ACUTE ALLERGIC REACTION

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OBJECTIVES

• The participant will be able to:
  – Describe the triggers and causes of acute allergic reaction.
  – Understand the pathophysiology of diseases that lead to acute allergic reaction.
  – Formulate acute management plan for acute allergic reaction.

DEFINITION

• Allergic reaction
  – Allergic reactions occur when hypersensitivity to a foreign protein or antigen that normally would not be deleterious is acquired.

• Spectrum of reaction
  – Skin rash, hives
  – Wheezing, Shortness of breathing
  – Anaphylaxis

CAUSES FOR ACUTE ALLERGIC REACTION

• Allergic rhinitis and Asthma
• Food
• Drug
• Insect venom/bites
• Latex
• Vaccines
• Exercise
• Perioperative
• Mastocytosis and mast cell activation syndrome
• Idiopathic
• Urticaria

TYPES OF HYPERSENSITIVITY

<table>
<thead>
<tr>
<th>Type I</th>
<th>Type II</th>
<th>Type III</th>
<th>Type IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td>delayed</td>
<td>delayed</td>
<td>immediate</td>
</tr>
<tr>
<td>Antigen</td>
<td>B cell</td>
<td>B cell</td>
<td>B cell</td>
</tr>
<tr>
<td>Antigen action</td>
<td>IgE binding</td>
<td>IgG binding</td>
<td>IgG binding</td>
</tr>
<tr>
<td>Immune mechanism</td>
<td>mast cell degranulation</td>
<td>complement activation</td>
<td>complement activation</td>
</tr>
<tr>
<td>Immune mediator</td>
<td>histamine, cytokines</td>
<td>complement factors</td>
<td>complement factors</td>
</tr>
</tbody>
</table>

TYPE I HYPERSENSITIVITY

[Diagram showing the immune response to type I allergy]

[Diagram showing the immune response to type II allergy]
TYPE IV HYPERSENSITIVITY

(a) sensitisation phase

(b) effector phase

Overview

- Rhinitis is characterized by sneezing, itching, rhinorrhea, nasal congestion.
- 50% of all cases of rhinitis are caused by allergy.
- Seasonal allergic rhinitis = hay fever, seen in 10% of general population.
- Perennial rhinitis is found in 10-20% of population.
- Prevalence of allergic rhinitis in childhood has increased.
- 20% of children are affected by allergic rhinitis by age 3, 40% by age 6.

Symptoms

- Cough
- Sneezing
- Nasal pruritus
- Nasal congestion
- Sore throats – recurrent infections
- Hypernasality
- Peri-orbital swelling

Signs

- Allergic Salute
- Allergic Shiners
- Nasal Crease
- Buggy Turbinates

Cold or Allergy

<table>
<thead>
<tr>
<th></th>
<th>Cold</th>
<th>Allergic rhinitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runny nose</td>
<td>Common</td>
<td>Common</td>
</tr>
<tr>
<td>Stuffiness</td>
<td>Common and often severe</td>
<td>Common and variable in severity</td>
</tr>
<tr>
<td>Sneezing</td>
<td>Usual</td>
<td>Common</td>
</tr>
<tr>
<td>Itchy nose</td>
<td>Never</td>
<td>Usually</td>
</tr>
<tr>
<td>Watery eyes</td>
<td>Usual</td>
<td>Normal</td>
</tr>
<tr>
<td>Watery nose</td>
<td>Rare to usual</td>
<td>Common</td>
</tr>
<tr>
<td>Cough</td>
<td>Common</td>
<td>Often</td>
</tr>
<tr>
<td>Fever</td>
<td>Rare</td>
<td>Never</td>
</tr>
<tr>
<td>General debility</td>
<td>Slight</td>
<td>Slight or sometimes slight</td>
</tr>
<tr>
<td>Fatigue, weakness</td>
<td>Slight</td>
<td>Sometimes slight</td>
</tr>
<tr>
<td>Sore throat</td>
<td>Common</td>
<td>Never</td>
</tr>
<tr>
<td>Itchy palate and throat</td>
<td>Never</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Duration</td>
<td>1-3 days</td>
<td>Weeks to months</td>
</tr>
</tbody>
</table>
Management

- Avoidance
- Nasal steroid
- Decongestant
- Antihistamine
- Immunotherapy

Overview

- Chronic lung condition
- Reversible reactive airway obstruction
- Tightening of the muscles surrounding the bronchial passages in the lungs
- Asthma is a variable condition
- Can be developed at any age

