Chapter 14:

ALLERGOLOGY

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This chapter covers the following topics:

- Allergic rhinitis
- Urticaria
- Asthma
- Anaphylaxis
- Food allergy
- Drug hypersensitivity
- Other conditions to recognise

ALLERGIC RHINITIS

Allergic rhinitis is characterized by intense sneezing, rhinorrhoea, nasal obstruction, and itching of the eyes (see related image here), nose and palate. It may be intermittent/seasonal (hay fever) or persistent/perennial (all year round).

Pathophysiology

Atopic individuals produce allergen-specific immunoglobulin E (IgE) when exposed to allergens. IgE antibodies then bind to the IgE receptors on mast cells in the respiratory mucosa. Upon subsequent exposure to the same allergen, the allergen binds and cross-links IgE on the mast cell surface, resulting in the activation and release of inflammatory mediators (histamine, prostaglandins, leukotrienes platelet-activating factor, bradykinin and others). The release of inflammatory mediators results in the signs and symptoms of allergic rhinitis.

Table 14.1: Summary Table of Intermittent and Persistent Allergic Rhinitis

	Intermittent or Seasonal	**Persistent or Perennial**
Timing	It is usually precipitated by exposure to certain seasonal pollens e.g. grass or tree pollen. Thus, it usually occurs in spring and at the change of seasons.	It is usually due to sensitivity to allergens present all year round e.g. grass pollen, house dust mites, pet allergens, fungal spores.
Clinical Features	The patient may have: ● Nasal symptoms – congestion, otorrhoea, itching, sneezing ● Ocular symptoms – itching, tearing ● Postnasal drip – sore throat, cough (see related image here) On examination, one may find allergic facies, characterised by: ● Allergic shiners ● Allergic salute and resultant nasal crease (from chronic performance of the salute) ● Swollen and pale nasal mucous membranes ● Wet turbinates with watery nasal discharge (turbinates may obstruct by >50% and there may be a post-nasal drip oral examination) ● Mouth-breathing ● Injected sclera	

	● Intense sneezing ● Rhinorrhoea ● Itching of the nasal, palate and auditory canals	● Nasal itching not common ● Obstruction and rhinorrhoea
Investigations	● Total IgE (Immuno-CAP) is non-specific. One may do nasal smears of nasal mucous stained with Hansel's stain to look for eosinophil clumping. ● Skin prick testing (SPT) is the gold standard for identifying allergens. ● Radioallergosorbent testing (RAST) is often performed as an inhalant mix, although it is more expensive than SPT and does not identify individual causative organisms.	
Management	Non-pharmacological management includes allergen avoidance (usually difficult) and desensitisation through immunotherapy (effective in monosensitive patients). Pharmacological management includes the use of: ● Short-acting non-sedating oral antihistamines for itching, rhinorrhea and sneezing e.g. second-generation antihistamines (cetirizine, loratadine). Newer agents (e.g. desloratadine) have the added benefit of not being sedating, which is important for school-going children. ● Intranasal corticosteroids for nasal congestion e.g. beclomethasone, budesonide,	Non-pharmacological management also includes allergen avoidance desensitisation through immunotherapy (effective if monosensitive to a single unavoidable allergen). Pharmacological management includes the use of: ● Intranasal corticosteroids for nasal congestion. They are given as "controller" medication for persistent allergic rhinitis and are very effective in this form of rhinitis e.g. beclomethasone, budesonide, fluticasone, mometasone, ciclesonide. Correct intranasal steroid technique is imperative to allow optimal delivery and minimise side effects, which include nasal irritation, sneezing and bleeding. ● Decongestants in the short-term (5-7 days).

	fluticasone, mometasone, ciclesonide. Adverse effects include nasal irritation, sneezing and bleeding.	Adverse effects include rebound rhinitis, tachycardia, anxiety, insomnia.

Note: Allergic rhinitis is a common comorbidity . It may be treated with antihistamine eye drops (olopatadine or ketotifen eye drops have mast cell-stabilising action) and non-sedating, oral antihistamines as above.

ECZEMA

See *Dermatological Conditions* chapter.

URTICARIA

It is characterised by the presence of itchy lesions varying from flat, erythematous papules to large plaques or wheals. These skin lesions appear within minutes and disappear within hours with no trace. It may be acute (lasting <6 weeks) or chronic (lasting >6 weeks).

Infection-associated urticaria is the most common cause of acute urticaria (see related image here). It is commonly misdiagnosed as antibiotic allergy if the child has been prescribed an antibiotic for the acute infection.

Pathophysiology and Clinical Presentation

Lesions are red due to vasodilation and the oedema is the result of increased permeability of blood vessels from the release of histamine and other immune mediators in the skin.

Angioedema results when deeper vessels are involved. Laryngeal oedema and respiratory compromise are life-threatening.

