Module no. 4
Cardio Vascular System

Learning objectives:

By the end of the chapter, non-specialist medical officers should be able to:

- Enumerate age-related changes which occur in the cardiovascular system.

- Enumerate common cardiovascular diseases in the elderly; and

- Develop care plans for common age related cardiovascular diseases.

Concept and Definition:

Cardiovascular disease is the most frequent cause of death in elderly in developed countries and increasingly important in developing countries. Early recognition of heart disease can reduce morbidity and mortality.

Normal age-related changes in cardiovascular system
- The heart gets flabbier and less efficient.
- Heart valves become thicker and less elastic.
- Decline in the sinoatrial (SA) node discharges and disruption of the atrioventricular (AV) conduction system.
- Blood vessels become rigid and narrowed with atherosclerosis.
- Cardiac contractility is normal but the duration of contraction and relaxation is prolonged.
- Maximal heart rate response to exercise declines but cardiac output is maintained by an increase in stroke volume.
- Left ventricular and diastolic volume and rest pre-load is normal but after – load increases with age.
- Cardiovascular reflexes are blunted

Most common condition affecting the elderly include:
1. Hypertension
2. Coronary Artery Disease
3. Cardiac Failure
4. Cardiac Arrhythmias

HYPERTENSION

Magnitude and epidemiology:

Hypertension is the commonest health problem in old age. More than half of the elderly population in all developed and most of the developing societies have hypertension. However, a majority of these hypertensives are either undiagnosed or uncontrolled. Systolic blood pressure (SBP) has greater predictability for vascular events (stroke, IHD, CHF, renal failure and mortality) than diastolic blood pressure in older individuals. A large number of the elderly hypertensives have isolated elevation

of SBP, which greatly enhances cardiovascular risk. Pseudohypertension and white coat hypertension need to be ruled out.

Definition: Hypertension in elderly is defined as systolic blood pressure (SBP) of 150 mm of hg or more, and/ or a diastolic blood pressure (DBP) of 90 mm of Hg or more, or taking antihypertensive medication.

**Classification of Blood Pressure as per JNC 7 Classification:**

Blood Pressure Classification	SBP (mmHg)	DBP (mmHg)
Normal	<120	and <80
Prehypertension	120–139	or 80–89
Stage Hypertension	140–159	or 90–99
Stage 2 Hypertension	≥160	or ≥100

Targets of Blood Pressure as per JNC 8 guidelines

Patient subgroup	Target SBP (mm Hg)	Target DBP (mmHg)
≥ 60 years without CKD/ Diabetes	< 150	< 90
< 60 years	< 140	< 90
>18 years with CKD	< 140	< 90
>18 years with Diabetes	< 140	< 90

