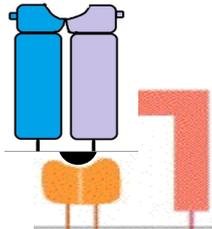
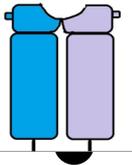
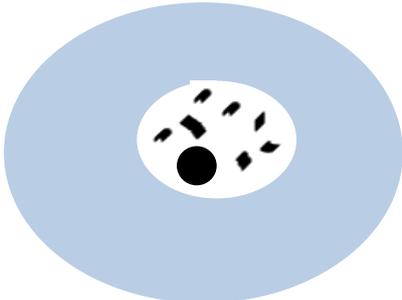
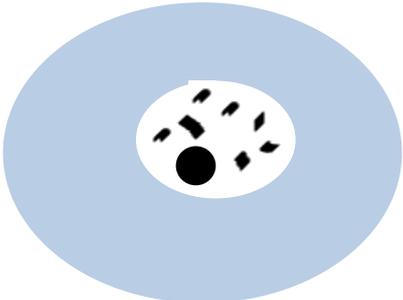
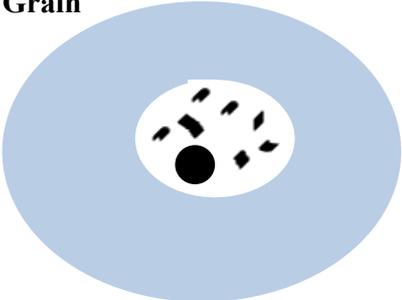
Prerequisites for Ab production

Mohammad

Ali

Ahmad

Flower
Pollen
Grain



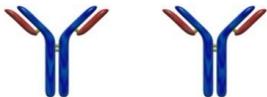
naïve T
cell

naïve T
cell

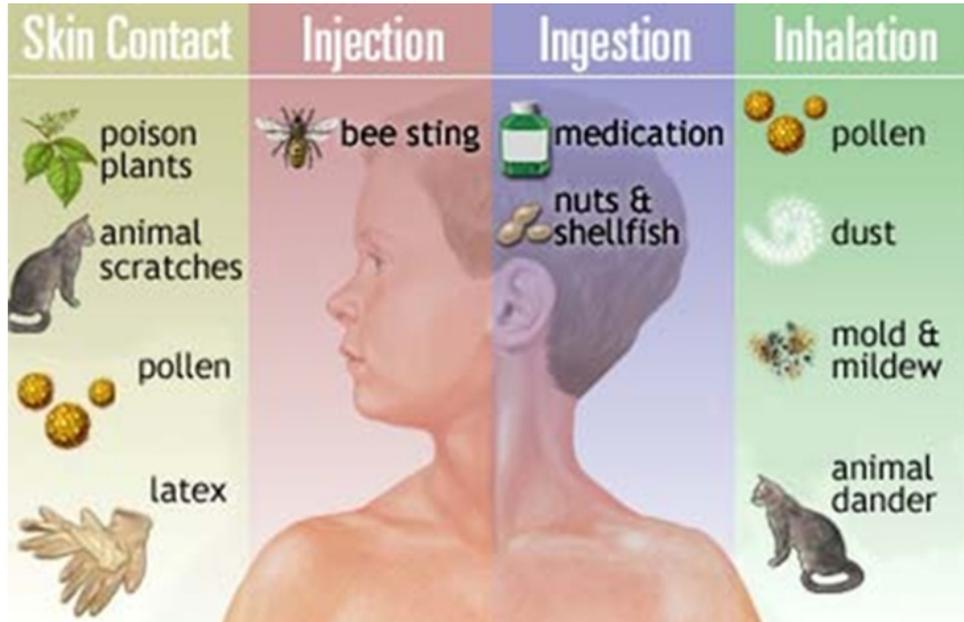
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No MHC molecules
specific
for the processed allergen

