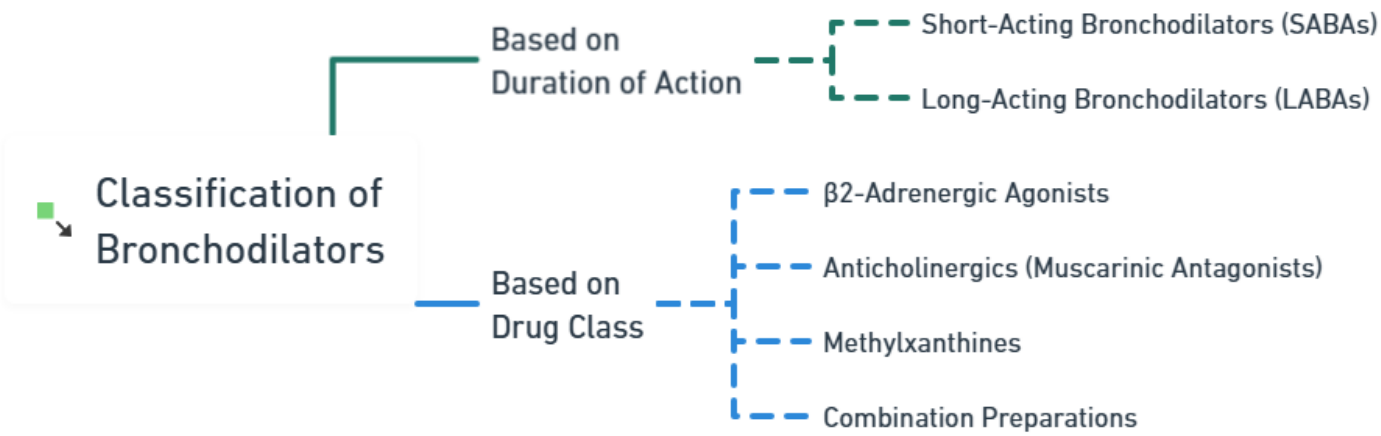
Drugs acting on Respiratory tract

Bronchodilators

Introduction

- Bronchodilators are a class of drugs that reduce resistance in the respiratory airway and increase airflow to the lungs.
- These drugs do not alter the underlying inflammation in airway diseases but help in symptom management by dilating constricted bronchi and bronchioles.
- There are three main types of bronchodilators based on their mechanism of action:
    - **β2-adrenergic agonists**
    - **Anticholinergics (Muscarinic antagonists)**
    - **Methylxanthines**
- They may be used as short-acting for quick relief or long-acting for maintenance therapy.

Classification



A. Based on Duration of Action

1. Short-Acting Bronchodilators (SABAs)

- Provide quick relief
- Onset: Within minutes
- Duration: 4–6 hours
- Example: Salbutamol (Albuterol), Terbutaline

2. Long-Acting Bronchodilators (LABAs)

- Maintenance therapy
- Onset: Slower (variable)
- Duration: ≥12 hours
- Example: Salmeterol, Formoterol

B. Based on Drug Class

1. β2-Adrenergic Agonists

- Mechanism: Stimulate β2 receptors causing smooth muscle relaxation
- Examples:
  - Short-acting: Salbutamol, Terbutaline
  - Long-acting: Salmeterol, Formoterol
  - Ultra-long-acting: Indacaterol, Olodaterol

2. Anticholinergics (Muscarinic Antagonists)

- Mechanism: Block M3 muscarinic receptors, inhibit vagal-mediated bronchoconstriction
- Examples:
  - Short-acting: Ipratropium
  - Long-acting: Tiotropium, Aclidinium

3. Methylxanthines

- Mechanism: Non-selective phosphodiesterase inhibitors → ↑ cAMP → bronchodilation
- Example: Theophylline, Aminophylline

4. Combination Preparations

- β2 agonist + anticholinergic (e.g., Salbutamol + Ipratropium)
- LABA + inhaled corticosteroid (e.g., Formoterol + Budesonide)

Mechanism of Action

A. β2-Adrenergic Agonists

- These drugs bind to β2-adrenergic receptors on bronchial smooth muscle.
- Activation of β2 receptors → stimulation of adenylate cyclase → increased cyclic AMP (cAMP) → activation of protein kinase A → inhibition of myosin light chain kinase → smooth muscle relaxation → bronchodilation.

B. Anticholinergics

- Inhibit M3 muscarinic receptors on airway smooth muscle.
- M3 receptor stimulation normally causes bronchoconstriction via the parasympathetic nervous system.
- By blocking these receptors, these drugs prevent bronchoconstriction and reduce mucus secretion.

