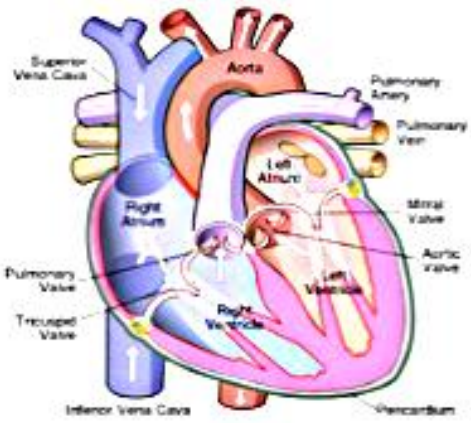
7.1 CARDIOVASCULAR SYSTEM



- Cardiovascular system is the system of heart and blood vessels that circulates blood throughout the body.
- It is mainly a transport system.
- It transports respiratory gases, nutrients and excretory products to various parts of the body.
- Blood is the medium through which these substances are transported.

7.2 ANTI-ARRHYTHMIC DRUG

- Antiarrhythmic are medications that prevent and treat a heart rhythm that's too fast or irregular.
- They can reduce symptoms and help avoid life-threatening complications. Some of these drugs stop irregular, extra electrical impulses.

❖ Arrhythmia

- An arrhythmia is a disorder of the heart that affects the rate or rhythm at which the heart beats basically the way the electricity works.
- It happens when electrical impulses that direct and regulate heartbeats don't function properly.

7.2.2 Classification of Antiarrhythmic Drugs

CLASS	DRUGS
CLASS – I (Sodium channel blocker)	Quinidine Sulphate, Procainamide HCl, Lidocaine HCl , Phenytoin Sodium, Lorcainide HCl
CLASS – II (β Blocker)	Propranolol, Esmolol, Acebutolol,
CLASS – III (Potassium channel blocker)	Amiodarone, Dronedarone, Ibutilide, Sotalol, amiodarone.
CLASS – IV (Calcium channel blocker)	Verapamil , Diltiazem

❑ QUINIDINE SUPHATE

- It is a cinchona alkaloid derived from the bark of the cinchona tree.
- It is considered as a class IA antiarrhythmic agent.
- It is available as salt such as quinidine sulphate and quinidine bisulphate

❖ **Chemical Formula** - $C_{40}H_{54}N_4O_{10}S$

❖ **Structure**

❖ **IUPAC Nomenclature**

- (S)-[(2R,4S,5R)-5-ethenyl-1-azabicyclo[2.2.2]octan-2-yl]-(6-methoxyquinolin-4-yl)methanol;sulfuric acid

❖ **Physiochemical Properties**

- Quinidine sulphate occurs as white needle like crystals.
- It is sparingly soluble in water, freely soluble in alcohol and chloroform.
- The aqueous solution of Quinidine sulphate is sterilized by autoclaving or by filtration.

❖ **Pharmaceutical Formulation**

- Quinidine is in formulated form of tablet, liquid and solution.

❖ **Stability and storage**

- It should be stored in well-closed airtight containers and protected from light.
- Store at room temperature (20°C to 25°C).

❖ **Popular Brand Names**

- Natcardine
- Sandoz
- Quinalan

❖ **Dose**

- Quinidine sulphate 100–200 mg TDS oral, rarely 100–300 mg slow intravenous injections.

❖ **Medicinal Uses**

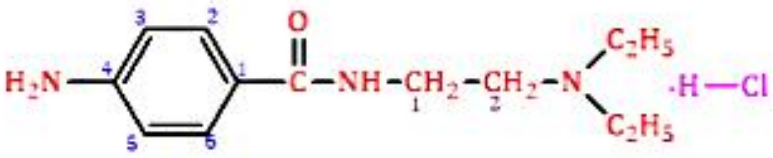
- Quinidine is very useful for long-term treatment of ventricular premature depolarization or to prevent recurrences of ventricular tachycardia after cardioversion of this arrhythmia.

