



## Heart: Anatomy and Physiology with Diseases

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### Abstract:

‘HEART’ is the great pumping organ. It is Vital organ of the body, which maintains the circulation throughout the body. Heart is muscular organ that pumps blood throughout the circulatory system. As Heart is vital organ of Body so it is important to maintain Healthy Heart. According to WHO 32. 4 million Myocardial Infarction and Strokes worldwide every year. Survivors MI are at increased risk of recurrent infarctions and have an annual death rate of 5 percent 6 times that in people of same age who do not have Coronary heart disease. So, significantly contribute to reduction in Cardio vascular diseases is necessary. Therefore by avoiding various risk factors(like Smoking, alcohol consumption, less exercise, etc.) we can reduce the risk of major Cardiac events. Evidence based interventions for secondary prevention include use of Aspirin, Beta blockers, Angiotensin converting enzyme inhibitors ; lipid lowering drugs and other anti hypertensive, as well as modifying lifestyle related risk behavior.

Key words= Introduction, Anatomy and physiology, Cardiovascular Diseases, Medication.

Introduction :

The Heart is Cone shaped, hollow, muscular organ, having base above and apex below. The heart pumps blood through blood vessels to all body tissues. Human Heart weighs about 300 gm.

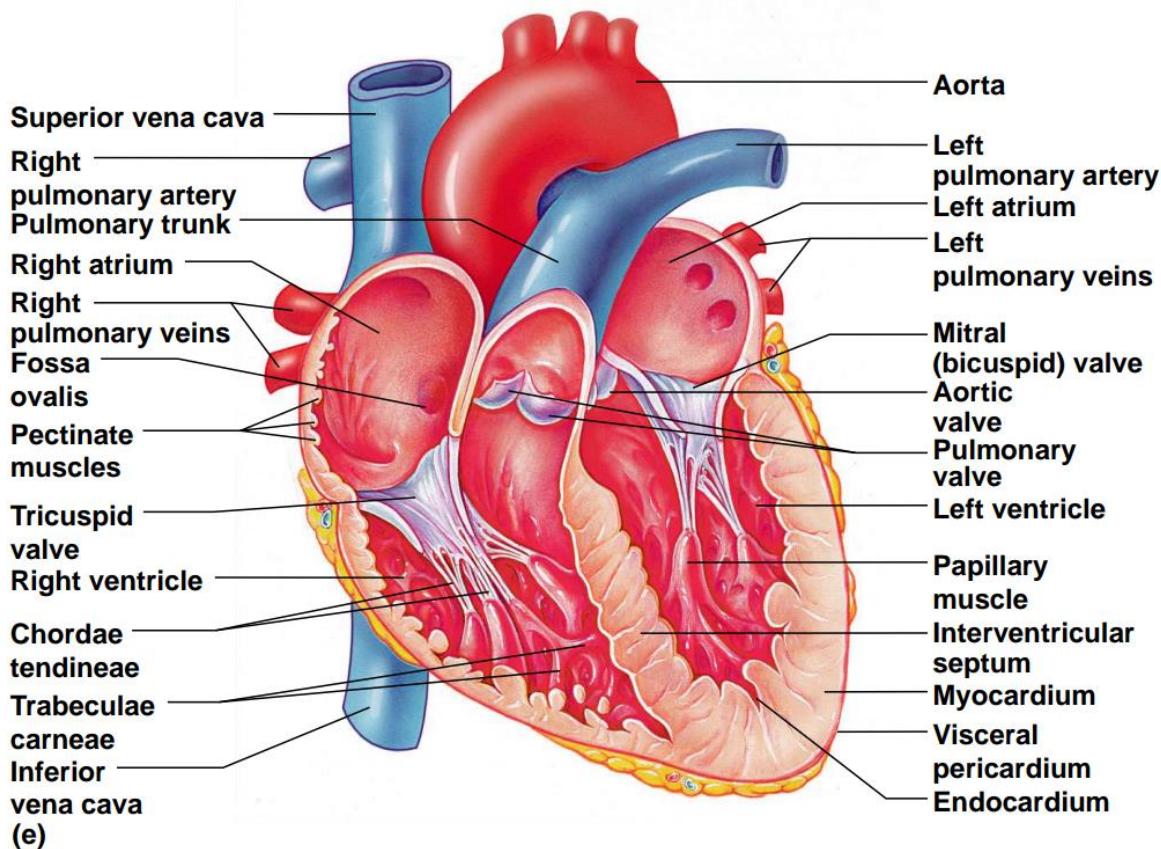
Anatomy And Physiology =