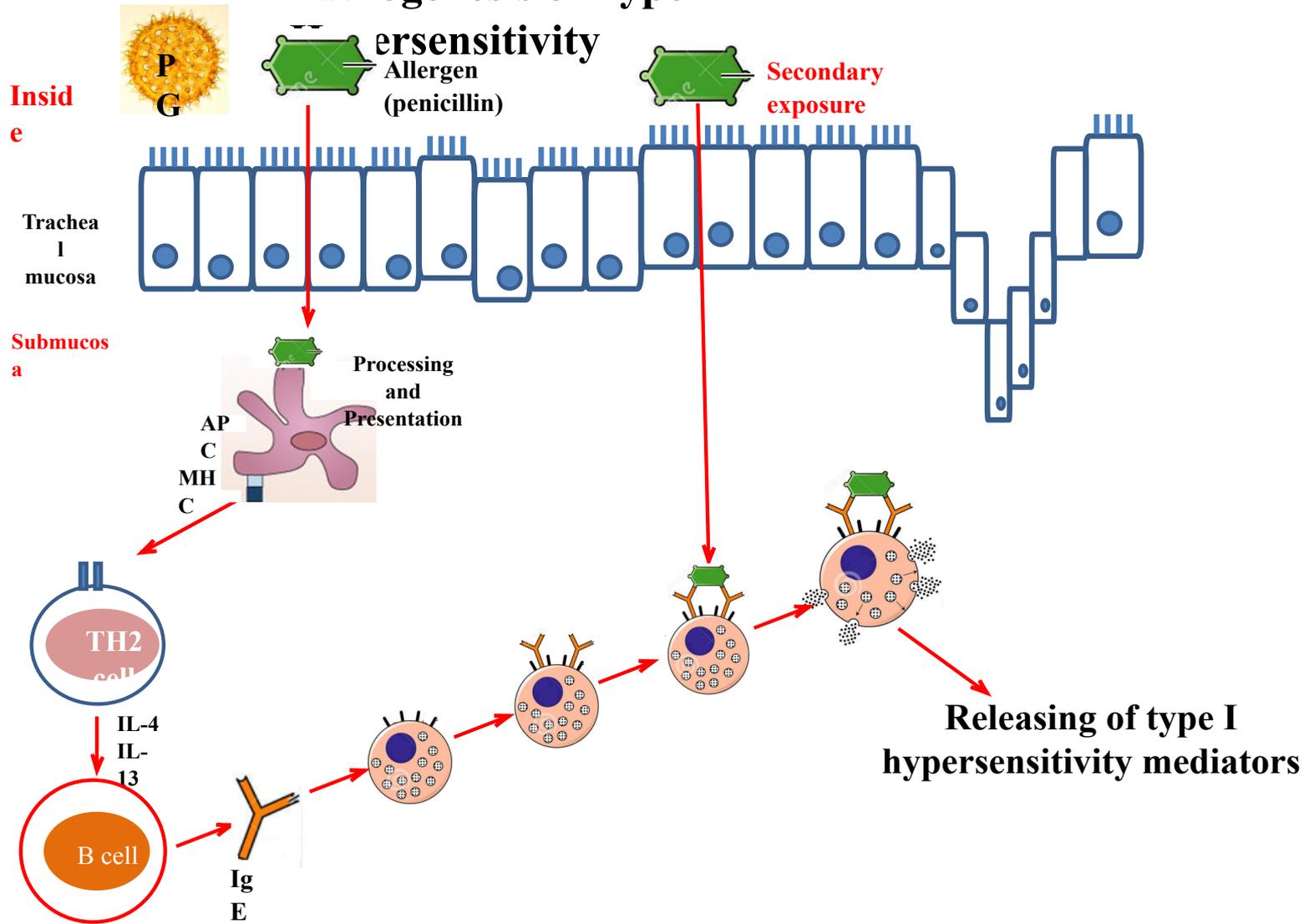
No TCR specific
for the processed allergen