Symptoms

- Cough
- Shortness of Breath
- Wheezing
- Chest Tightness

Asthma Triggers

- Allergen exposure
  - Dust mites, pollens, animal dander, mold, food
- Exercise
- Cold
- Infection
- Smoke
- Fragrances and chemicals
- Occupational irritants

Exercise Induced Asthma

- Exercise can induce asthma symptoms in people who have no other asthma triggers.
- Exercise is a trigger for 90% of people with asthma.
Dealing with Exercise Induced Asthma

- If prescribed, take bronchodilator 15 min before exercise
- Warm up and cool down gradually for 10-20 minutes
- If you have a flare-up, stop and take your medication, resume only when symptom-free

Diagnosing Asthma: Small Children

The wheezing child <3 years of age has an increased risk of asthma if either:

1. Major Criterion
   - Parent with asthma
   - Atopic dermatitis
   - Positive Skin Test

2. Minor Criteria
   - Allergic rhinitis
   - Wheezing apart from colds
   - Eosinophilia (>4%)

Asthma Predictive Index

- Loose index
  - Early wheezing (<3 episodes/year) +
  - ≥ 1 major or
  - ≥ 2 minor
- Stringent index
  - Early frequent (≥ 3 episodes/year) wheezing +
  - ≥ 1 major or
  - ≥ 2 minor

Diagnosing Asthma: Older Children

- Gold Standard: Methacholine Challenge

<table>
<thead>
<tr>
<th>Time</th>
<th>Test Phase</th>
<th>FEV1</th>
<th>QC Score</th>
<th>dFEV1 (% of baseline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>Baseline</td>
<td>3.10</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>9:10</td>
<td>Diluent</td>
<td>3.00</td>
<td>B</td>
<td>100%</td>
</tr>
<tr>
<td>9:15</td>
<td>0.06 mg/ml</td>
<td>3.05</td>
<td>A</td>
<td>102%</td>
</tr>
<tr>
<td>9:20</td>
<td>0.25 mg/ml</td>
<td>2.94</td>
<td>C</td>
<td>98%</td>
</tr>
<tr>
<td>9:25</td>
<td>1.0 mg/ml</td>
<td>2.62</td>
<td>A</td>
<td>87%</td>
</tr>
<tr>
<td>9:30</td>
<td>4.0 mg/ml</td>
<td>2.16</td>
<td>A</td>
<td>72%</td>
</tr>
<tr>
<td>9:45</td>
<td>BD recovery</td>
<td>3.20</td>
<td>B</td>
<td>107%</td>
</tr>
</tbody>
</table>

Diagnosing Asthma: Older Children

- Spirometry: Bronchodilator Reversibility

Treatment of Asthma

- Remove triggers
- Rescue Medication
- Controller Medication
**Rescue Medication**
- Known as rescue, reliever, and quick relief medications
- Reverses symptoms fast
- Bronchodilator inhaled directly to the lungs
- Begins working immediately, peaks at 5-10 minutes

**Controller Medication**
- Prevents asthma symptoms from starting
- Taken daily by people with persistent asthma
- Brings down inflammation/treats constriction

**Classification**
- Adverse reaction to food
  - Nontoxic
  - Toxic
  - Food allergy
    - IgE
    - Non-IgE
    - Food protein induced enterocolitis
  - Food intolerance
    - Metabolic
    - Pharmacologic
    - Idiosyncratic
    - Other

**Incidence**
- Public perception of food allergy: 30%
  - Higher than can be documented by food challenge procedures
  - Chocolate: most often suspected, rarely documented
- Incidence of adverse reactions to foods
  - 8% in children
  - 2% in adults
- Most children outgrow food sensitivities by 3 yrs
- Foods are frequently implicated as a cause of anaphylaxis

**Foods Responsible for Most Food Allergy**
- **Children**
  - Peanut, milk, egg, soy, tree nuts, wheat, fish, shellfish.
- **Adults**
  - Peanuts, tree nuts, fish, shellfish.
Symptoms

- **GI**
  - Nausea
  - Vomiting
  - Abdominal pain
  - Diarrhea

- **Systemic**
  - Anaphylaxis

- **Cutaneous**
  - Urticaria
  - Angioedema
  - Atopic dermatitis

- **Respiratory**
  - Rhinitis
  - Laryngeal edema
  - Asthma

Diagnosis

- Subjective tests:
  - Diet diaries
  - Elimination diets

- Objective tests:
  - Epicutaneous skin testing
  - Positive predictive accuracy = 50%
  - Negative predictive accuracy = 95%
  - Immunocap: Specific IgE
  - Food challenges

Treatment

- Avoidance
- Early recognition
- Administer liquid or chewable antihistamine
- Early administration of epinephrine
- Ambulance to emergency room

Food Protein-Induced Enterocolitis

- T cell-mediated with or without milk specific IgE
- Accounts for 40% cow’s milk protein hypersensitivity in infants and young children
- 30% develop atopic diseases
  - Atopic dermatitis: 25-65%
  - Asthma: 3-20%
  - Allergic rhinitis: 20%
- Family history of atopic diseases: 40-80%
- 20% pts have family history of food allergy. 