- Position of heart = Heart lies in thorax, between the lungs and behind the Sternum, and directed more to left than right side. A point marked on left side between fifth and sixth left ribs or in the fifth left intercostals 9cm from middle line, gives the position of apex of the heart, which is pointed extremity of the ventricles.
- Structure of Heart = Heart is about the size of a closed fist , the adult heart weighs about 220 to 260 gm. It is divided by a septum into 2 sides, left and right. There is normally no communication between these 2 sides after birth. Each side of heart is further subdivided into 2 chambers, Two smaller chambers called 'Atrium' are near the base, and two larger chambers called 'Ventricle' are close to the apex.
  - Right atrium (RA) after receiving deoxygenated blood from body tissues through the superior and inferior vena cava, pumps the blood into the right ventricle (RV) via the right atria ventricular orifice.
  - Right Ventricle then pumps the blood to the lungs for gas exchange, through the pulmonary trunk and arteries. Left atrium (LA) after receiving oxygenated blood from the lungs through the pulmonary veins, pumps the blood into the left ventricle (LV) via the left atria ventricular orifice.

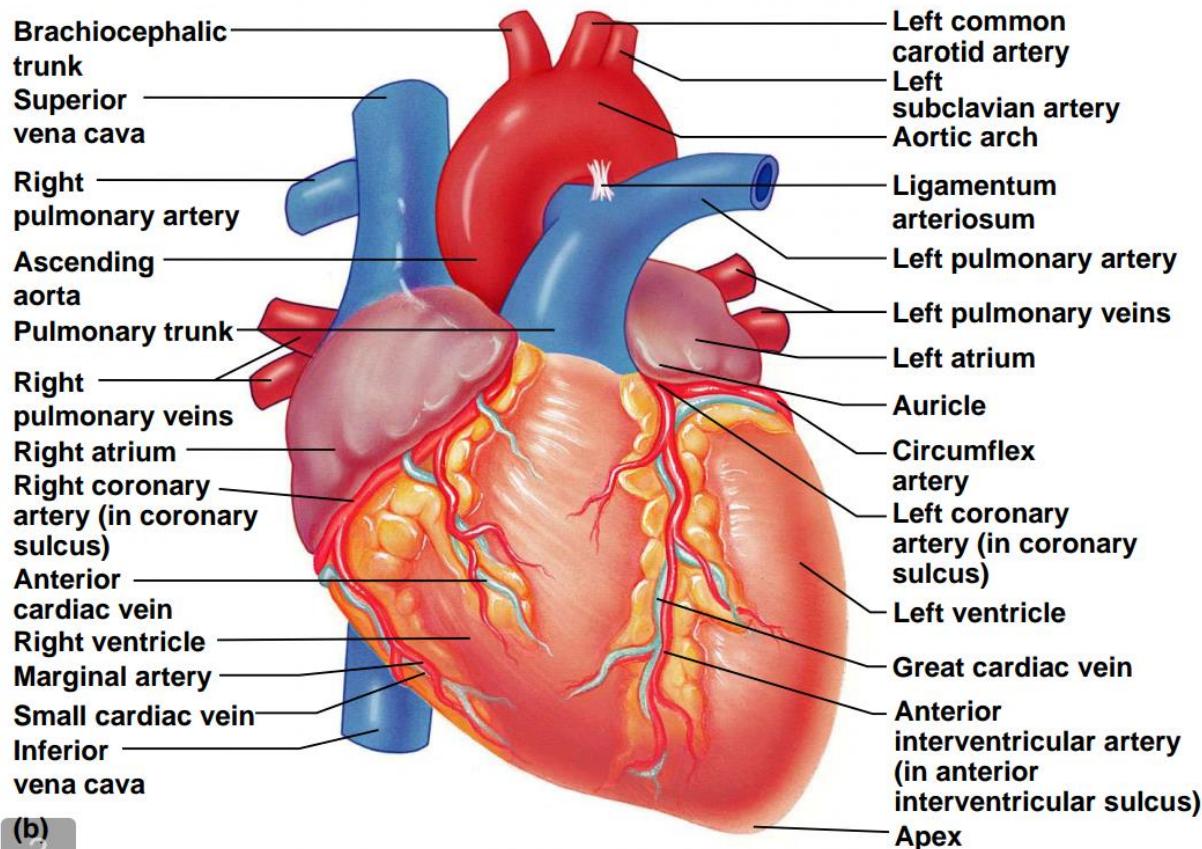
- Left Ventricle then pumps the blood to the body tissues for supplying oxygen to everybody cell, through the aorta.
- RA and LA are separated by a central heart wall called interatrial septum, while RV and LV are separated by interventricular septum.
- LV has a thicker myocardium layer (for stronger contractions) and contains rough ridges called ‘trabeculae carneae’ (for containing a larger blood volume in exercising conditions).