❑ PROCAINAMIDE HYDROCHLORIDE

- It is the hydrochloride salt form of procainamide.
- It is the class-IA antiarrhythmic drug.
- It is an amide derivative of procaine.

❖ **Chemical Formula -** $C_{13}H_{22}ClN_3O$

❖ **Structure**



❖ **IUPAC Nomenclature**

- 4-Amino-N-(2-diethylaminoethyl) benzamide Hydrochloride

❖ **Physiochemical Properties**

- It occurs as white or yellowish white crystalline powder and odourless.
- It is soluble in water. Its aqueous solution is sterilized by autoclaving or filtration.

❖ **Pharmaceutical Formulation**

- Procainamide hydrochloride is available in the form of capsules, tablets, and injections.

❖ **Stability and storage**

- It should be stored in well-closed airtight containers and protected from light.

❖ **Popular Brand Names**

- Procan
- Pronestyl
- Procanbid

❖ **Dose**

- For abolition of arrhythmia - 0.5–1 g oral or intramuscular followed by 0.25–0.5 g every 2 hours, or 500 mg intravenous injection loading dose (25 mg/min injection) followed by 2mg/kg/hour.
- Maintenance dose—0.5 g every 4–6 hours.

❖ Medicinal Uses

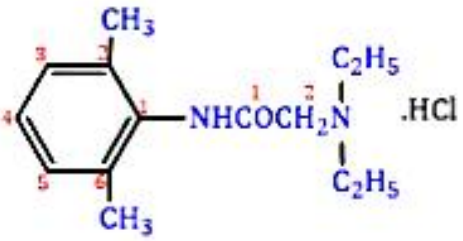
- It is used in the management of myotonia.
- It is also used in the treatment of arrhythmias in alcohol withdrawal.
- It is also used in the treatment of ventricular arrhythmias.

❑ LIDOCAINE HCl

- It is the hydrochloride salt of lidocaine.
- It is also known as lignocaine or xylocaine.
- It is an antiarrhythmic medication of the class- IB type.

❖ Chemical Formula - $C_{14}H_{22}N_2O$

❖ Structure



❖ IUPAC Nomenclature

- 2-(diethylamino)-N-(2,6-dimethylphenyl)acetamide hydrochloride

❖ Physiochemical Properties

- It is white crystalline powder, odourless with bitter taste.
- It is soluble in water, freely soluble in alcohol.

❖ Pharmaceutical Formulation

- Lidocaine hydrochloride is available in various formulations including topical and solutions for injection or infusions.
- It is also available as a transdermal patch that is applied directly to the skin.

❖ Stability and storage

- It should be stored in well-closed airtight containers and protected from light.

❖ Popular Brand Names

- Otek
- Zingo
- Xylocaine
- Lidoject

❖ Dose

- Solution for injection: 1% without epinephrine and 1.5% with epinephrine is used in local anaesthetic.

❖ **Medicinal Uses**

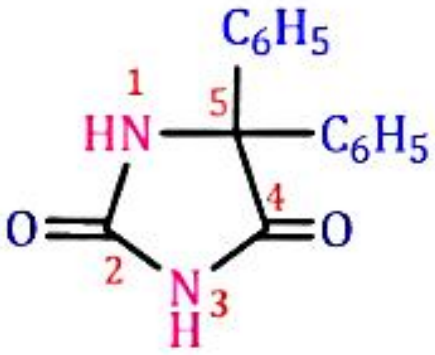
- It is indicated for the acute management of ventricular arrhythmia.
- It is also used as local anaesthetic.

❑ PHENYTOIN SODIUM

- It is an antiarrhythmic medication of the class- IB type.

❖ **Chemical Formula -** $C_{15}H_{12}N_2O_2$

❖ **Structure**



❖ **IUPAC Nomenclature**

- 5,5-diphenylimidazolidine-2,4-dione

❖ **Physiochemical Properties**

- It is a white crystalline powder, slightly hygroscopic, insoluble in methylene chloride, soluble in water and alcohol.

