

ANAPHYLACTIC SHOCK

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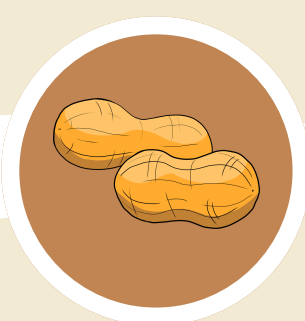
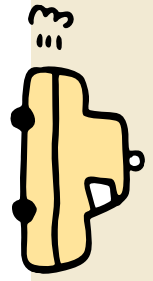
What is anaphylactic shock?

It's a systemic hypersensitivity reaction that occurs after exposure to exogenous molecules - allergens.¹ There are 2 types:

- Immune-mediated anaphylaxis¹
- Non-immune mediated anaphylaxis^{2,3}

Allergens include:

- certain foods (peanuts, fish, eggs, wheat)⁴
- drugs (NSAIDs, antibiotics)^{2,5}
- exercise of any caliber (EIA)⁵
- a combination of food and exercise (FDEIA)⁵



Main mechanism

2

Non-immune mediated anaphylaxis isn't commonly researched, and the mechanisms aren't well understood.⁵ The immune mediated anaphylaxis commonly involves immune system mass activation of mast cells via IgE and FcεRI interactions upon allergen exposure¹:

- IgE binds to allergen and FcεRI receptor located on mast cells¹
- Upon allergen re-exposure, IgE will recognize allergen and cross-link, resulting in mass mast-cell activation and degranulation¹
- Mast cells release inflammatory cytokines (histamine, prostaglandins, etc.)¹



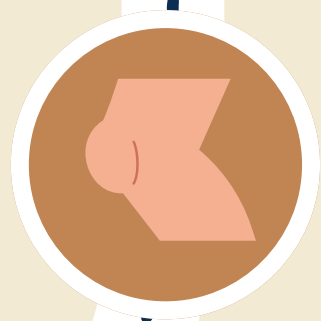
Pathological response

3

- Swelling caused by inflammatory cytokines¹
- Vasodilation (widening of blood vessels)¹
- Abnormal perfusion and shortness of breath¹

If the cardiovascular and respiratory systems are extremely affected, the allergic reaction is severe and leads to anaphylactic shock¹

- It can lead to death if not treated



4

General Symptoms and Signs

- Hives, rashes, swelling^{1,5}
- Shortness of breath, difficulty breathing and/or swallowing¹
- Low blood pressure, tachycardia, bradycardia¹

Immune Mediated Anaphylaxis

Mechanism of Anaphylaxis (IgE- mediated Hypersensitivity)

Limited data from human subjects as well as ethical concerns.⁶

IgE is a type of antibody involved in allergies; small amount of it is in our blood, but stick to immune cells that causes allergic reactions; these immune cells include mast cells (in tissues), and basophils (in blood).⁶

- IgE antibodies bind to a receptor called FcεRI (high-affinity IgE receptor) located on the surface of mast cells and basophils, now the antibodies can recognize a specific allergen⁶
- If the same allergen enters the body again, it will bind to multiple antibodies, known as “cross-linking”, connecting multiple IgE molecules together, which then activates the mast cell⁶
- Once the mast cell is activated, they undergo degranulation and release substances that cause allergic reactions⁶
- There are two types: immediately released (already stored), which include histamine and proteases, and newly produced inflammatory chemicals, which include leukotrienes, prostaglandins, and cytokines⁶

Additional Mediators

- Monocytes and Macrophages; immune cells involved in inflammation and immune defense⁶
- Express Fcγ receptors; bind IgG antibodies, and can respond to inflammatory molecules produced during anaphylaxis⁶
- Platelet Activating Factor (PAF); an inflammatory mediator that promotes platelet aggregation, vascular permeability, and inflammation; high levels are associated with severe reactions⁶
 - Reduced activity of the enzyme that breaks down PAF is associated with increased sensitivity for anaphylaxis⁶
- Neutrophils also release enzymes such as myeloperoxidase (MPO), which are seen at rising levels during reactions⁶