### ❖ Heart Valves=

Coronary arteries (from the first branching of aorta) supply oxygenated blood to the cardiac muscle. Two heart valves located between atria and ventricles are called ‘Atrioventricular valves’ (AV valves) which include the tricuspid valve between RA and RV, and bicuspid valve (or mitral valve) between LA and LV. Two heart valves located at the exiting arteries are called ‘Semilunar valves’ (SL valves) which include the pulmonary semilunar valve at the base of pulmonary trunk, and the aortic semilunar valve at the base of aorta. Each AV valve consists of cusps (extensions of endocardium), chordae tendineae, and papillary muscles (the latter two are designed to prevent eversion of the cusps into the atria). AV valves prevent backflow into atria, while SL valves prevent backflow into ventricles.



## Internal Structure of Human Heart



## External Structure of Human Heart

Systemic and Pulmonary Circulation of Heart = In postnatal (after birth) circulation, the heart pumps blood into two closed circuits with each beat—systemic circulation and pulmonary circulation. The output of one becomes the input of the other, as would happen if you attached two garden hoses. The left side of the heart is the pump for systemic circulation; it receives bright red, oxygen-rich blood from the lungs. The left ventricle ejects blood into the aorta. From the aorta, the blood divides into separate streams, entering progressively smaller systemic arteries that carry it to all organs throughout the body—except for the air sacs (alveoli) of the lungs, which are supplied by pulmonary circulation. In systemic tissues, arteries give rise to smaller diameter arterioles, which finally lead into extensive beds of systemic capillaries. Exchange of nutrients and gases occurs across the thin capillary walls. Blood unloads O<sub>2</sub> and picks up CO<sub>2</sub>. In most cases, blood flows through only one capillary and then enters a systemic venule. Venules carry deoxygenated (oxygen-poor) blood away from tissues and merge to form larger systemic veins. Ultimately the blood flows back to the right atrium. The right side of the heart is the pump for pulmonary circulation; it receives all the dark red, deoxygenated blood returning from systemic circulation. Blood ejected from the right ventricle flows into the pulmonary trunk, which branches into pulmonary arteries that carry blood to the right and left lungs. In pulmonary capillaries, blood unloads CO<sub>2</sub>, which is exhaled, and picks up inhaled O<sub>2</sub>. The freshly oxygenated blood then flows into pulmonary veins and returns to the left atrium.

## Coronary Artery & Veins =

2 coronary arteries, the right and left coronary arteries, branch from the ascending aorta and supply oxygenated blood to the myocardium.

Blood passes through the arteries of the coronary circulation, it flows into capillaries, where it delivers oxygen and nutrients to the heart muscle and collects carbon dioxide and waste, and then moves into coronary veins.