Aetiology

Causes include:

- Infection and infestation – tonsillitis, otitis, UTI, sinusitis, multiple viral triggers, worm infestation, schistosomiasis

- Drugs – aspirin, penicillin
- Food – hen's eggs, peanuts, cow's milk, fish, preservatives

Investigations

No routine investigations are indicated for acute urticaria. The clinician may tailor investigations to the child based on his/her clinical condition and presentation. It is imperative to exclude food allergy on history in any child presenting with acute urticaria.

Baseline investigations for chronic idiopathic urticaria are done to identify underlying infection or systemic disease. Investigations may include FBC, erythrocyte sedimentation rate (ESR), urine dipstick and blood pressure monitoring.

Management

The child must avoid identified triggers. Non-sedating oral antihistamine should be given to the child who has had a mild attack of unknown cause. Systemic antibiotics are given if an underlying infection is suspected.

Chronic urticaria requires discussion with a paediatric allergist or suitably trained clinician. Severe attacks may require systemic corticosteroids

ASTHMA

Pathophysiology

Asthma is a chronic inflammatory condition which leads to airway narrowing through various mechanisms, including:

- Spasm of the smooth muscle of the airways
- Mucous-plugging in airways
- Inflammation in airways – due to infiltration by inflammatory cells, membrane thickening secondary to collagen deposition epithelial damage of the airways or activation of mast cells

These processes can be triggered by exposure to allergens and irritants, and can lead to acute bronchoconstriction and chronic inflammation.

Precipitating factors

- Viral respiratory tract infections

- Exercise
- Weather/seasons
- Cigarette smoke
- Stress
- Allergens
    - House dust mite
    - Animal dander
    - Pollens
    - Moulds
    - Grasses
- Irritants
    - Paint
    - Chemicals – cleaning products
    - Perfumes
    - Fumes
    - Nitrogen dioxides
    - Room deodorizers

Clinical Features and Investigations

History

The child may present with a history of:

- Cough
- Wheeze
- Dyspnoea
- Chest tightness
- Chest pain
- Symptoms related to the seasons
- Symptoms worse at night
- Family history of asthma (see related image here) or atopy

Examination

It is usually normal unless there is an acute exacerbation. On general examination, one may find dry cough, atopic facies, and signs of rhinitis, conjunctivitis or eczema. Respiratory examination may show:

- Hyperinflation
- Long expiratory phase
- Wheeze on auscultation
- Signs of infection

In a severe acute attack, the child may present with:

- Anxiety
- Restlessness
- Tachycardia
- Wheezing
- Unable to speak
- Pulsus paradoxus

Investigations

One should get peak flow meter readings and perform lung function tests.

Assessment

Assessment of Control

Long-term asthma control is determined based on symptoms, activity limitation, frequency of reliever use and lung function tests.

Table 14.2: Assessment of Asthma Control

	Intermittent	**Mild**	**Moderate**	**Severe**
Symptoms	<2 days/week	>2 days/week but not daily	Daily	Throughout the day
Nocturnal symptoms	<2 times/month	3-4 times/month	>1/week but not every night	Often, 7 times/week
Daily activity	No limitation	Minor limitation	Some limitation	Extreme limitation

β_2-agonist use	≤2 days/week	>2 days a week but not daily	Daily	Several times a week
Lung function tests	Normal FEV_1 FEV_1 >80% FEV_1/FVC >85%	FEV_1 >80% FEV_1/FVC >80%	FEV_1 60-80% FEV_1/FVC 75-80%	FEV_1 <60% FEV_1/FVC <75%

Assessment of Attack Severity

The severity of an asthma attack is determined based on the patient's clinical features:

- Moderate:
    - Saturation < 92%
    - No signs of severe
    - PEF ≥50%
- Severe:
    - Saturation <92%
    - Tachycardia
    - Tachypnoea
    - Accessory muscle use
    - PEF 33-50%
- Life-threatening:
    - Saturation <92% and one of:
    - Silent chest
    - Poor respiratory effort
    - Altered consciousness
    - PEF <33%
    - Cyanosis

Management

Routine Management

Non-pharmacological management includes:

- Avoiding triggers
- Avoiding/reducing exposure to allergens or irritants

- Treating comorbid conditions e.g. allergic rhinitis

Pharmacological management includes the use of:

- Relievers (should be given to all patients) – β_2-agonists
- Controllers (given to persistent asthmatics) – inhaled corticosteroids, leukotriene receptor antagonists, and long acting be β_2-agonists

The choice of controller is dependent on the severity of the asthma.