❖ **Pharmaceutical Formulation**

- It is formulated form of tablet, capsule and intravenous injection.

❖ **Stability and storage**

- It should be stored in well-closed airtight containers.

❖ **Popular Brand Names**

- Dilantin
- Phenytek
- Pheuton-100

❖ **Dose**

- Orally 15 mg/kg first day, 7.5 mg/kg on the second day, followed by 300 to 400 mg per day.

❖ **Medicinal Uses**

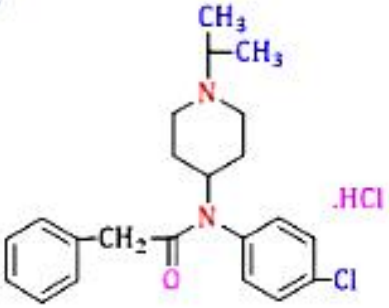
- Phenytoin is a medication used in the management and treatment of epilepsy, generalized tonic-clonic seizures, complex partial seizures, and status epilepticus.
- It is also used in the treatment of cardiac arrhythrmias.

❑ LORCAINIDE HCl

- Lorcainide is a Class-IC anti-arrhythmic agent. It occurs as hydrochloride salt.

❖ **Chemical Formula** - $C_{22}H_{27}ClN_2O$

❖ **Structure**



❖ **IUPAC Nomenclature**

- N-(4-chlorophenyl)-N-(1-isopropylpiperidin-4-yl)-2-phenylacetamide

❖ **Physiochemical Properties**

- It is soluble in water, ethanol and DMSO.
- Lorcainide proved to be effective in reducing ventricular arrhythmias and tachycardia's.

❖ **Pharmaceutical Formulation**

- It is formulate form of tablet.

❖ **Stability and storage**

- It should be stored in well-closed airtight containers.

❖ **Popular Brand Names**

- Remivox
- Lorivox

❖ **Dose**

- The usual dose is 100 mg, 2 or 3 times/day.
- But in case parenteral administration, the normal adult dose is 2 mg/kg body weight to a maximum of 400 mg/day.

❖ **Medicinal Uses**

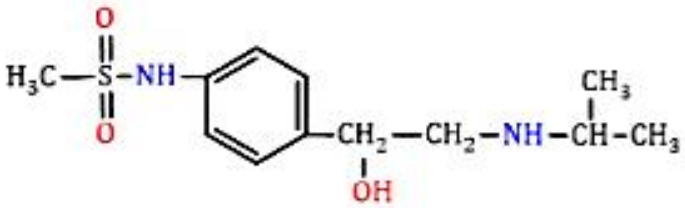
- It is used efficiently for the treatment of ventricular arrhythmias. It is also having local anaesthetic activity.

❑ SOTALOL

- Sotalol is a β-blocker and is categorized under class II antiarrhythmic drug. It is available as sotalol hydrochloride.

❖ **Chemical Formula** - $C_{12}H_{20}N_2O_3S$

❖ **Structure**



❖ **IUPAC Nomenclature**

- (RS)-N-{4-[1-hydroxy-2-(propan-2-ylamino)ethyl]phenyl}methanesulfonamide

❖ **Physiochemical Properties**

- It is a white powder, freely soluble in water.

❖ **Pharmaceutical Formulation**

- It is formulated form of tablet and intravenous injection.

❖ **Stability and storage**

- It should be stored in well-closed airtight containers.
- It should be stored in well-closed airtight containers and protected from light

❖ **Popular Brand Names**

- Mepha
- Sorine
- Sotacor

❖ **Dose**

- The usual dose is 80 to 320 mg twice a day oral.

❖ **Medicinal Uses**

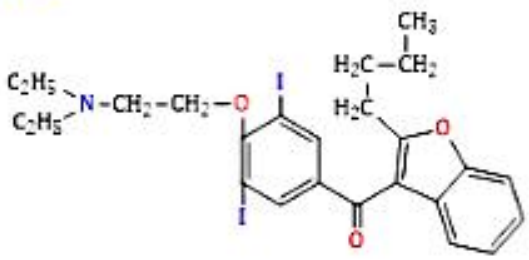
- It's used to treat atrial fibrillation and other conditions that cause an irregular heartbeat (arrhythmia).