Clinical Presentation

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Chronic</th>
<th>Acute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermittent, chronic diarrhea</td>
<td>Repetitive diarrhea onset 1-3 hours after ingestion</td>
<td>Diarrhea onset about 5 hours after ingestion</td>
</tr>
<tr>
<td>Dehydration</td>
<td>Lethargy</td>
<td>Fatty</td>
</tr>
<tr>
<td>Abdominal distension</td>
<td>Weight loss</td>
<td>Dehydration</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anemia</td>
<td>Hypochromic, normochromic</td>
<td></td>
</tr>
<tr>
<td>Hyperbiliaemia</td>
<td>Elevated white count</td>
<td>Leukocytosis</td>
</tr>
<tr>
<td>Lactic acidosis</td>
<td>Metabolic acidosis</td>
<td>Metabolism acidosis</td>
</tr>
<tr>
<td>Methemoglobinemia</td>
<td>Fecal leukocytosis and eosinophils</td>
<td>Fecal leukocytes and eosinophils</td>
</tr>
<tr>
<td>stool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiology</td>
<td>Increased carbohydrate content in stool</td>
<td>Elevated gastric juice leukocytes</td>
</tr>
<tr>
<td>Intrinsic gas</td>
<td>Air-fluid levels</td>
<td></td>
</tr>
</tbody>
</table>

Treatment

- 90% patients have (-) skin test to food
- No elevation of food-specific IgE
- Food challenge
  - CBC pre and post showing ↑ Neutrophils
- Biopsy
  - Villous atrophy
  - Tissue edema
  - Crypt abscesses
INSECT STING ALLERGY

TAXONOMY

Aculeata (stinging Hymenoptera)
- Apidae (Bees)
  - Apis melifera (honeybee)
  - Bombus spp. (bumblebee)
- Formicidae (ants)
  - Solenopsis invicta (fire ant)
- Vespidae (wasps)
  - Polistinae
    - Polistes exclamans (paper wasp)
  - Vespinae
    - Vespa (old world hornets)
    - Vespula (concealed yellow jackets)
    - Dolichovespula (aerial nesting yellow jackets and hornets)

Symptoms
- Local reactions
  - Redness
  - Swelling
  - Itching
  - Pain
- Large local
  - Swelling and erythema
  - Contiguous with sting site
- Systemic reaction
  - Remote or not contiguous with the site of sting
  - Urticaria and angioedema
  - Bronchospasm
  - Hypotension and shock (anaphylaxis)

Treatment
- Local or large local reaction
  - Cold compresses
  - Local anesthetic cream
  - PO antihistamine
- Anaphylaxis
  - Wear MedicAlert bracelet
  - EpiPen (0.15 mg for <30 kg, adult 0.3mg)

URTICARIA AND ANGIOEDEMA
**Urticaria**
- Sudden appearance of wheals and/or angioedema
- Central swelling surrounded by a reflex erythema
- Associated itching, or sometimes, burning sensation
- Skin returning to normal appearance within 1-24 h

**Angioedema**
- Deeper subcutaneous swelling
- Less circumscribed than urticaria
- Sometimes pain rather than itching
- Leakage of plasma into subcutaneous/mucosal tissue

**Acute Urticaria**
- < 6 weeks
- Could be triggered by allergy to food, drug, insect sting, allergen exposure
- Viral infection very common

**Chronic Urticaria**
- Physical Urticaria
- Chronic Spontaneous Urticaria
- Chronic Autoimmune Urticaria
- Urticarial Vasculitis

**Chronic Urticaria**
- Not contagious
- Recurrent
- Histamine mediated
- Specific diagnostic modality available for most but not all patients
- Treatment
  - Antihistamine (H1 and H2 blockers)
  - Prednisone
  - Cyclosporine
  - Omalizumab

**ANAPHYLAXIS**
**Definition**

- Clinical: “Anaphylaxis is a serious allergic reaction that is rapid in onset and may cause death.”
- Pathophysiological: “mass degranulation of mast cell and basophils leading clinical symptoms”