Management of an Acute Attack

If the child is having:

- Moderate asthma attack:
    - Give a β_2-agonist (2-10 puffs via spacer; increase by 2 puffs every 2 minutes if not responding)
    - Give oral prednisone (2 mg/kg)
- Severe asthma attack:
    - Admit and give facemask oxygen
    - Give a β_2-agonist (10 puffs via spacer or 2.5-5 mg via nebuliser)
    - Give oral prednisone (2 mg/kg) or IV hydrocortisone (4 mg/kg)
    - If there is a poor response, add ipratropium bromide (0.25 mg via nebuliser)
    - Repeat β_2-agonist and ipratropium every 20-30 minutes as needed
- Life-threatening asthma attack:
    - Admit and give facemask oxygen
    - Give nebulised β_2-agonist (2.5-5 mg) and ipratropium bromide (0.25 mg)
    - Give IV hydrocortisone (4 mg/kg)
    - Repeat bronchodilators every 20-30 minutes as needed
    - Admit to PICU if there is a poor response

See diagram related to asthma here.

ANAPHYLAXIS

Definition

It is an acute, life-threatening, multi-systemic reaction to an allergen that may be mediated by IgE and causes a systemic release of mast cell mediators. Causes include food, drugs and insect bites/stings e.g. *Hymenoptra* allergy – wasps, bees, ants. The reaction may also be non-IgE-mediated (previously termed an anaphylactoid reaction).

Pathophysiology and Clinical Features

The IgE-mediated response leads to the release of mast cell mediators, such as histamine, tryptase and others. These mediators produce a rapid response in the skin, respiratory system, GIT and cardiovascular system (CVS), leading to the following clinical features:

- Skin – rash (e.g. urticaria), itching, flushing, tongue swelling, conjunctival swelling, angioedema, flushing, pruritus
- Respiratory system – shortness of breath, wheezing, stridor, rhinorrhoea or congestion, sensation of the closing of the throat, stridor
- GIT – nausea, vomiting, diarrhoea, abdominal pain (usually cramping), abdominal tenderness
- CVS – dizziness, collapse, palpitations, tachycardia, hypotension

Diagnostic

Anaphylaxis can be diagnosed if one of these criteria is met:

- Criterion 1 – acute onset of respiratory dysfunction, hypotension or symptoms associated with hypotension (e.g. syncope) AND skin and/or mucosal involvement in the patient with no known allergies
- Criterion 2 – two or more of the following occurring in the patient with a known allergy and a history of recent allergen exposure (but not necessarily to the allergen to which s/he is known to be allergic):
    - Skin and/or mucosal involvement
    - Respiratory dysfunction
    - Hypotension or symptoms associated with hypotension such as syncope

    - Persistent signs and symptoms of gastrointestinal dysfunction
- Criterion 3 – hypotension in the patient with a known allergy after exposure to that allergen
    - Low systolic BP (SBP) is age-specific in children – 1 month to 1 year = SBP <70 mmHg; 1-10 years = SBP <70 mmHg + (2 x age in years); 11-17 years = SBP <90 mmHg

Investigations

Mast cell tryptase levels should be measured at the time of reaction, 6 hours after the reaction and again at 12 hours. Other investigations related to the systemic effects of anaphylaxis and the resuscitation required may be performed.

Management

Non-pharmacological management includes:

- Calling for help
- Resuscitating the patient – assessing the airway, breathing and circulation and managing as required
- Removing the cause, if known

Pharmacological management includes

- Administering adrenaline IM (1:1000, 0.3-0.5 mL; can be repeated in 20 min-intervals if needed) (see related image here)
- Administering antihistamines e.g. promethazine (0.25-0.5 mg/kg IM)
- Giving IV fluids (crystalloids)
- Giving facemask or nasal prong oxygen
- Administering aminophylline (slow IV at 4 mg/kg; if there is bronchospasm)
- Administering hydrocortisone (100-200 mg IV 4-6 hourly for 24 hours and longer if needed)

FOOD ALLERGY

Pathophysiology

Food allergies are IgE-mediated or non-IgE mediated, abnormal responses to a particular food. This leads to the release of mast cell mediators and a systemic response.

Aetiology

Food allergy is commonly caused by:

- Egg
- Cow's milk
- Soya
- Peanuts
- Wheat
- Fish

See related image here.

Clinical Features

They include:

- Gastrointestinal manifestations – vomiting, diarrhoea
- Skin manifestations – urticaria, atopic dermatitis, angio-oedema
- Respiratory – nasal obstruction, wheezing

Investigations

- SPT
- ImmunoCAPRAST

See related image here.

Management

Non-pharmacological management includes avoidance of the offending food or ingredient in non-food items. Pharmacological management includes antihistamines for mild itching and rashes and anaphylaxis management (if required).

DRUG HYPERSENSITIVITY

This is an adverse reaction which occurs after exposure to a drug and it can be immunologic or non-immunologic. SPT may be done to identify the offending agent.

Clinical Features

The hypersensitivity reaction can be immediate (60 minutes), accelerated (1-72 hours) or late (>72 hours). Skin manifestations are most common e.g. serum sickness, dermatitis, Stevens-Johnson syndrome (SJS), toxic epidermal necrolysis (TEN). However, anaphylaxis can occur.