❑ AMIODARONE

- Amiodarone is a categorized under class III antiarrhythmic drug.

❖ **Chemical Formula -** $C_{25}H_{29}I_2NO_3$

❖ **Structure**



❖ **IUPAC Nomenclature**

- (2-{4-[(2-butyl-1-benzofuran-3-yl)carbonyl]-2,6-diiodophenoxy}ethyl)diethylamine

❖ **Physiochemical Properties**

- It is a white to cream-coloured crystalline powder, which is sparingly soluble in water, soluble in alcohol and chloroform

❖ **Pharmaceutical Formulation**

- It is formulated form of tablet and intravenous injection.

❖ **Stability and storage**

- It should be stored in well-closed airtight containers and protected from light at a temperature not exceeding 30°C.

❖ **Popular Brand Names**

- Duron
- Coradrone
- Livdarone

❖ **Dose**

- The usual dose is 400 mg alternating with 600 mg daily for 1 to 3 weeks orally.

❖ **Medicinal Uses**

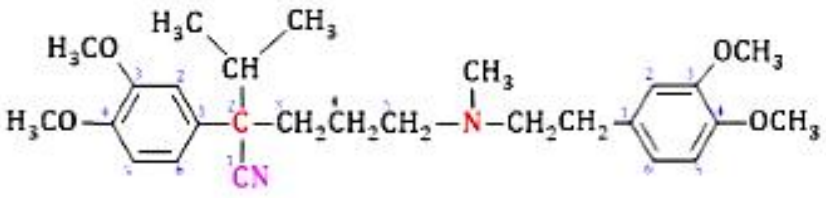
- It is used to maintaining rhythms in patients (life-threatening heart rhythm problems) who has direct current shock for atrial fibrillation.
- It is also used as an antianginal agent.

❑ **VERAPAMIL**

- Verapamil is categorized under class IV antiarrhythmic drug.

❖ **Chemical Formula** - $C_{27}H_{38}N_2O_4$

❖ **Structure**



❖ **IUPAC Nomenclature**

- (RS)-2-(3,4-Dimethoxyphenyl)-5-{[2-(3,4-dimethoxyphenyl)ethyl](methyl)amino}-2-(propan-2-yl)pentanenitrile

❖ **Physiochemical Properties**

- It is soluble in organic solvent like ethanol.
- It is white crystalline powder, odourless, soluble in water

❖ Pharmaceutical Formulation

- Verapamil is available in various formulations such as; tablet, capsule and solution.

❖ Stability and storage

- It is stored at controlled room temperature and protected from light and freezing.

❖ Popular Brand Names

- Isoptin
- Calan
- Covera

❖ Dose

- Daily oral dose is 180 to 480 mg in acute cases, 5 to 10 mg slow I.V. over 2 min.