## Heart sound =

The 2 sounds may be heard during action of heart due to passive closing of valves. First sound is due to closing of atrioventricular valve, and the second to the closing of aortic and pulmonary valves, after contraction of ventricles. First is long and dull like 'Lubb' and second short and sharp like 'Dup'. Cardiac Impulse =

Also known as Apex Beat is impact of left ventricle against the anterior wall of chest, occurring during contraction of ventricles.

Arterial Pulse= It is wave of increased pressure which is left at arteries vein blood is pumped out of heart. Pumping rate of heart varies in health under condition of living, working, food intake, age, and emotion. Pulse rate corresponds with cardiac cycle. If impulse count is 70, the cardiac cycle will occur 70 times a min.

## Normal pulse rate range=

In new born	140	Age of 5 yr	96 - 100
During first yr	120	Age of 10 yr	80- 90
During second yr	110	In adult	60-80

## Cardiovascular Diseases :-

American Heart Association estimate that greater than fifty percent of deaths are related to some form of Cardiovascular Diseases, and many of these may be effectively prevented by

appropriate external intervention. The classification of Cardiovascular Diseases are below;

1. Coronary heart diseases
2. Strokes
3. Peripheral arterial disease
4. Aortic disease

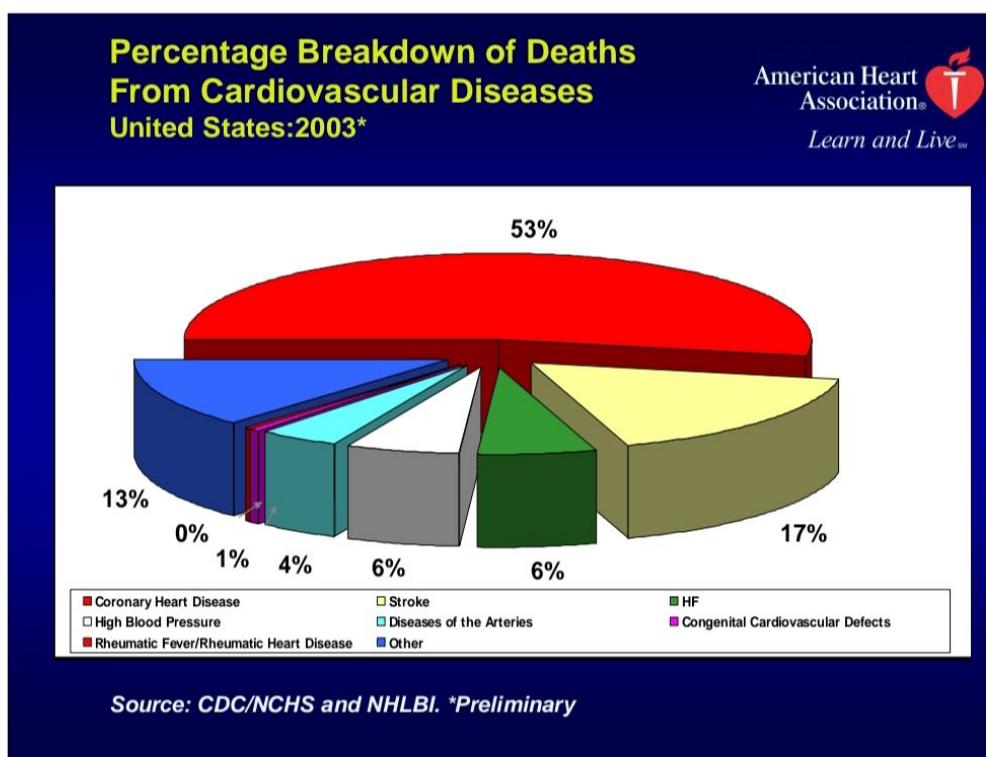
The Cardiovascular diseases are as follows;

Hypertension, Angina pectoris, Arrhythmia, CHF, Lipidemia, Marfan Syndrome, Coronary artery disease, Deep vein thrombosis and pulmonary embolism, Heart attack, Heart Failure, Cardio Myopathy, Heart Valve disease, Pericardial disease, Peripheral Vascular disease, Rheumatic