Precautions to be taken in the measurement of blood pressure:
Although the use of mercury sphygmomanometer is regarded as the 'gold standard' for office blood pressure measurement, widespread ban in use of mercury devices has diminished their role in hospital settings. Alternative methods such as automated electronic devices have gained increased popularity. The preferred location of measurement is the upper arm, but errors may occur because of changes in the position of the arm. Other technical sources of error include inappropriate cuff size and too rapid deflation of the cuff. Clinic readings may be unrepresentative of the patient's true blood pressure because of the white coat effect, which is defined as the difference between the clinic readings and the average daytime blood pressure. Patients with elevated clinic pressure and normal daytime pressure are said to have white coat hypertension, which is often explained by state anxiety or conditioned response.
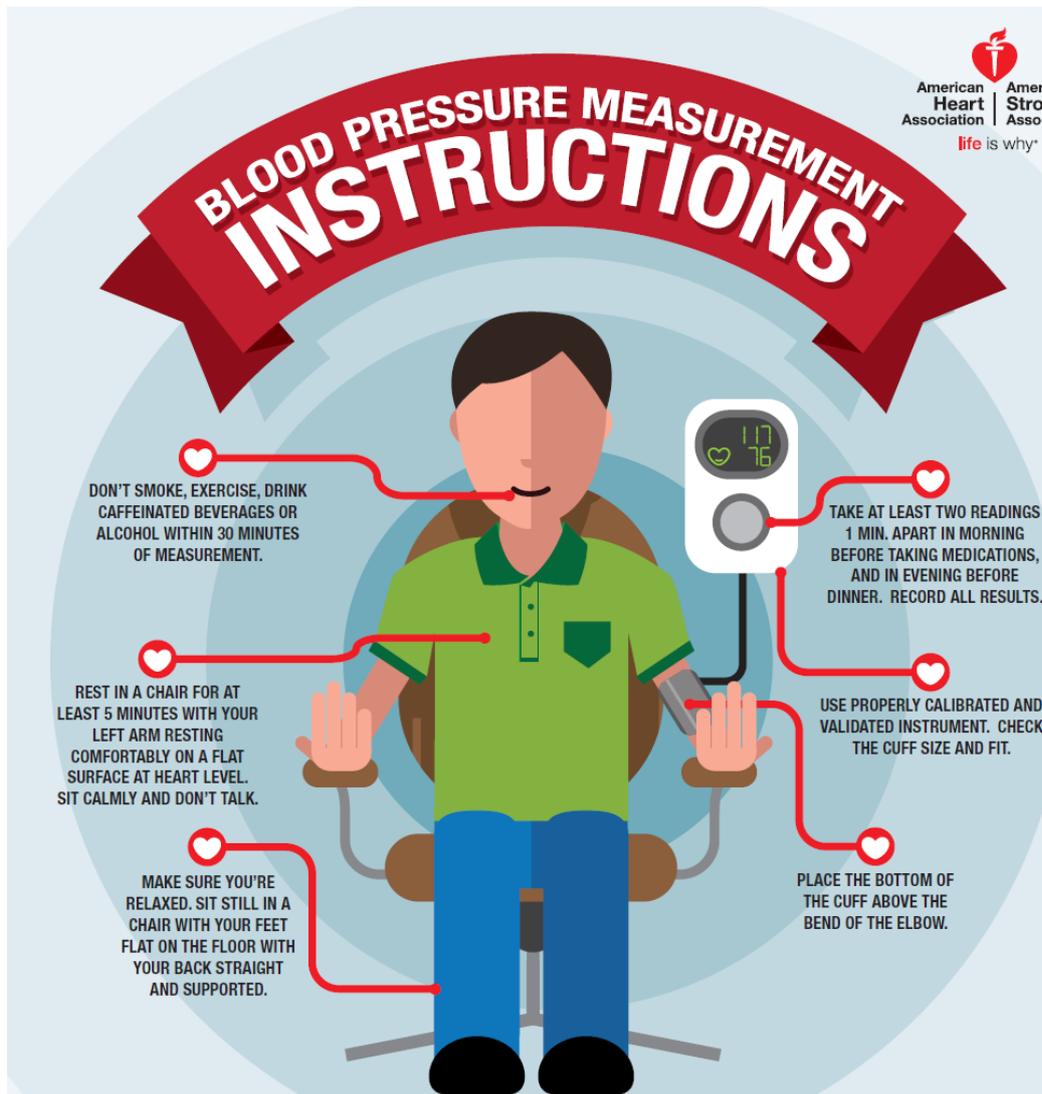
Types of Hypertension

1. Primary or Idiopathic hypertension: - Here a single reversible cause of hypertension cannot be identified. It is the commonest cause of high blood pressure in old age.
2. Secondary hypertension: - A definite reason for hypertension can be found such as renal disease, endocrine problems, drugs (like steroids, NSAIDS) etc.
3. Isolated SBP: - The systolic blood pressure is elevated, and the diastolic pressure is normal. This is seen commonly in the elderly.

RISK FACTORS (BOX):

Non Modifiable	Modifiable
Age	Habits – Tobacco use
Gender	Lifestyle – sedentary/ lack of physical activity
Genetic Factors	Personality – Stress
Race	Obesity -
	Diet – Sodium excess/ Fat

Clinical features
Symptom
- Hypertension has been termed as "silent killer," because it hardly produces any symptoms.
- Headache and giddiness are commonly reported symptoms. Epistasis and Breathlessness may be present.

Signs
- BP is elevated (≥150/90 mm of Hg). Accelerated HTN needs to be taken care of on an emergency basis.
- Loud second heart sound
- Signs of an underlying cause should be sought.
- Optic fundus should be examined in all patients for hypertensive retinopathy changes.

Investigations
Primary level:
Hemoglobin, Blood Glucose, Urea, creatinine, urine examination, Electrocardiography

