Cardiovascular Pharmacology

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- Cardiovascular pharmacology deals with drugs that act on the **heart and blood vessels** to treat diseases like hypertension, angina, arrhythmias, heart failure, and lipid disorders.

Basic Concepts

- The cardiovascular system maintains **blood flow, oxygen delivery, and blood pressure**.
- **Drugs act by modifying:**
  - Heart rate (chronotropy)
  - Force of contraction (inotropy)
  - Blood vessel tone (vasodilation or vasoconstriction)
  - Blood volume

Key Targets for Drugs

1. **Receptors**
   - β1 receptors → increase heart rate and force
   - β2 receptors → vasodilation
   - α1 receptors → vasoconstriction
2. **Ion channels**
   - Calcium channels → control contraction
   - Sodium channels → affect electrical conduction
3. **Renin-Angiotensin-Aldosterone System (RAAS)**
   - Controls blood pressure and fluid balance

Major Drug Actions

- Decrease cardiac workload
- Improve oxygen supply
- Reduce blood pressure
- Prevent clot formation
- Correct abnormal rhythms

Clinical Importance

- Used in life-threatening conditions
- Require careful dose adjustment

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- Many drugs have narrow therapeutic index
- Drug interactions are very common

Diuretics

- Diuretics are drugs that increase the excretion of water and electrolytes (mainly sodium) from the body through urine.
- They are widely used in cardiovascular diseases, especially hypertension and heart failure.

Why Diuretics are Used

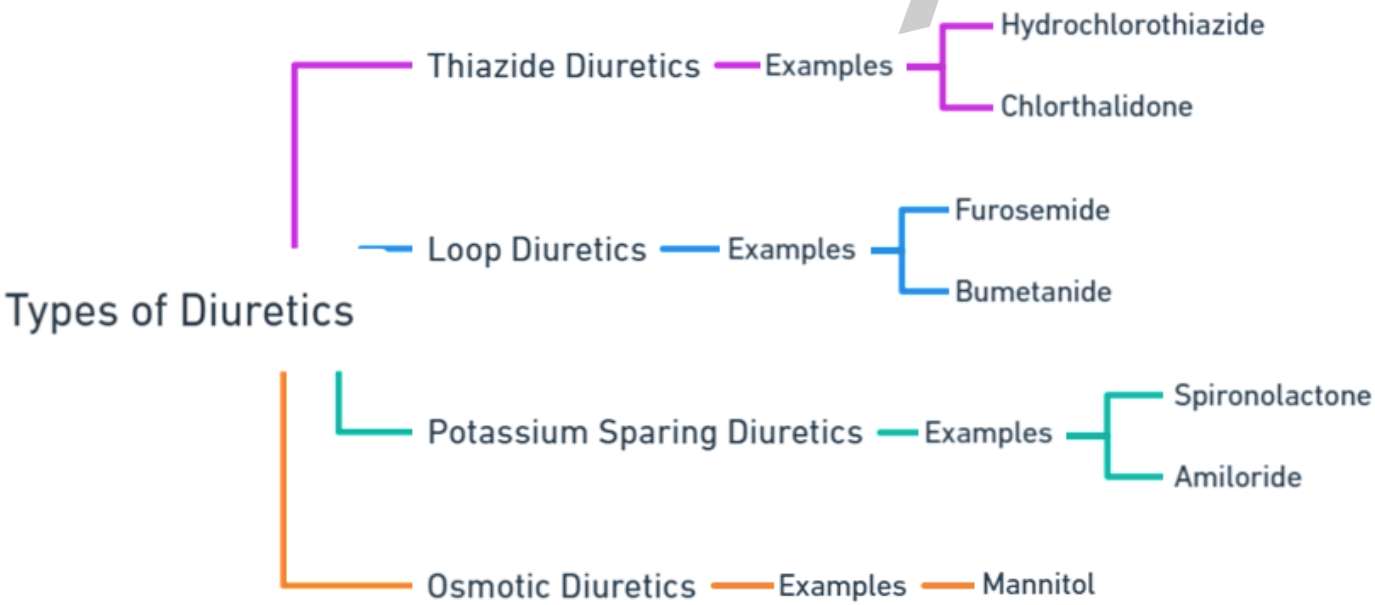
- Reduce blood volume → lowers blood pressure
- Decrease edema (fluid accumulation)
- Reduce workload on the heart
- Improve symptoms in heart failure