❖ Medicinal Uses

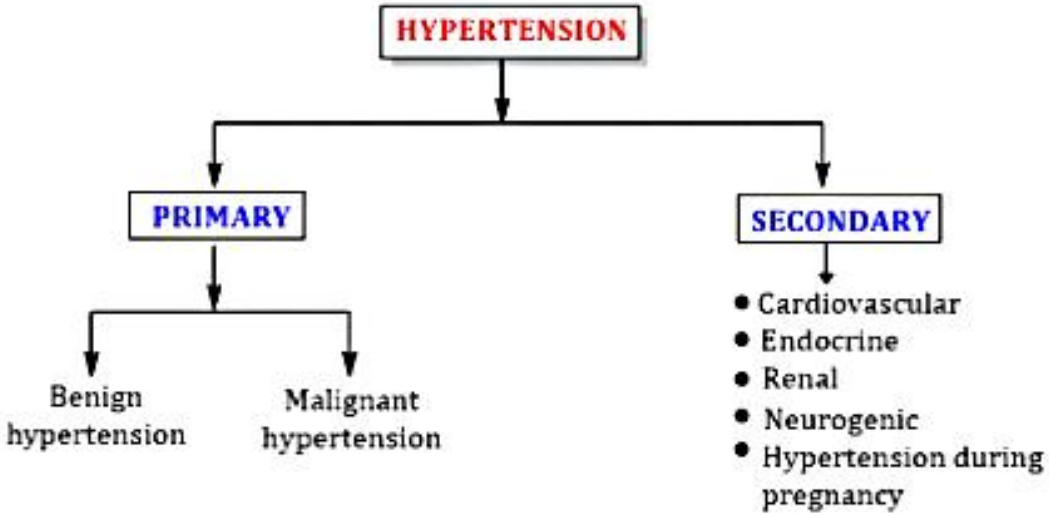
- Verapamil is used for controlling ventricular rate in supraventricular tachycardia.

7.3 ANTIHYPERTENSIVE AGENTS

- Antihypertensive are a class of drugs that are used to treat hypertension.
- Antihypertensive therapy seeks to prevent the complications of high blood pressure, such as stroke and myocardial infarction.

❖ Hypertension (HTN or HT)

- Hypertension (HTN or HT), also known as high blood pressure (HBP), is a long-term medical condition in which the blood pressure in the arteries is persistently elevated
- Long-term high blood pressure, however, is a major risk factor for stroke, coronary artery disease, heart failure, atrial fibrillation, peripheral arterial disease, vision loss, chronic kidney disease, and dementia.
- There are two types of hypertension such as primary or essential and secondary.



7.3.1 Types of Hypertension

BLOOD PRESSURE	SYSTOLIC PRESSURE	DIASTOLIC PRESSURE
Normal	Under 120	Under 80
Prehypertension	120 -139	80 – 89
Hypertension stage – 1	140 – 159	90 – 99
Hypertension stage – 2	Above 160	100
Hypertensive crises	Above 180	Above 110

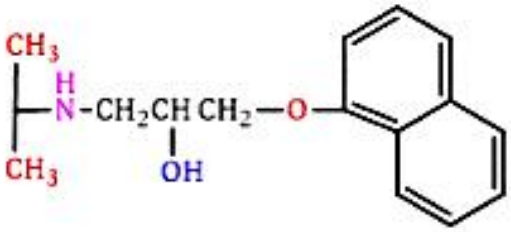
7.3.2 Classification of Antihypertension Drugs

CLASS	SUB – CLASS	DRUG
Sympathetic inhibitors	β-adrenergic blockers	Propranolol
	Central sympatholytic	Clonidine, Methyldopa
Renin-angiotensin system inhibitors	ACE inhibitors	Captopril, Ramipril
Calcium channel blockers	Dihydropyridines	Nifedipine
Vasodilators	Arteriolar dilator	Hydralazine

❑ PROPRANLOL

❖ **Chemical Formula** - $C_{16}H_{21}NO_2$

❖ **Structure**



❖ **IUPAC Nomenclature**

- 1-(1-methylethylamino)-3-(1-naphthyloxy)propan-2-ol

❖ **Physiochemical Properties**

- It is a white powder, freely soluble in water. Its solution is sterilized by autoclaving or by filtration.

❖ **Pharmaceutical Formulation**

- It is formulated form of tablet, capsule and injection.

❖ **Stability and storage**

- It should be stored in well-closed airtight containers and protected from light.

❖ **Popular Brand Names**

- Betacap plus
- Inderal LA
- Ciplar
- Hemangeol

❖ **Dose**

- Daily doses of propranolol as per prescription ranged from 80-320 mg.

❖ **Medicinal Uses**

- Propranolol slows down your heart rate and makes it easier for your heart to pump blood around your body.
- It's usually prescribed for high blood pressure and other heart problems. But it can also help with the physical signs of anxiety, like sweating and shaking.