Heart

disease,

Cardiac



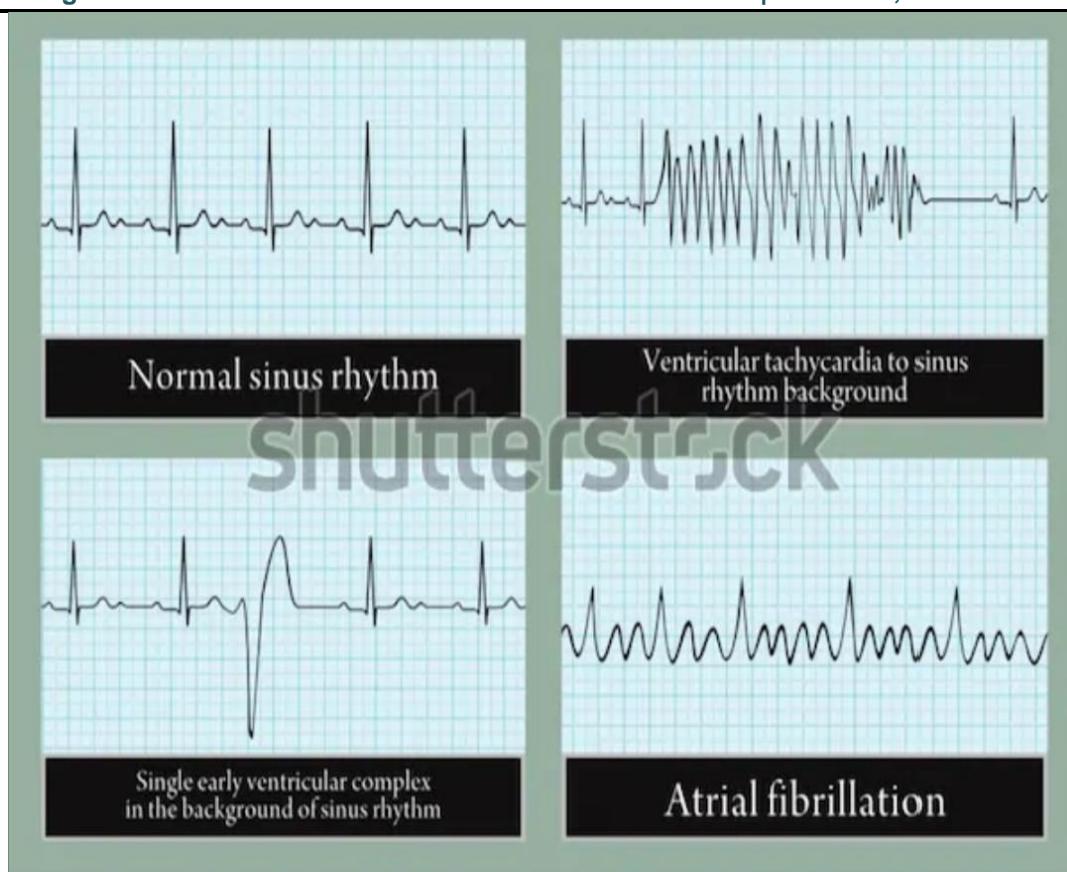
cachexia, Endocarditis, Aortic Aneurysm, Cardiac Arrest.