Etiology

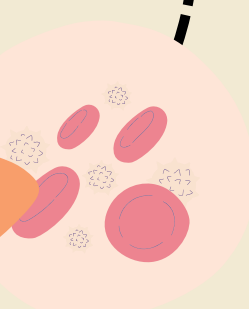
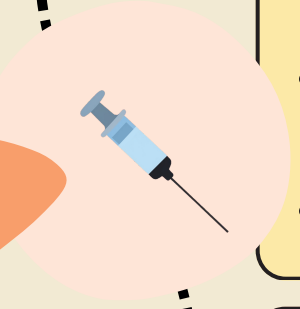
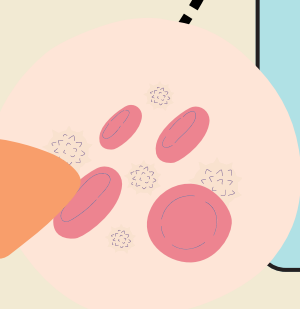
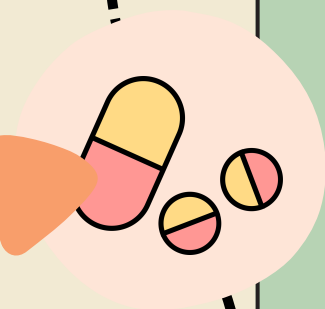
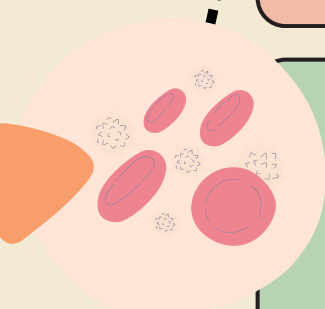
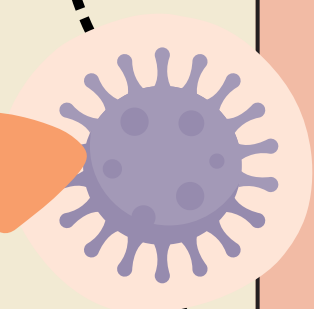
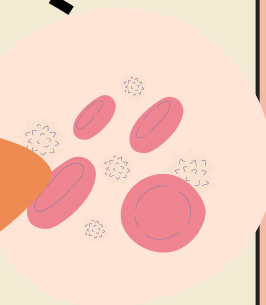
Triggered by allergens such as foods (peanuts, shellfish, tree nuts, soy, sesame, wheat, milk), drugs (antibiotics, aspirin, etc), insect venom, which stimulate an immune response leading up to an allergic reaction.¹

Signs + Symptoms

- hives, itching, flushing, swelling of lips, face, and tongue¹
- airways tightening leading to shortness of breath, wheezing, throat swelling, difficulty breathing¹
- fluid leaking from vessels, leading to swelling + blood vessels widening leading to low blood pressure, rapid or weak pulse, dizziness or fainting¹
- diarrhea, nausea, vomiting, abdominal pain¹

Prevention

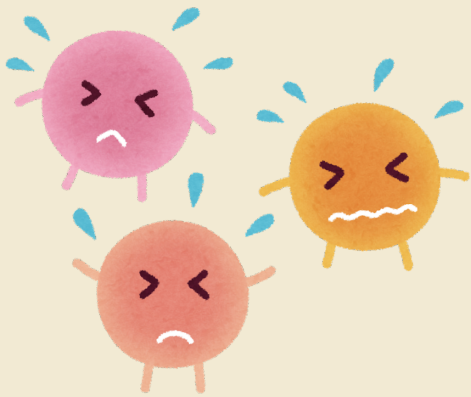
- Wear a medical necklace to indicate you have an allergy to specific substances¹
- Keep an emergency kit with all prescriptions necessary to help you¹
- Always update medical providers on reactions you've had¹
- Carry and know how to use an epinephrine autoinjector¹
- Always read nutrition labels and ingredients¹



Immune Mediated Case Study

Case Overview

- 29 year old female⁷
- Previously healthy, however started demonstrating new symptoms after drinking cow milk⁷
- Had multiple episodes starting from age 28⁷
- Sneezing, shortness of breath
- Eyes and lips swelling⁷