❑ CLONIDINE HYDROCHLORIDE

❖ **Chemical Formula** - $C_9H_9Cl_2N_3$

❖ **Structure**

❖ IUPAC Nomenclature

- N-(2,6-Dichlorophenyl)-4,5--1H-imidazol-2-amine

❖ Physiochemical Properties

- It is white crystalline powder, odourless with bitter taste.
- It is soluble in water.

❖ Pharmaceutical Formulation

- It is formulated form of tablet and injections.

❖ Stability and storage

- It should be stored in well-closed airtight containers and protected from light.

❖ Popular Brand Names

- Catapres
- Cloud 0.1
- Nexiclon

❖ Dose

- Clonidine tablet is most commonly employed with therapeutic dose of 0.2 mg to 0.6 mg /day.

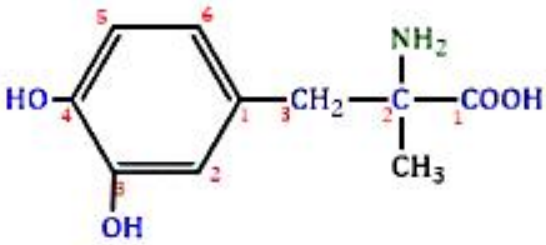
❖ Medicinal Uses

- Clonidine is used to treat high blood pressure, attention deficit hyperactivity disorder (ADHD).

❑ METHYLDOPA HYDROCHLORIDE

❖ Chemical Formula - $C_{10}H_{13}NO_4$

❖ Structure



❖ **IUPAC Nomenclature**

- (S)-2-amino-3-(3,4-dihydroxyphenyl)-2-methyl-propanoic acid

❖ **Physiochemical Properties**

- It is white crystalline powder, freely soluble in water.

❖ **Pharmaceutical Formulation**

- It comes in tablet and injectable form.

❖ **Stability and storage**

- It should be stored in well-closed airtight containers and protected from light.

❖ **Popular Brand Names**

- Aldomet
- Dopagyt
- Emdopa
- Almet

❖ **Dose**

- It comes in tablet dosage forms of 250 mg and 500 mg as well as injectable solutions with a dose of 50 mg/ml.

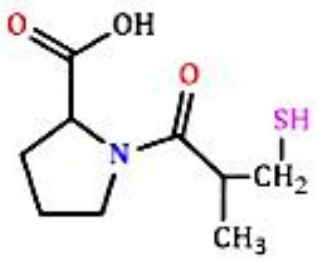
❖ **Medicinal Uses**

- It is used alone or with other medications to treat high blood pressure.
- Lowering high blood pressure helps prevent strokes, heart attacks, and kidney problems.
- Methyldopa works by relaxing blood vessels so blood can flow more easily.

❑ **CAPTOPRIL HYDROCHLORIDE**

❖ **Chemical Formula**

❖ **Structure**



❖ **IUPAC Nomenclature**

- (2S)-1-[(2S)-2-methyl-3-sulfanylpropanoyl]pyrrolidine-2-carboxylic acid

❖ **Physiochemical Properties**

- It is white crystalline powder with slight sulfur-like odour. It is freely soluble in water and alcohol.

❖ **Pharmaceutical Formulation**

- It comes in tablet and injectable form.

❖ **Stability and storage**

- It should be stored in well-closed airtight containers, and protected from light.

❖ **Popular Brand Names**

- Captobes
- Captoril
- Aceten

❖ **Dose**

- It is available as tablet dosage form with varying dose of 12.5 mg, 25 mg, 50 mg and 100 mg.

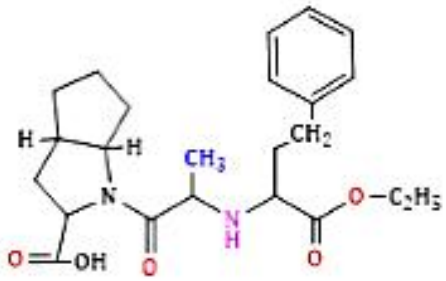
❖ **Medicinal Uses**

- Captopril is used alone or together with other medicines to treat high blood pressure (hypertension).
- High blood pressure adds to the workload of the heart and arteries.