Common Symptoms of Cardiac Diseases=

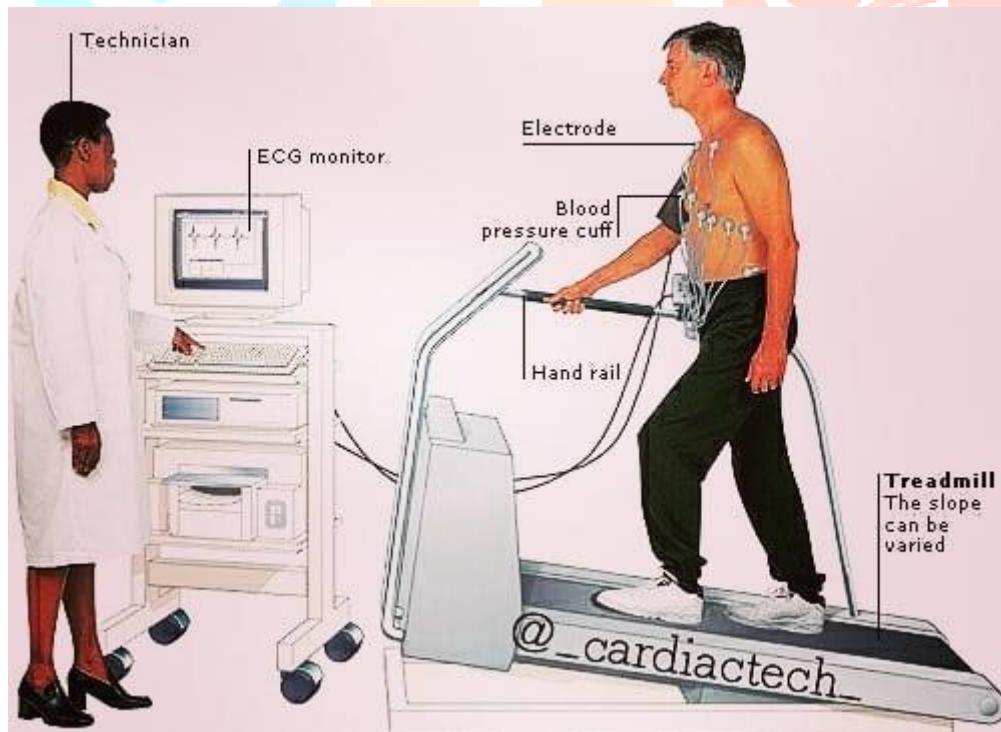
- Chest Pain
- Chest tightness
- Chest pressure
- Shortness in breath
- Pain
- Numbness
- Coldness in legs or arm
- Sweating
- Tiredness
- Light Headedness
- Coughing
- Swollen ankles
- Abdominal bloating

Diagnosis of Cardiac Diseases =

1. ECG or EKG (Electrocardiogram)
2. Echocardiogram
3. Blood test
4. Chest X ray
5. Spirometer
6. Holter monitoring
7. Stress test
8. Cardiac Catheterization
9. Cardiac Computerised (CT) Scan
10. Cardiac magnetic resonance imaging (MRI)



## Change in ECG according to different diseases



## Treadmill Stress test (TMT)



## Echocardiogram

### 1. Hypertension

It is very common disorder in which Sustained systolic BP more than 140 mmHg and sustained Diastolic BP more than 90 mmHg.

#### a) Etiology =

- Increase in cholesterol level
- Increase in total peripheral resistance
- Increase in cardiac output (CO) Increase in blood volume

#### b) Sign and Symptoms =

Severe headaches, Nosebleed, Fatigue, Vision problems, chest pain, Difficulty in Breathing, Irregular heart beat , Blood in urine .

### c)Treatment=

- ACE Inhibitor - relaxes blood vessels, lowers BP and prevents Diabetes related kidney disease.
- Diuretics- taking medicine that helps eliminate extra water from body. Also treat high BP.
- Beta Blocker= slows heart rate and decrease BP, in eye drops reduces eye pressure.
- Anti hypertensive drug= lowers BP
- Calcium channel blockers= relax blood vessel.
- Vasodilator= widens blood vessels.

### d)Contraindication=

Pregnancy, hyperkalemia, bilateral renovascular disease ,etc.

### e) Drugs= Captopril 25–100 mg

## 2. Congestive heart Failure= (CHF)

It is a condition in which heart is unable to pump sufficient blood to meet metabolic demand of body. And also unable to receive it back because every time after systole.

### a) Etiology=

- High BP
- Coronary artery disease
- Alcohol abuse

b)Sign & symptoms=

Dilated pupils, sympathetic nervous system response, skin grey, pale anxiety, Falling oxygen saturation, nausea and vomiting, decrease urine output, enlarged spleen.

c)Treatment=

- Beta adrenergic agonist
- Vasodilators-calcium channel blocker
- Inotropic agent
- Phosphodiesterase inhibitor
- Calcium sensitizers
- Diuretics agent
- ACE 1 and AT1 antagonist
- Beta adrenergic antagonist

d) Contraindication=

Pregnancy, hyperthyroidism, hypokalemia, hypercalcemia, renal impairment, pulmonary disease.

e) Drug= Metoprolol 25–100 mg

3. Angina Pectoris=

It is severe chest pain towards left arm shoulder due to less supply of oxygen or more demand of oxygen.