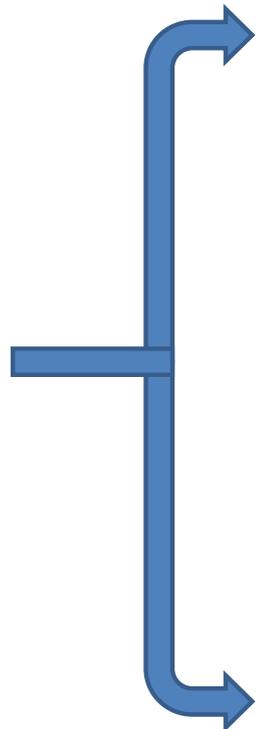
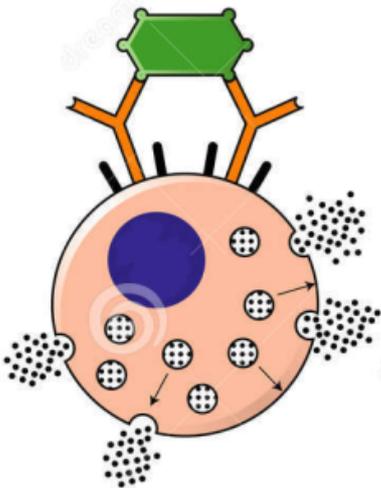
Common Antigens Associated with Type I Hypersensitivity