Basic Mechanism

- Kidneys filter blood and reabsorb sodium and water
- Diuretics block sodium reabsorption at different parts of the nephron
- Water follows sodium → increased urine output

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Types of Diuretics



1. Thiazide Diuretics (e.g., Hydrochlorothiazide, Chlorthalidone)

- Act on distal convoluted tubule
- Moderate diuretic effect
- First-line drugs for hypertension

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Mechanism

- Block Na^+/Cl^- transporter → increased sodium and water loss

Effects

- Decrease blood volume
- Long-term: reduce peripheral resistance

2. Loop Diuretics (e.g., Furosemide, Bumetanide)

- Act on Loop of Henle (thick ascending limb)
- Most powerful diuretics

Mechanism

- Inhibit Na^+-K^+-$2Cl^-$ transporter

Effects

- Massive fluid loss
- Used in pulmonary edema, severe heart failure

3. Potassium-Sparing Diuretics (e.g., Spironolactone, Amiloride)

- Act on collecting duct

Mechanism

- Spironolactone: blocks aldosterone receptor
- Amiloride: blocks sodium channels

Effects

- Mild diuresis
- Prevent potassium loss

4. Osmotic Diuretics (e.g., Mannitol)

- Increase osmotic pressure in tubules

Uses

- Reduce intracranial pressure
- Acute renal failure

Adverse Effects

- Hypokalemia (except potassium-sparing)
- Dehydration
- Hypotension
- Electrolyte imbalance

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Therapeutic Uses

- Hypertension
- Heart failure
- Edema (lung, liver, kidney disease)
- Increased intracranial pressure

Antihypertensives

- These drugs lower blood pressure and reduce the risk of complications like stroke, myocardial infarction, and kidney damage.

Mechanisms to Lower Blood Pressure

1. Reduce cardiac output
2. Decrease peripheral resistance
3. Reduce blood volume
4. Block hormonal systems (RAAS)

Major Classes



1. ACE Inhibitors (e.g., Enalapril, Lisinopril)

- Block conversion of Angiotensin I → Angiotensin II

Effects

- Vasodilation
- Reduced aldosterone → less sodium/water retention

2. ARBs (e.g., Losartan, Valsartan)

- Block angiotensin II receptors

Effects

- Similar to ACE inhibitors
- No cough (important difference)

3. Beta-Blockers (e.g., Atenolol, Metoprolol)

- Block β_1 receptors in heart

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Effects

- Decrease heart rate
- Reduce cardiac output
- Reduce renin release

4. **Calcium Channel Blockers (e.g., Amlodipine, Verapamil)**

- Block calcium entry into smooth muscle

Effects

- Vasodilation
- Reduced heart contraction (some drugs)

5. **Diuretics**

- Already discussed
- Reduce blood volume

6. **Alpha Blockers (e.g., Prazosin)**

- Block α_1 receptors

Effects

- Vasodilation

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Adverse Effects

- Hypotension
- Dizziness
- Electrolyte imbalance
- Specific effects (e.g., ACE inhibitors → dry cough)

Anti-Ischemic Drugs (Anti-Anginal Drugs)

- These drugs are used to treat **angina pectoris**, which occurs due to **reduced oxygen supply to heart muscle**.

Pathophysiology of Angina

- **Imbalance between:**
  - Oxygen supply
  - Oxygen demand

Goal of Treatment

- Increase oxygen supply OR

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