**a) Etiology=**

- Heart diseases
- Fatty substances
- Blood clot in arteries
- Thickened heart
- Tearing of wall of aorta

**b) Sign & symptoms=**

Burning, fatigue, discomfort, sweating, shortness in breath, feeling of fullness in chest, pressure feeling.

**c) treatment=**

- Anti anginal drugs= reduce chest pain.
- Beta blocker= slower heart rate and decrease BP.
- Anti hypertensive drug= lower BP.
- Nitrates= improve blood flow.
- Calcium channel blocker= relaxes blood vessel.
- Anti coagulant= inhibit blood clot.
- Potassium channel opener= decrease preload and after load.

**d) Contraindications=**

Obstructive cardiomyopathy, in heart failure, bradycardia, hypotension.

**e) Drug= Aspirin**

#### 4. Arrhythmia=

Disturbances in heart rate, rhythm, impulse generation or conduction of electric impulses responsible for membrane depolarization.

##### a) Etiology=

- Stress
- Irregular and fast heart beat
- Smoking
- Congenital heart defects
- Diabetic

##### b) Sign & symptoms=

Fluttering in chest, chest pain, bradycardia, tachycardia, shortness in breath, sweating, fatigue, anxiety.

##### c) treatment=

- Sodium channel blocker
- Potassium channel blocker
- Anti adrenergic agent
- Calcium channel blocker

##### d) Contraindication=

tachycardia, sinus tachycardia, multifocal tachycardia.

##### e) Drug= Amiodarone

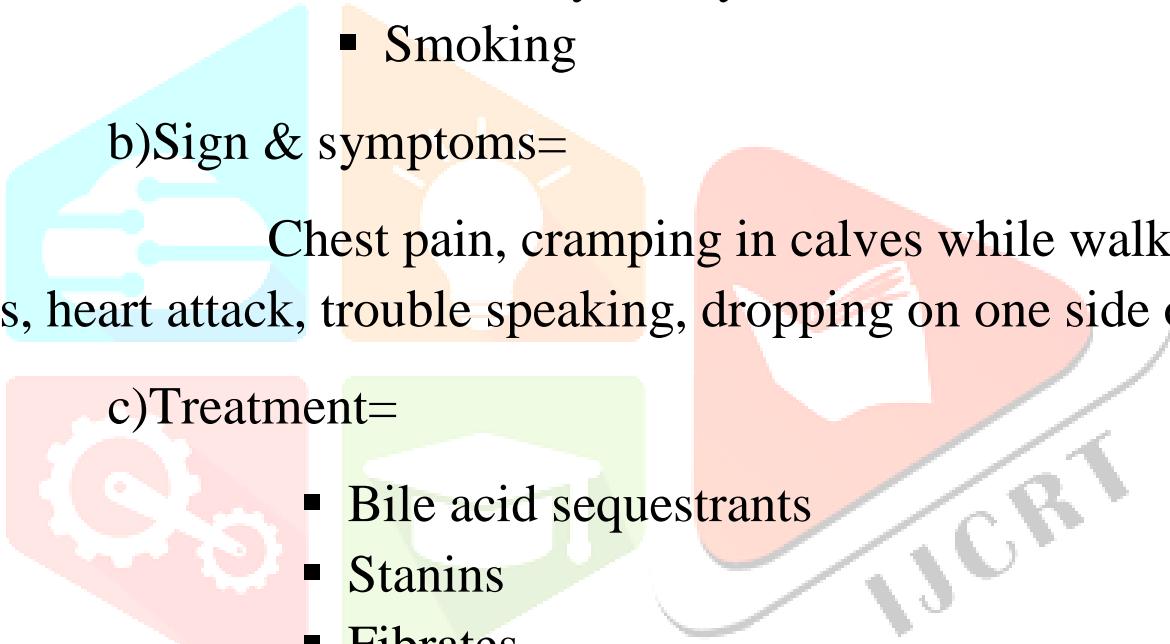
## 5.Hyperlipidemia=

It refers to increased levels of lipids in blood including cholesterol and triglycerides.