Pathophysiology: IgE-mediated mechanism

1

The initial exposure to milk proteins lead to the immune system producing IgE antibodies, which then bind to mast cells and basophils via FcεRI receptors.⁶

2

The milk enters the body again, causing the allergen to bind to IgE on mast cells, which causes cross-linking.⁶

4

Physiological effects:

- Vasodilation occurs, leading to decreased blood pressure⁶
- Increased vascular permeability, leading to swelling⁶
- Bronchoconstriction, leading to shortness of breath⁶

3

Mast cells release mediators such as histamine, leukotrienes, and prostaglandins.⁶

5

These steps overall cause a rapid, systemic reaction, which leads to anaphylaxis.⁶

Patient Treatment

The patient now currently avoids all dairy products, and carries Adrenaline autoinjectable (AAI), and has not had any reported anaphylaxis since.⁷

General Treatments

Epinephrine (first-line therapy)

- Constricting blood vessels, increasing blood pressure⁶
- Relaxes the airway muscles, improves breathing⁶
- Reduces the mediator release from mast cells⁶

IV fluids

- Support and relieve symptoms
- Treat low blood pressure²
- Includes antihistamines²

Other treatments include exposing the patient to small doses of the allergen every day to build tolerance. The tolerance can help to reduce symptoms of future anaphylactic shock.⁴



Non-immune Mediated Anaphylaxis

Overview

Non-immune mediated anaphylaxis does not directly involve the binding of IgE to FcERI receptors.⁵ However, it includes:

- Mast cell degranulation¹
- Releasing inflammatory mediators like histamine¹

→ Full mechanisms are unknown⁵

Types: EIA, FDEIA, NSAID⁵



FDEIA

Food-Dependent exercise-induced anaphylaxis



- FDEIA is like EIA, but anaphylaxis depends on food + exercise⁵
- Certain foods like wheat and tomatoes can exacerbate EIA pathology by not fully understood mechanisms → likely transglutaminase and allergen interactions⁵

Etiology

Triggered by allergens such as

- NSAIDs (aspirin, naproxen)⁵
- Certain food types (wheat, cereal, tomatoes, peanuts)^{5,8}
- Exercise such as jogging, aerobics, walking⁵
- Food combined with exercise⁵



Prevention

- Avoid exercise for at least 4-6 hours after eating (FDEIA & EIA)⁵
- Consult with healthcare provider for NSAID-like medications that are less likely to trigger anaphylaxis²
- Carry an epinephrine autoinjector^{1,2}

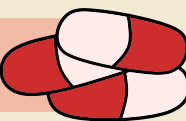


EIA

Exercise-induced anaphylaxis

- Exercise increases blood redistribution in tissues outside of GI tract⁵
- Gut-associated immune cells enter non-intestinal tissues (skin and muscles)⁵
- Mast cells release inflammatory granules⁵
- Results in vasodilation, hypotension, dyspnea (reduced breathing), edema (swelling) → anaphylactic shock^{1,5}

NSAID Anaphylaxis



- Triggers direct mast cell degranulation and IgE-dependent and independent anaphylaxis³
- NSAID promotes vasodilation via COX1/2 enzyme inhibition → changes in osmolarity & blood redistribution → exacerbates EIA and FDEIA^{2,5}
- Thought to be caused by a leukotriene increase (inflammatory mediator)²

Signs and symptoms

- Skin: hives, itching, flushing, swelling of lips, face and tongue^{1,5}
- Respiratory: shortness of breath, throat swelling, difficulty breathing^{1,5}
- Cardiovascular: low blood pressure, rapid/weak pulse, chest tightness^{1,5}
- Gastrointestinal: diarrhea, nausea, vomiting, abdominal pain, difficulty swallowing^{1,5}



Similar conditions mistaken as EIA/FDEIA

- Cholinergic urticaria: small, itchy wheals (1-5mm) from increased body temperature → larger in EIA/FDEIA⁵
- Cold urticaria: small skin lesions similar to those observed in EIA → caused by exercising in the cold → similar EIA manifestation⁵
- Mastocytosis: Uncontrolled accumulation and hyperplasia of mast cells → more susceptible to anaphylaxis⁵
- Exercise-induced Asthma: Respiratory and cardiovascular signs and symptoms of asthma are exacerbated by exercise → mimics anaphylaxis⁵