Management

It includes:

- Education
- Avoidance of the offending drug
- Wearing a MedicAlert bracelet
- Desensitisation
- Management of anaphylaxis

The patient should be referred if there are severe skin reactions.

OTHER CONDITIONS TO RECOGNISE

Hereditary Angioedema

It is characterised by recurrent episodes of angioedema without urticaria or pruritus. The swelling is usually self-limiting and resolves within a few days. It is thought to arise from a deficiency in or dysfunction of C1 inhibitor (C1INH; an acute-phase reactant).

Hereditary angioedema should be suspected in patients with:

- Recurrent episodes of angioedema without urticaria or pruritus and which last 2-5 days
- Positive family history of angioedema
- Unexplained laryngeal oedema
- Unexplained recurrent episodes of self-limited, colicky, abdominal pain
- Low complement component 4 level

See related image here.

Once the diagnosis has been made, family members should be encouraged to get tested. It is important to note that infants under <1 year normally have lower levels of C1INH, which makes diagnosis difficult. Thus, testing is usually done when the infant is older to avoid false-positives and false-negatives.

Most patients do not respond to antihistamines and glucocorticoids.

Inherited Complement Deficiency

Inherited complement deficiencies are very rare. Individuals lose function of the specific, deficient protein as well as the function of the proteins that follow in that specific cascade. Thus, those affected are predisposed to recurrent bacterial infections and/or SLE.

Screening is indicated in patients with:

- Recurrent unexplained pyogenic infections with no obvious aetiology
- Recurrent *Neisseria* infections
- Multiple family members with *Neisseria* infections

Management involves patient education (to look out for early signs of infection) and vaccinations against organisms to which the patient has a higher risk of infection.

Sinusitis or Rhinosinusitis

It is the infection of the paranasal sinuses and can be caused by various microorganisms, but is commonly caused by viruses. It is also known as the common cold.

One must differentiate uncomplicated viral sinusitis from acute bacterial sinusitis. Both present with similar symptoms but have different clinical courses. Common symptoms include cough, fever, nasal discharge or congestion, headache and facial pain.

Viral sinusitis is usually self-limiting and will resolve within 7-10 days, with symptoms peaking in days 3-6. Antibiotics do not help with the treatment of viral sinusitis

In bacterial sinusitis, the above symptoms persist for longer than 10 days and are often more severe (e.g. higher temperatures) or may worsen. It can have complications, such as local spread of infection which may lead to periorbital cellulitis, orbital cellulitis and meningitis. It needs to be treated with antibiotics.

Latex Allergy

Natural rubber latex allergy is caused by the sensitisation to proteins in the sap-like fluid from the tree *Hevea brasiliensis.* Most individuals are sensitised after exposure to latex gloves, dental dams or balloons.

The prevalence of latex allergy is higher in patients sensitised to other allergens and those with eczema or a fruit/vegetable allergy. Children with spina bifida are at high risk of latex sensitisation because they undergo multiple surgeries, frequent bladder catheterisations and manual rectal evacuation.

Symptoms depend on the route of exposure, the amount of allergen in the rubber and the mechanism of the reaction. Common presentations include:

- Dry, crusted, irritated skin with/without erythema and vesicle formation (a form of irritant contact dermatitis – non-IgE mediated reaction)
- Urticaria, rhinoconjunctivitis, asthma and anaphylaxis i.e. IgE-mediated reactions

The diagnosis is made based on a strong suggestive history and significant association between exposure and symptoms. Management includes avoidance, pharmacotherapy, immunotherapy and anti-IgE therapy.

Insect Venom Allergy

Pathophysiology

It is similar to that of food allergy. Insects commonly involved include mosquitoes, fleas, flies, bees, wasps, hornets, and fire and harvester ants.

Clinical presentation

The child will present with history of:

- A sting or bite from an insect
- Localised pain, swelling and redness
- Anaphylactic symptoms

Examination findings:

- Localised tenderness, swelling, erythema and blisters
- Signs of anaphylaxis

Investigations

One should attempt to identify the insect and perform venom testing.

Management

Non-pharmacological management includes cleaning the wound and applying a cold compress.

Pharmacological management includes the use of antihistamines, analgesia and steroids (if there is significant swelling). Anaphylaxis management should be performed, as needed.

Mastocytosis

This is a group of conditions in which there is accumulation of mast cells in various tissues, and it can be divided in two categories:

- Cutaneous – limited to the skin
- Systemic – there is accumulation of cells in organs; can have cutaneous involvement

There may be various skin findings with pruritus being common. The child may also have symptoms related to the effects of mast cell mediators (e.g. hypotension, nausea, diarrhoea, vomiting) and the organ that has been infiltrated.