Secondary and tertiary levels:
Lipid Profile, Electrolytes, Thyroid function tests, Chest X Ray, Renal Doppler and ultrasonography abdomen, fundoscopy
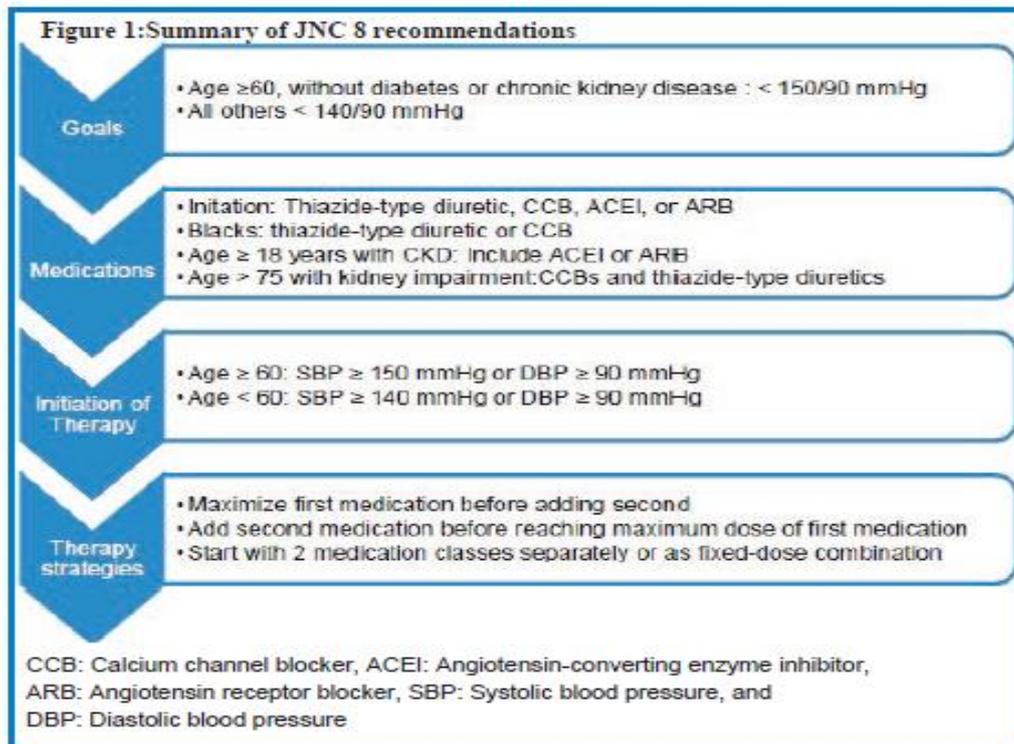
Treatment

Non Pharmacological measures:
- Diet: Low fat, low sodium diet (<5gm per day)
- Weight reduction: BMI should be targeted to < 25kg/m2
- Exercise: Regular exercise, preferably aerobic type for at least 30 minutes per day
- Relaxation techniques, yoga, meditation.
- Tobacco cessation

Antihypertensive Agents
- **Calcium channel blockers** like Amlodipine (2.5 – 5 mg OD), cilnidipine (5-10 mg OD/ BD), etc.
- **Anigiotensin Conversion Enzyme (ACE)** inhibitors like ramipril (1.25 mg OD), enalapril (2.5 – 5 mg OD/ BD), and Angiotensin Receptor Blockers (ARB) like Losartan (25 – 50 mg OD/ BD), Telmisartan (20 mg OD/ BD) and Olmesartan (20 mg OD/ BD).
- **Diuretics** like furosemide (20 – 40 mg OD), hydrochlorothiazide (12.5 mg OD), spironolactone (25 – 50 mg OD).
- **Beta Blockers** like atenolol (25 – 50 mg OD/ BD), metoprolol (25 – 50 mg OD/ BD).

Figure 1: Summary of JNC 8 recommendations

Goals
- Age ≥60, without diabetes or chronic kidney disease : < 150/90 mmHg
- All others < 140/90 mmHg

Medications
- Initation: Thiazide-type diuretic, CCB, ACEI, or ARB
- Blacks: thiazide-type diuretic or CCB
- Age ≥ 18 years with CKD: Include ACEI or ARB
- Age > 75 with kidney impairment: CCBs and thiazide-type diuretics

Initiation of Therapy
- Age ≥ 60: SBP ≥ 150 mmHg or DBP ≥ 90 mmHg
- Age < 60: SBP ≥ 140 mmHg or DBP ≥ 90 mmHg

Therapy strategies
- Maximize first medication before adding second
- Add second medication before reaching maximum dose of first medication
- Start with 2 medication classes separately or as fixed-dose combination

CCB: Calcium channel blocker, ACEI: Angiotensin-converting enzyme inhibitor,
ARB: Angiotensin receptor blocker, SBP: Systolic blood pressure, and
DBP: Diastolic blood pressure

Compelling Indication Initial Therapy Options:

Heart failure	THIAZ, BB, ACEI, ARB, ALDO ANT
Post myocardial infarction	BB, ACEI, ALDO ANT
High CVD risk	THIAZ, BB, ACEI, CCB
Diabetes	THIAZ, BB, ACEI, ARB, CCB
Chronic kidney disease	ACEI, ARB, THIAZ
Recurrent stroke prevention	THIAZ, ACEI

Compelling indications for Individual Drug Classes Key: THIAZ = thiazide diuretic, ACEI= angiotensin converting enzyme inhibitor, ARB = angiotensin receptor blocker, BB = beta blocker, CCB = calcium channel blocker, ALDO ANT = aldosterone antagonist

Key messages
- The goal of treatment is to achieve a blood pressure of less than 150/90mm Hg. For patients with diabetes and renal disorders, this further needs to be reduced to 140/90.
- Older patients are likely to demonstrate orthostatic fall of blood pressure. Drugs that produce orthostatic hypotension should be avoided (β-blockers, peripheral adrenergic blockers and high-dose diuretics). Drugs that cause congnitive dysfunction (central α2- agonists, i.e. clonidine) should be used with caution.

Further reading:
1. JNC 8 Criteria
2. Davidson's Principles and Practice of Medicine, 23rd Edition

3. Ogedegbe G, Pickering T. Principles and techniques of blood pressure measurement. *Cardiology clinics.* 2010; 28(4):571-586.

CORONARY ARTERY DISEASE

Introduction
Coronary artery disease (CAD) is also known as ischemic heart disease (IHD). Myocardial ischemia occurs when there is an imbalance between the supply of oxygen and the myocardial demand. IHD is a very common cause of disability and death in old age.

Risk Factors for IHD
- Hypertension (systolic and diastolic)
- Tobacco use
- Dyslipidemia
- Obesity
- Sedentary life style
- Diabetes mellitus

Clinical Manifestations
The manifestations of IHD include chest pain or discomfort, radiating to left shoulder, neck and epigastrium. Other symptoms include dyspnea, sweating, palpitations, nausea and vomiting. However, in older patients silent ischaemia and cardiac failure are more frequent.

Investigations:
These are at a secondary and tertiary level.
- Electrocardiogram
  Changes are characteristic in different leads in different infarcts

I Lateral	aVR	V1 Septal	V4 Anterior
II Inferior	aVL Lateral	V2 Septal	V5 Lateral
III Inferior	aVF Inferior	V3 Anterior	V6 Lateral

- Blood chemistry – CPK-MB and Troponin I
- Echocardiogram
- Tread Mill Test for Angina

Treatment

General Management
- Patients should be reassured.
- Comorbid conditions such as anemia, thyroid dysfunction, hypertension, and dyslipidemia should be treated.
- Tobacco use should be stopped
- Regular exercise and low salt and low fat diet should be encouraged.
- Stress management through yoga, meditation, etc

- Adequate rest

Medical management
At a primary level, when IHD is suspected, patient should be referred immediately for further evaluation to a secondary/ tertiary centre. Cardio Pulmonary resuscitation is to be done in cases of Cardiac arrest. Administration of Asprin, Clopidogrel and Statin to stabilize
Medical management includes
- Short-acting nitrates (e.g. Glyceryl trinitrate)
- Long-acting nitrates (e.g. isosorbide dinitrate and monotrate)
- Aspirin &/or clopidogrel
- Statins
- β -adrenergic blockers (Metoprolol, carvedilol), ACE Inhibitors

At a district hospital level
- Thrombolysis by streptokinase/urokinase within 6 hrs. Thrombolytic therapy in old age is limited by the presence of several contraindications (Eg: Age ≥ 85 years) and is associated with higher rates of mortality and complications.
- Low molecular weight heparin
- Coronary angioplasty is an option for older subjects who continue to have symptoms despite medical management. CABG has better survival over medical management and similar survival as coronary angioplasty in the long run.

Key message:

- Older persons may manifest with atypical symptoms of IHD and will require immediate referral to a higher centre for proper management.

CARDIAC FAILURE

Definition
Heart failure (HF) is defined as a complex clinical syndrome that can result from any structural or functional cardiac disorder that impairs the ability of the ventricle to fill with or eject blood.

Causes of cardiac failure:
In the elderly, cardiac failure may be a manifestation of various conditions that include IHD, Cardiomyopathy, other cardiac disorders, anemia, thyroid disorders, uncontrolled hypertension. Lung diseases, renal diseases and fulminant infections may also cause failure.