Pathogenesis of Type I

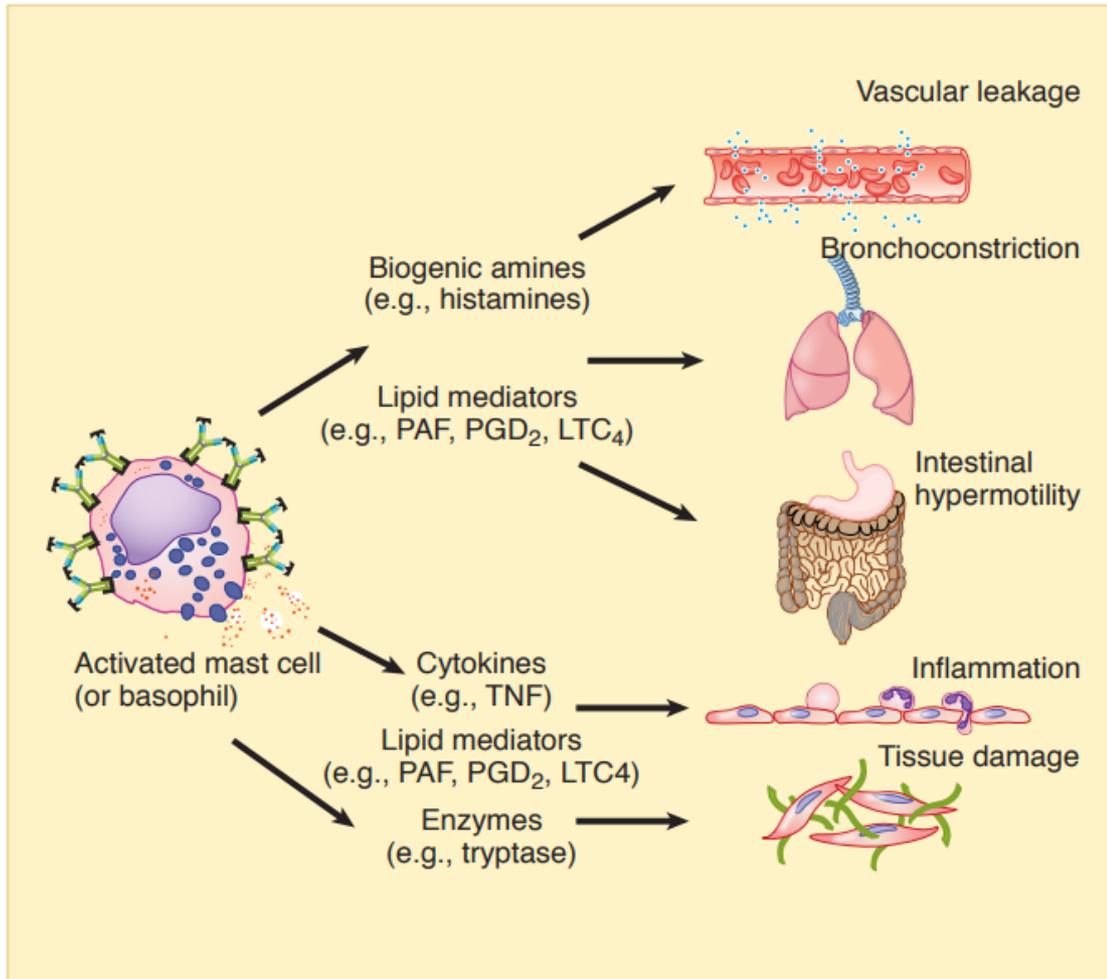


Functions of the type I hypersensitivity mediators



Chemoattractants	
Cytokines e.g. IL-5, TNF α IL-8	Neutrophils Basophils Eosinophils
LTB ₄ , PAF	Basophils
Activators	
Histamine	Vasodilatation & vascular permeability
PAF	Microthrombi
Tryptase	Proteolytic enzyme activates C3
Kininogenase	Kinins (vasodilatation, edema)
Spasmogens	
Histamine	Bronchial smooth muscle contraction
PGD ₂	
LTC ₄ , LTD ₄	

Functions of the type I hypersensitivity mediators



Clinical responses

Urticaria/angioedema:

- Release of the above mediators in the superficial layers of the skin can cause pruritic wheals (surface swelling in the skin) with surrounding erythema.
- If deeper layers of the dermis and subcutaneous tissues are involved, angioedema results.



Allergic rhinitis (nasal inflammation):

- Sneezing, itching, nasal congestion, rhinorrhea, and itchy or watery eyes.



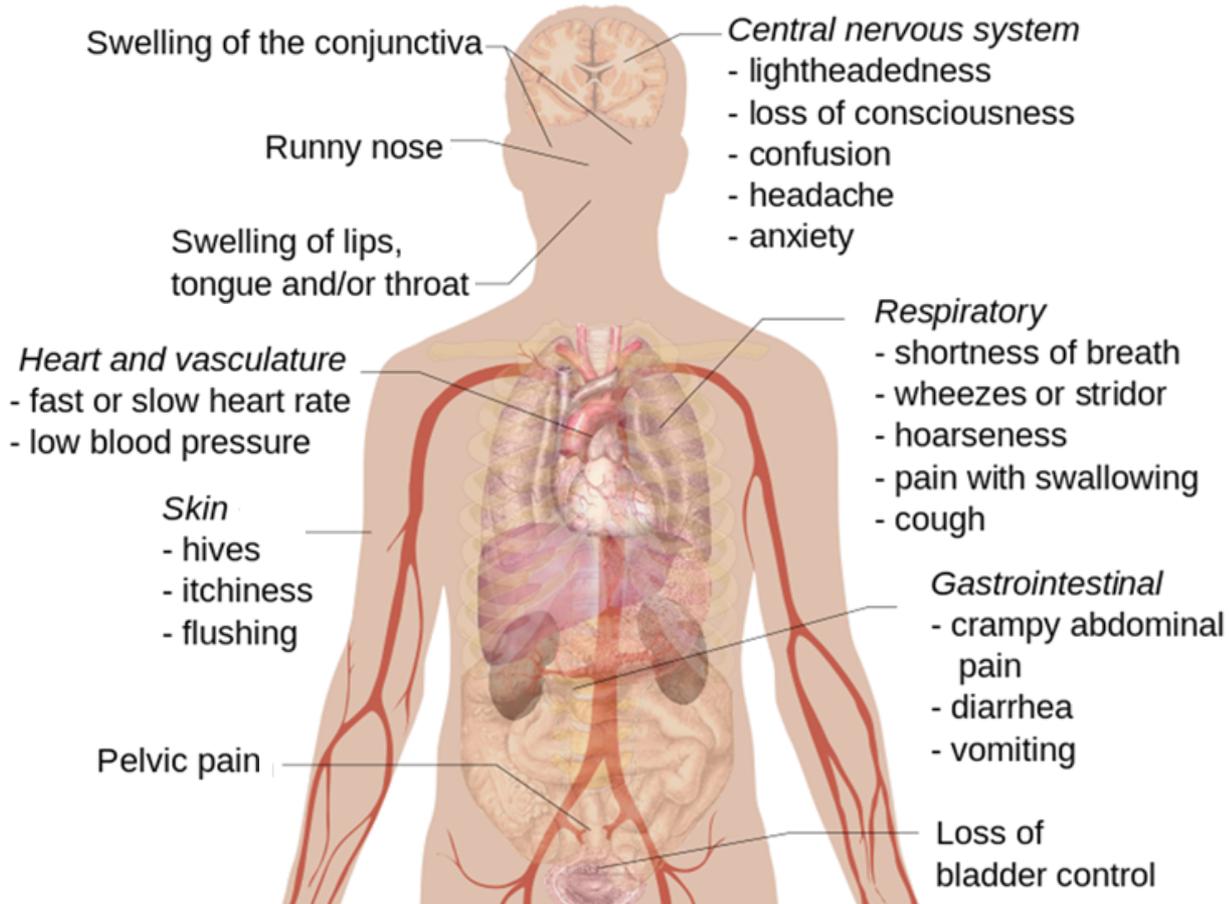
Allergic asthma:

- Release of the above mediators in the lower respiratory tract can cause bronchoconstriction, mucus production, and inflammation of the airways, resulting in chest tightness, shortness of breath, and wheezing.



Clinical manifestations of type I hypersensitivity

Signs and symptoms of Anaphylaxis



Allergic Diseases Due to Specific Allergens and their Clinical Manifestations

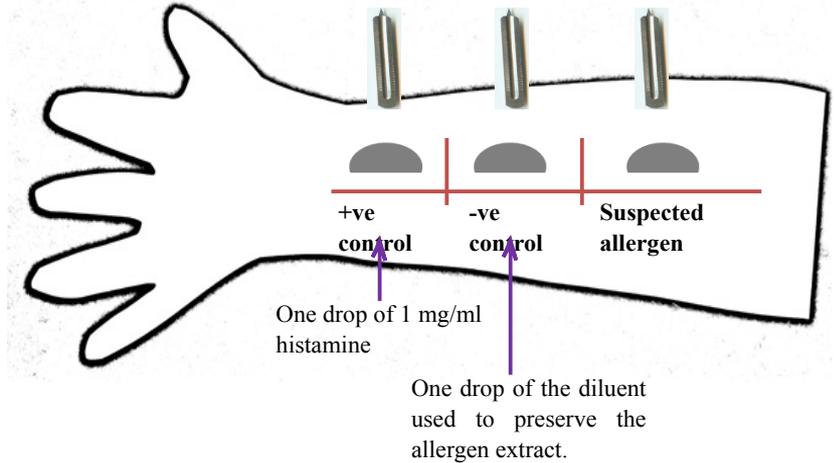
Allergic Disease	Allergens	Clinical Findings
Allergic rhinitis (hay fever)	Trees, grasses, dust, cats, dogs, mites	Edema, irritation, mucus in nasal mucosa
Systemic anaphylaxis	Insect stings, drug reactions	Bronchial and tracheal constriction, complete vasodilation and death
Food allergies	Milk, eggs, fish, cereals, grains	Hives and gastrointestinal problems
Asthma	Inhaled materials	Bronchial and tracheal constriction, edema, mucus production, massive inflammation