❑ **RAMIPRIL**

❖ **Chemical Formula -** $C_{23}H_{32}N_2O_5$

❖ **Structure**



❖ **IUPAC Nomenclature**

- (2S,3aS,6aS)-1-[(2S)-2-[[(2S)-1-Ethoxy-1-oxo-4-phenylbutan-2-yl]amino]propanoyl]-3,3a,4,5,6,6a-hexahydro-2H-cyclopenta[b]pyrrole-2-carboxylic acid

❖ **Physiochemical Properties**

- Ramipril is white crystalline powder, sparingly soluble in water and freely soluble in polar organic solvents.
- Ramipril melts between 105-112°C

❖ **Pharmaceutical Formulation**

- It is formulated form of tablet and capsule.

❖ **Stability and storage**

- It should be stored in well-closed airtight containers and protected from light.

❖ **Popular Brand Names**

- Altace
- Tritace
- Cardace

❖ **Dose**

- For hypertension: Adult: Initial, dose is 1.25 mg once daily given at bed time. Maintenance: 2.5–5 mg daily as a single dose, up to 10 mg daily as needed.

❖ **Medicinal Uses**

- It is used in the treatment of hypertension, heart failure and myocardial infarction.

❑ **NIFEDIPINE**

❖ **Chemical Formula -** $C_{17}H_{18}N_2O_6$

❖ **Structure**

❖ **IUPAC Nomenclature**

- 3,5-dimethyl 2,6-dimethyl-4-(2-nitrophenyl)-1,4-dihydropyridine-3,5-dicarboxylate

❖ **Physiochemical Properties**

- It occurs as yellow crystalline powder, odourless and tasteless. It is insoluble in water, slightly soluble in alcohol.

❖ **Pharmaceutical Formulation**

- It is formulated form of tablet and capsule.

❖ **Stability and storage**

- It is degraded on exposure to light. It should be protected from light. So, it is stored in tightly closed container.

❖ **Popular Brand Names**

- Aminifd 20
- Afeditab
- Procardia

❖ **Dose**

- Starting dose 30 mg or 60 mg once per day.

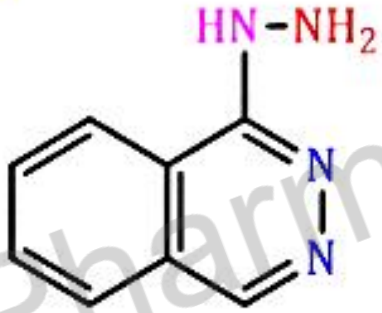
❖ **Medicinal Uses**

- Nifedipine is used alone or together with other medicines to treat severe chest pain (angina) or high blood pressure (hypertension).

❑ **HYDRALAZINE HYDROCHLORIDE**

❖ **Chemical Formula** $C_8H_8N_4$

❖ **Structure**



❖ **IUPAC Nomenclature**

- 1-hydrazinylphthalazine

❖ **Physiochemical Properties**

- Its hydrochloride salt occurs as white to off-white crystalline powder.
- It is odourless with bitter saline taste. It is soluble in water and slightly soluble in alcohol.

❖ **Pharmaceutical Formulation**

- It is formulated form of tablet and intravenous injection.

❖ **Stability and storage**

- It should be stored in well-closed airtight containers and protected from light.

❖ **Popular Brand Names**

- Aprezine
- Corbetazine
- Carbetazine

❖ Dose

- The usual dose is 25 to 100 mg oral twice daily; 20 to 40 mg I.V. in emergency.

❖ Medicinal Uses

- Hydralazine is used to treat high blood pressure (hypertension).
- It is also used to control high blood pressure in a mother during pregnancy (pre-eclampsia or eclampsia) or in emergency situations when blood pressure is extremely high.