### a)Etiology=

- High fat diet
- Obesity
- Hypercholesterolemia
- Diabetes
- Sedentary lifestyle
- Smoking

### b)Sign & symptoms=

 Chest pain, cramping in calves while walking, sores on toes, heart attack, trouble speaking, drooping on one side of face.

### c)Treatment=

- Bile acid sequestrants
- Stanins
- Fibrates
- Cholesterol absorption inhibitor
- Omega 3 fatty acid supplement
- HMG CoA reductase

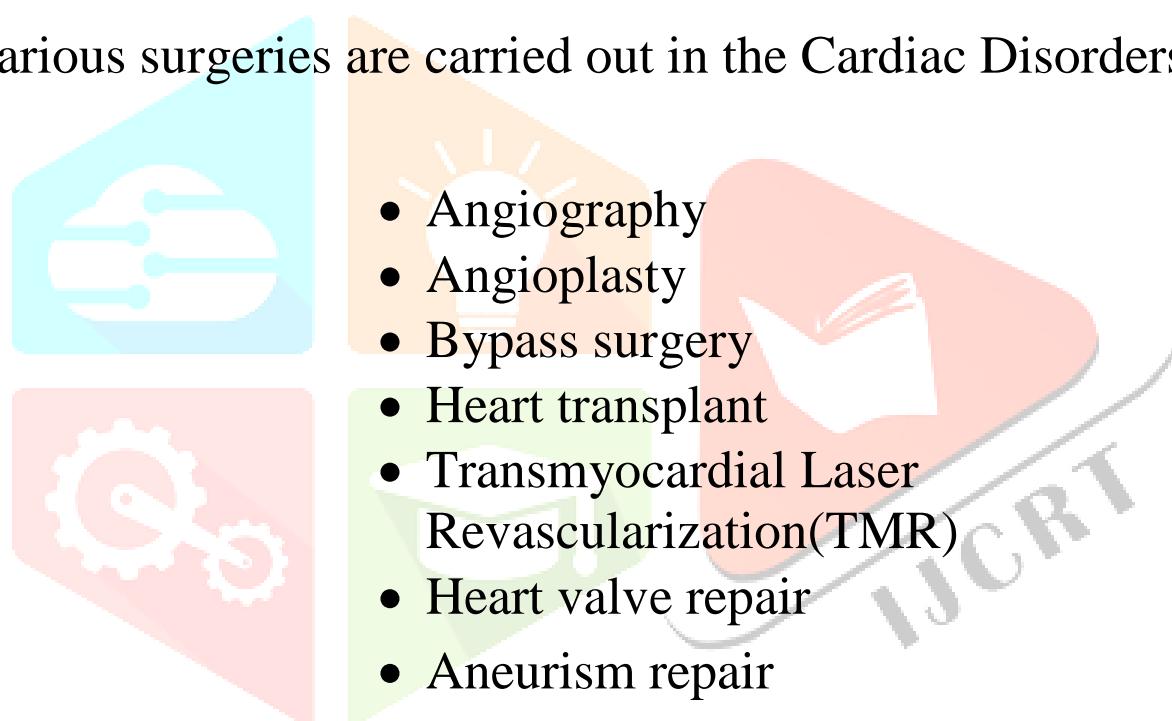
### d)Drug= Crestor

## 6. Cardiac Cachexia=

It is condition that can happen to have heart failure. It means loss a serious amount of body fat, muscle and bone.

- Complication of end stage of HF
- Loss of muscle mass and adipose tissue
- Resulting in reduced exercise tolerance, fatigue and dyspnoea
- Ensure adequate nutrition supplement
- Advised from dietician

The various surgeries are carried out in the Cardiac Disorders namely ;



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