C. Methylxanthines

- Inhibit phosphodiesterase (PDE), especially PDE-3 and PDE-4.
- This prevents breakdown of cAMP → higher cAMP levels → smooth muscle relaxation.
- Also, have some anti-inflammatory and mild central stimulant effects.

Pharmacokinetics

Class	Absorption	Distribution	Metabolism	Elimination
β2-agonists	Inhaled forms act locally; oral absorbed well	Local for inhaled	Hepatic (CYP450 enzymes)	Urine (metabolites)
Anticholinergics	Poor systemic absorption (mainly local action)	Lungs	Minimal metabolism	Excreted in urine/feces
Methylxanthines	Well absorbed orally	Wide	Hepatic (CYP1A2, CYP3A4)	Renal (as metabolites)

Pharmacodynamics

- **Onset of action**:
  - SABAs: Within 5–15 minutes
  - LABAs: 30 minutes to few hours
  - Anticholinergics: 15–30 minutes
  - Methylxanthines: Oral onset within 1 hour
- **Duration of action**:
  - Varies widely (SABAs: 4–6 h, LABAs: ≥12 h)
- **Effectiveness**:
  - Most effective when inhaled due to direct action and fewer systemic effects.
- **Dose-response relationship**:
  - SABAs have a ceiling effect beyond which side effects increase without more benefit.

Adverse Effects

1. β2-Agonists

- Tremors
- Tachycardia
- Palpitations
- Hypokalemia
- Headache

- Tolerance with long-term use

2. **Anticholinergics**
   - Dry mouth
   - Metallic taste
   - Urinary retention
   - Glaucoma risk if aerosol contacts eyes (especially with nebulization)
3. **Methylxanthines**
   - Nausea, vomiting
   - CNS stimulation (tremor, insomnia, seizures at high doses)
   - Cardiac arrhythmias
   - Narrow therapeutic index → requires monitoring

Contraindications

A. **β2-agonists:**
   - Caution in patients with cardiac arrhythmias, hypertension, hyperthyroidism

B. **Anticholinergics:**
   - Contraindicated in narrow-angle glaucoma, prostatic hypertrophy

C. **Methylxanthines:**
   - Avoid in peptic ulcer, epilepsy, cardiac arrhythmias

Therapeutic Uses

1. **Asthma**:
   - SABAs for acute attacks
   - LABAs (with corticosteroids) for maintenance
2. **COPD**:
   - Anticholinergics are especially useful
   - LABAs and combination therapies preferred
3. **Bronchospasm**:
   - Due to various triggers (exercise, allergens)

- **Apnea of prematurity** (methylxanthines like caffeine or theophylline)

Interactions

1. **β2-Agonists:**

- May interact with non-selective beta-blockers (e.g., propranolol)
- Diuretics and corticosteroids may increase risk of hypokalemia

2. Methylxanthines:

- Interactions with CYP1A2 inhibitors (e.g., ciprofloxacin, erythromycin) → increased theophylline levels
- Smoking induces CYP1A2 → lowers levels

3. Anticholinergics:

- Additive anticholinergic effects with other anticholinergics (e.g., atropine)

Dose and Route of Administration

Drug/Class	Dose Example	Route
Salbutamol (SABA)	100–200 mcg every 4–6 h	Inhalation (MDI, nebulizer)
Salmeterol (LABA)	50 mcg BID	Inhalation (DPI)
Ipratropium (SAMA)	20–40 mcg every 6–8 h	Inhalation
Tiotropium (LAMA)	18 mcg once daily	Inhalation (DPI)
Theophylline	300–600 mg/day (divided)	Oral/IV
Aminophylline	Loading: 5–6 mg/kg IV, then infusion	Intravenous

First Hope

FREE PREVIEW

Click here to visit our website

PHARMACY PREMIUM NOTES

Complete subject and semesters are available on FirstHope app only.

Scan or click here

Click here to get the app >

Available on Google Play

JOIN THE FIRSTHOPE COMMUNITY

Join our Telegram channel

Click here to join Telegram >

Scan or click here

@FirstHopeNotes

Instagram

@firsthope.official

Click here to follow >

YouTube channel

FirstHope-Pharmacy / Live streams

Click here to watch >

WhatsApp channel

Follow FirstHope on WhatsApp

Click here to join >

FirstHope website

firsthope.co.in

Click here to visit >

B.Pharm / D.Pharm / M.Pharm / Pharm.D

Preview notes. Complete subjects and semesters in the FirstHope app.