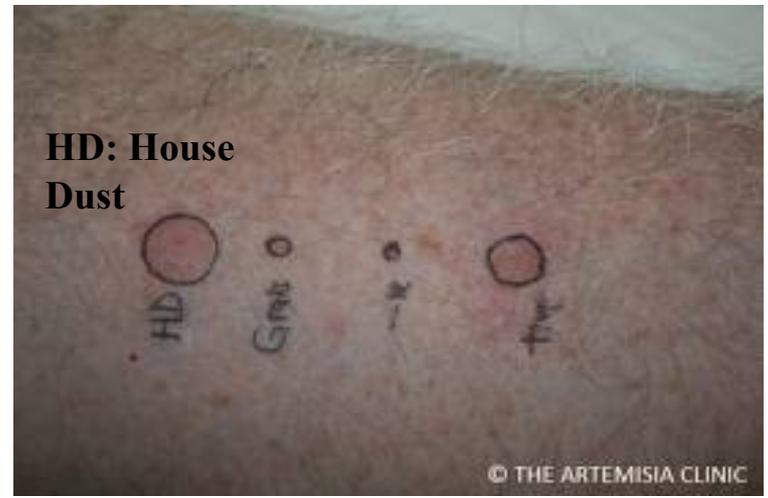
hives (also called urticaria), which is a **raised, itchy rash** that's usually caused by a reaction to things like food, pollen, insect bites or

Testing for Immediate Hypersensitivity

1- In Vivo Skin Tests: Skin Prick Test



The person is considered allergic (+ve result) when the allergen diameter on the skin is 3mm more than the -ve control. In this case the injected material is called allergen



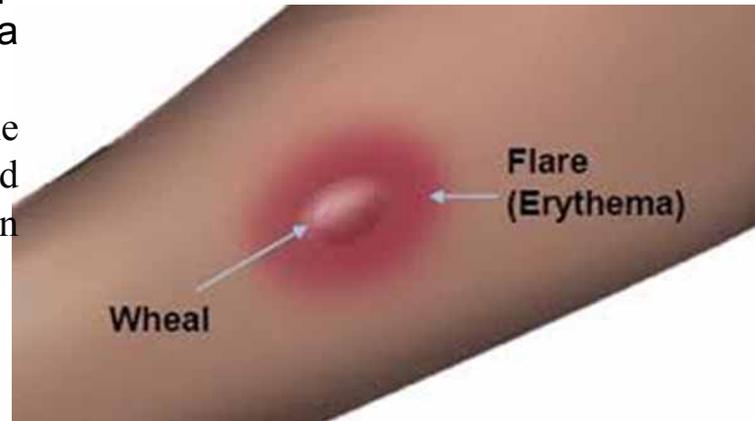
Testing for Immediate Hypersensitivity

1- In Vivo Skin Tests: Skin Prick Test

Wheal and flare	In vivo skin testing for allergies	Local skin edema, reddening, vasodilation of vessels
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Wheal and flare is a two-part allergic skin reaction, consisting of a raised, pale bump (**wheal**) surrounded by a red, flushed area (**flare**).

The wheal is caused by fluid leaking into the tissues, while the flare is the result of dilated blood vessels and is often seen in allergy skin tests like those for pollen or insect bites



Treatment of type I hypersensitivity

1. Treatment by drugs

Anti-histamine, leukotrienes antagonists, corticosteroids

For anaphylactic shock; IM adrenaline, IV anti-histamine and corticosteroids.

Humanized monoclonal Anti-IgE

2. Treatment by allergen immunotherapy

It is a long-term treatment approach that decreases a person's sensitivity to specific allergens and is administered either through:

Subcutaneous Immunotherapy (SCIT): This involves regular injections, typically administered in a doctor's office, with increasing doses of allergen extracts over several months during the initial "build-up" phase, followed by maintenance injections at regular intervals for several years.

Sublingual Immunotherapy (SLIT): This involves placing dissolvable tablets or drops containing allergens under the tongue. After an initial dose in a medical setting, daily maintenance doses are typically self-administered at home for several years.