**Clinical Presentations**

- Upper airway
  - Stridor, hoarseness, dysphonia, laryngeal edema — Obstruction — Death
- Lower airway
  - Dyspnea, wheezing, cough, chest tightness
- Cardiovascular
  - Tachycardia, hypotension, arrhythmias, lightheadedness, shock
- Gastrointestinal
  - Nausea, vomiting, diarrhea, dysphagia, abdominal cramping
- Genitourinary
  - Uterine cramping
- Neurologic
  - Confusion, loss of consciousness, seizures

**Progression of Anaphylaxis**

- Flushing
- Syncope
- Cyanosis
- Convulsions
- Death

- Uniphasic vs Biphasic
  - Same manifestations as at presentation recur up to 8 hours later and rarely much later (occurs in 1-20%)

**Diagnostic Criteria**

1. Acute onset of an illness (minutes to several hours) with involvement of the skin, mucosal tissue, or both (e.g., generalized hives, pruritus or flushing, swollen lips/tongue/eye)
   And at least one of the following:
   a. Respiratory compromise (e.g., dyspnea, wheezing, stridor, reduced PE, hypoxemia)
   b. Reduced BP or associated symptoms of end-organ dysfunction (e.g., hypotension [falling], syncope, incontinence)

2. Two or more of the following that occur rapidly after exposure to a likely allergen for the patient (minutes to several hours):
   a. Involvement of the skin/mucosal tissue (e.g., generalized hives, itch/flu, swollen lips/tongue/eye)
   b. Respiratory compromise (e.g., dyspnea, wheezing, stridor, reduced PE, hypoxemia)
   c. Reduced BP or associated symptoms (e.g., hypotension [falling], syncope, incontinence)
   d. Persistent gastrointestinal symptoms (e.g., cramp abdominal pain, vomiting)

3. Reduced BP after exposure to known allergen for the patient (minutes to several hours):
   a. Infants and children: low systolic BP (age-specific) or >30% decrease in systolic BP
   b. Adults: systolic BP <90 mm Hg or >30% decrease from that patient’s baseline

**Laboratory Testing**

<table>
<thead>
<tr>
<th>Clinical condition</th>
<th>Trypsin levels (mg/mL)</th>
<th>Trypsin ratio (total/mature)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>1-15</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Systemic anaphylaxis (acute)</td>
<td>&gt;Baseline &gt;15</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Systemic mastocytosis (nonacute)</td>
<td>&gt;20°</td>
<td>&lt;1 to small elevations &gt;20</td>
</tr>
</tbody>
</table>

Schwartz, Immunol Allergy Clin N Am. 2006:26:463
Management of anaphylaxis

- Emergency protocol
- First line medication
- Second-line medication

Emergency Protocol

1. Have a written emergency protocol for recognition and treatment of anaphylaxis and allergic reactions.

2. Determine whether the trigger agent is identified. If yes, discontinue contact with potential allergens. If not, assess the patient for other causes of anaphylaxis.

3. Assess the patient’s circulatory, respiratory, neurological, and cutaneous symptoms.

4. Provide appropriate treatment: perform steps 4.1 and 4.2.

5. Call for help: mechanism (e.g., hospital), or emergency medical services (if available).

6. Inject epinephrine (adrenalin) intramuscularly in the mid-axillary line of the patient’s thigh. Administer 0.01 mg/kg (max 0.5 mg) SC or IM.

7. Infuse ephedrine (ephedrine) if necessary. Consider i.v. access if needed.

8. Administer oxygen if respiratory distress.

9. Administer bronchodilators if necessary.

10. Provide cardiopulmonary resuscitation if necessary.

First Line Medication: Epi

- Dose: 0.01 mg/kg (max 0.5 mg)
- Route: SC, IM
- Format: Epi-pen: regular (0.3mg), Junior (0.15mg); Epi-card: recalled
- Injection: syringe: not available

2nd Line Medication

<table>
<thead>
<tr>
<th>Medication</th>
<th>2nd Line Medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medication</td>
<td>Articular Pleural Pain (AMP)</td>
</tr>
<tr>
<td>Dose</td>
<td>2-3 mg/kg (max 20 mg)</td>
</tr>
<tr>
<td>Route</td>
<td>SC, IM</td>
</tr>
<tr>
<td>Format</td>
<td>Epi-pen: regular (0.3mg), Junior (0.15mg)</td>
</tr>
<tr>
<td>Injection: syringe: not available</td>
<td></td>
</tr>
</tbody>
</table>

SUMMARY

- Acute allergic reaction may present with mild to severe clinical symptoms.
- Not all allergic reactions lead to anaphylaxis.
- Non-allergic disorders such as urticarial and angioedema may present similar symptoms as acute allergy.
- Early recognition and treatment of anaphylaxis is the key to survivor.