7.4 ANGINA

- Angina pectoris refers to chest pain towards left arm shoulder due to less supply or more demand of oxygen.
- Angina is a symptom of coronary artery disease.
- Angina feels like squeezing, pressure, heaviness, tightness or pain in the chest.
- It can be sudden or recur over time.
- Depending on severity, it can be treated by lifestyle changes, medication, angioplasty or surgery.

❖ Types of Angina

➢ Stable Angina

- Chest or arm discomfort that may not be described as pain but is associated with physical exertion or stress.
- Retrosternal region, radiates to or occasionally isolated to the neck, jaw, epigastrium, shoulder or arms usually the left.

➢ Unstable Angina

- Unstable angina may occur more often and be more severe than stable angina.
- Unstable angina also can occur with or without physical exertion, and rest or medicine may not relieve the pain.
- Unstable angina is very dangerous and requires emergency treatment.
- This type of angina is a sign that a heart attack may happen soon.

➢ Variant (Prinzmetal's) Angina

- Variant angina is rare.
- A spasm in a coronary artery causes this type of angina.
- Variant angina usually occurs while you are rest, and the pain can be severe.

- It usually happens between midnight and early morning.
- Medicine can relieve this type of angina.

7.4.1 ANTIANGINAL DRUGS

- An antianginal is a drug used in the treatment of angina pectoris, a symptom of ischemic heart disease.

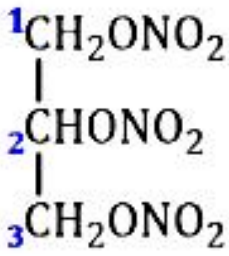
7.4.2 Classification of Antianginal Agents

CLASS	DRUGS
Nitrates	Glyceryl trinitrate, Isosorbide Dinitrate, Mononitrate, Erythrityl tetranitrate.
β- blocker	Propranolol , Metoprolol, Atenolol
Calcium channel blocker	Verapamil, Diltiazem, Amlodipine, Nifedipine, Nimodipine, Felodipine.
K^+ channel blocker	Nicorandil
Others	Trimetazidine, Ranolazine

❑ **NITROGLYCERINE**

❖ **Chemical Formula** $C_3H_5N_3O_9$

❖ **Structure**



❖ **IUPAC Nomenclature**

- Propane-1,2,3-triyl trinitrate

❖ **Physiochemical Properties**

- It is a Colourless, odourless liquid with a sweet taste.
- Glyceryl trinitrate is the trinitrate ester of glycerol.

❖ Pharmaceutical Formulation

- It is formulated form of Nitroglycerin Capsule, tablet, and Nitroglycerin Injection.
- And also formulated form of transdermal patches and spray.

❖ Stability and storage

- Store at controlled room temperature of 20°–25°C (68°–77°F).
- Nitroglycerin should be kept in the original glass container and must be tightly capped after each use to prevent loss of tablet potency

❖ Popular Brand Names

- Angised
- Corodil
- Nitro-G
- Myovin

❖ Dose

- Starting dose is 0.5 mg sublingual, and 5–15 mg oral tablet dose.
- One transdermal patch for 14–16 hour per day.

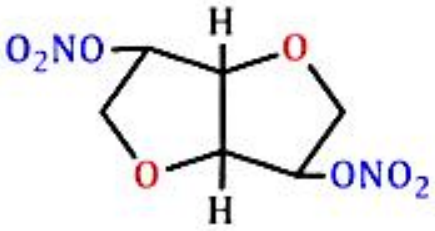
❖ Medicinal Uses

- Nitroglycerine is used in angina pectoris and extensively as an explosive in dynamite.

❑ ISOSORBIDE DINITRATE

❖ Chemical Formula - $C_6H_8N_2O_8$

❖ Structure



❖ IUPAC Nomenclature

- hexahydrofuro[3,2-b]furan-3,6-diyl dinitrate

❖ Physiochemical Properties

- It is a fine white crystalline powder, slightly soluble in water, well soluble in acetone, but sparingly soluble in alcohol.

❖ Pharmaceutical Formulation

- It is formulated form of tablet.