Non-immune Mediated: Case Study

Case Report

A 28 year old male is brought to the emergency department after experiencing anaphylactic shock while running. He has no complicated medical history and undergoes regular exercise. Over the last few years he has experienced diffuse pruritus and urticaria on multiple occasions during exercise.⁸



Symptoms

Pruritus: Intense and uncomfortable itching that can cause red and cracked skin.⁹

Urticaria: Itchy and red coloured hives that form on the skin.⁹

Shortness of breath and airway compromise can occur in severe situations.⁴



Pathophysiology

The pathophysiology of exercise induced anaphylaxis is not completely understood. The most anticipated cause is due to mast cell degranulation, leading to histamine release. The mechanism of action of this process is unknown, but there is know to be an association between mast cell degranulation and exercise induced anaphylaxis because elevated plasma histamine levels can be measured.⁸



Treatment and Prevention

Primary treatment is avoidance of exercise.⁴

Exercising with someone who can recognize symptoms and administer aid.⁴

Exercise with an epinephrine auto-injector.⁴



General Treatments

Base pharmacotherapy/treatment:

- Epinephrine⁵
- Antihistamines²
- Systemic corticosteroids²

To manage, we will use preventative treatments (depending on the type of anaphylaxis):

- Avoid precipitating factors such as exercising in very cold, hot, or humid weather⁵
- If you have seasonal atopy, don't exercise outside during pollen season⁵
- Don't take aspirin or NSAIDs in association with exercise⁵

Typically, the management is no different from other types of anaphylaxis. Overall, it's important to stop doing physical activity at the first sign; this helps your situation to be less fatal.⁵

Knowledge Check

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Question: My friend accidentally gave me walnut ice cream, and now my throat is closing up. Quick, what do I need to do?

Answer:

Inject myself with an epipen

2

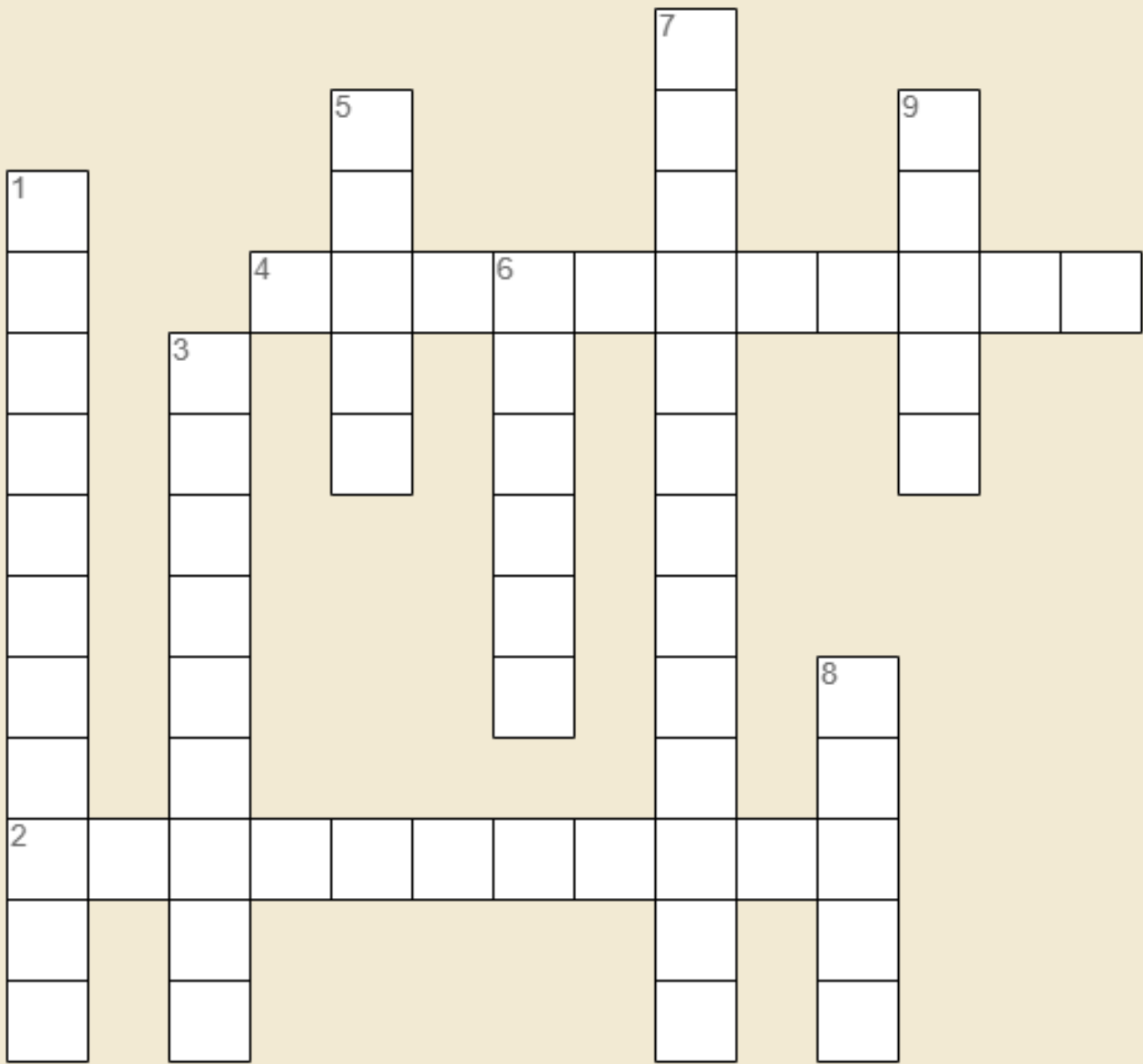
Question: Sally went to the beach, but as she was running she collapsed due to anaphylactic shock. What type does she have?