Both methods work by inducing immune tolerance to the allergen, which helps to reduce allergy symptoms and the need for medication

Type II hypersensitivity

Hypersensitivity reactions= Policeman and the thief



Type 2
hypersensitivity



Type 3
hypersensitivity



Type II Hypersensitivity

- **Detention:** Antibody-mediated (IgG and IgM)
- **Target of Antibodies:**
 - against cell surface antigens or
 - extracellular matrix antigens
 - they are not usually systemic.
- **Types of antibodies:**
 - **Autoantibodies**
 - they may be produced against a foreign antigen that is cross-reactive with self-components of tissues (Drug or bacterial induced altered self antigens).

Type II Hypersensitivity

Type II Hypersensitivity is subdivided into

Target cell depletion or
destruction without
inflammation
(cytotoxic)

Ab mediated cell dysfunction
(no cell depletion, destruction,
or inflammation) (non
cytotoxic)

Complement mediated
Inflammation (cytotoxic)

Type II Hypersensitivity

1. Target cell depletion or destruction without inflammation

Examples

1. Autoimmune Hemolytic Anemia (AIHA)
2. Autoimmune Neutropenia
3. Erythroblastosis fetalis
4. ABO incompatibility

Mechanism of cell destruction is mediated by

- Antibodies
- Complement
- Natural killer (NK) cells

Type II Hypersensitivity

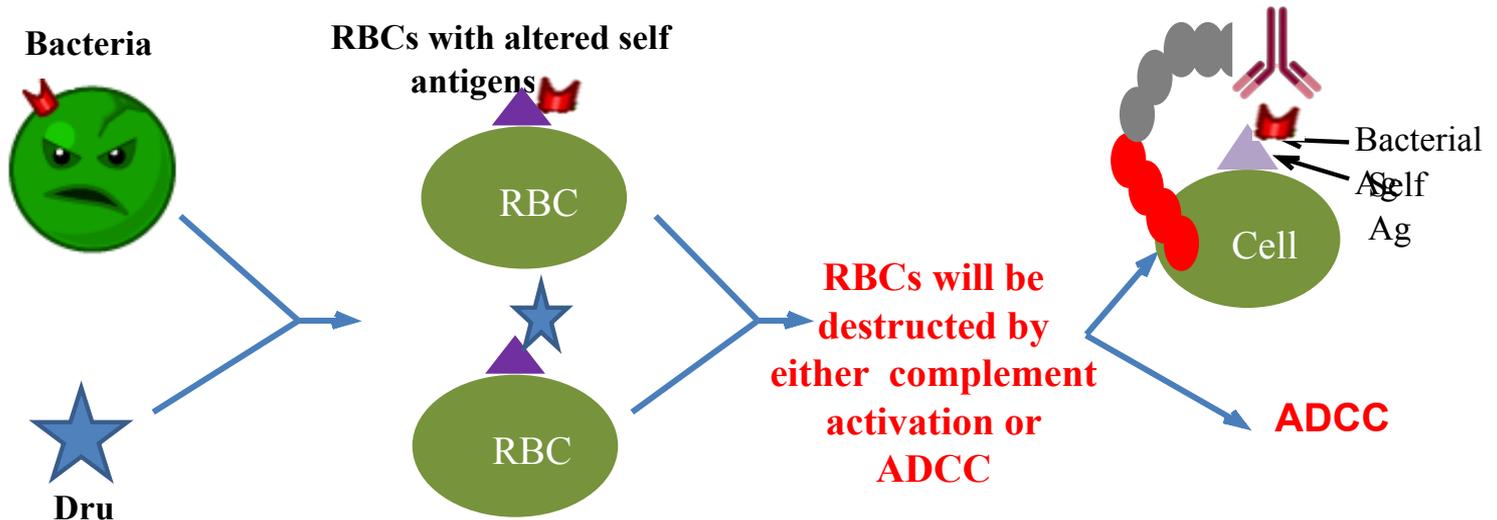
1. Target cell depletion or destruction without inflammation

Autoimmune Hemolytic Anemia (AIHA)

Causes of AIHA:

Idiopathic

Drug or bacterial induced altered self antigens



Thank You