Answer:
EIA

3

Question: What are the main antibodies used in immune-mediated anaphylaxis?

Answer:
IgE

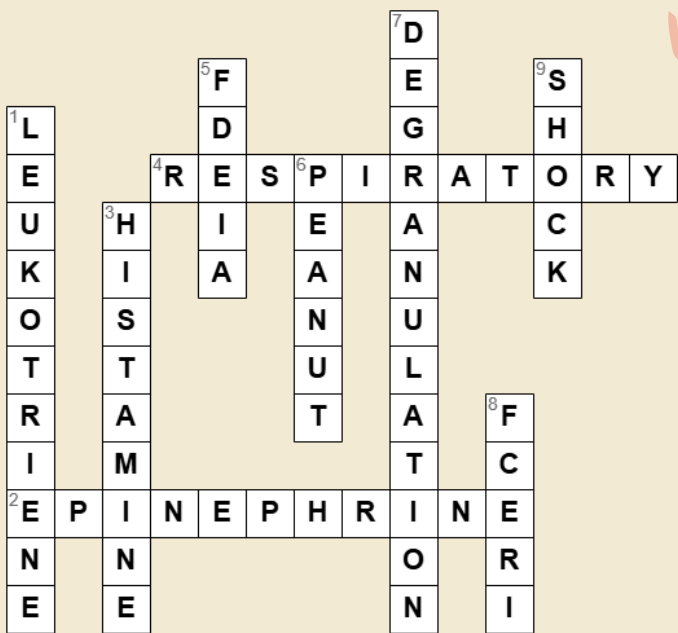


DOWN

- 1. What is thought to cause NSAID
- 3. Its a common chemical mediator released by mast cells
- 5. Anaphylaxis caused due to a combination of food and exercise
- 6. A common food allergy
- 7. The process which mast cells undergo when activated
- 8. Mast cell receptors which IgE antibodies bind to
- 9. Anaphylactic _____

ACROSS

- 2. A hormone/chemical contained in an auto-injector
- 4. Cardiovascular and _____ systems are affected during anaphylactic shock



Crossword Puzzle Answer Key



Scan for references