Clinical Features
- Breathlessness on exertion
- Orthopnea
- Paroxysmal nocturnal dyspnea
- Fatigue
- Weakness and tiredness

Physical signs
- Pulse is fast and of low volume
- BP is low in severe heart failure
- Respiratory rate may be high due pulmonary edema
- Peripheries are cold and may be cyanosed
- JVP is usually raised
- Pitting pedal edema may be present
- Third and fourth heart sounds are often audible
- Bilateral fine crepitations and rhonchi may be heard
- Liver may be enlarged and tender due to congestion

Investigations
At a primary level, CHF should be suspected based on symptoms and clinical examination.
At a Secondary and tertiary level:
- Chest x-ray: Presence of cardiomegaly, Pulmonary edema
- Echocardiography: provides information on left and right ventricular size, regional wall motion abnormality, condition of heart valves and ventricular hypertrophy.

Treatment of heart failure
- Chronic cardiac failure is primarily treated with diuretics.
- However, diuretics may cause several serious problems such as hyponatremia in older patients.
- Digoxin is a very useful drug in chornic cardiac failure in older patients. Features of digoxin toxicity include fatigue, depression, confusion, anorexia, nausea, vomiting, diarrhea, headache and a variety of arrhythmia.
- ACE inhibitors (captopril, enalapril, and lisinopril) and Vasodilators (nitrates, hydralazine, and prazosin) may have a role.
- Treatment -resistant cardiac failure in old age can be due to poor compliance, use of NSAIDs, simultaneous use of β - adrenergic blockers, calcium channel antagonists, persistent or frequent arrhythmias, infection, and unsuspected valve lesions.

CARDIAC ARRHYTHMIA

INTRODUCTION
An abnormality of the cardiac rhythm is called a cardiac arrhythmia. Arrhythmias may cause sudden death, syncope, heart failure, chest pain, palpitations and dizziness or can be asymptomatic.

TYPES OF ARRHYTHMIAS
There are two main types are arrhythmia
1.) Bradyarrythmia - An arrhythmia with a heart of < 60 beat per minute.
2.) Tachyarrythmia - An arrhythmia with a heart of > 100 beat per minute.

Tachyarrythmias are subdivided into supraventricular, which arise from the atrium or the atrioventricular junction and ventricular, which arise from the ventricles.

1. Sinus Arrhythmia –

It is normal phenomenon and results in a regularly irregular pulse (Note: Irregularly irregular pulse is seen in atrial fibrillation)
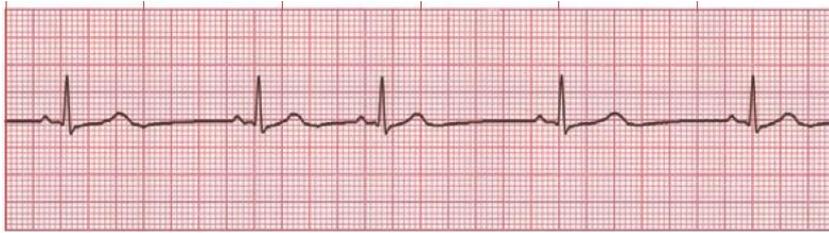
2. Sinus Bradycardia-

A heart rate of less than 60 beats per minutes originating in sinus node is called bradycardia. It is usually asymptomatic unless the rate is very slow.
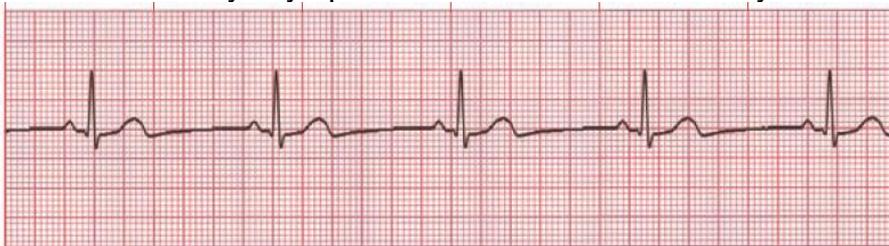
Table 2: Causes of Sinus bradycardia

Physiological	Pathological
- Sleep (due to decreased sympathetic tone) - Elderly - Athletes (due to increased vagal tone)	- Hypothyroidism - Cholestatic jaundice - Raised intracranial pressure - Myocardial infarction - Hypothermia - Idiopathic - Drugs (beta blocker)

Treatment of symptomatic bradycardia
1) Temporary pace maker – if the cause is reversible
2) Permanent pacemaker - if the cause is irreversible
3) Injection of Atropine may help temporarily

3. Sinus Tachycardia

A heart rate of more than 100 beats per minutes originating in sinus node is called sinus tachycardia. In the ECG, it is characterized by normal P waves, PR intervals and QRS complexes. It may be experienced as palpitations.
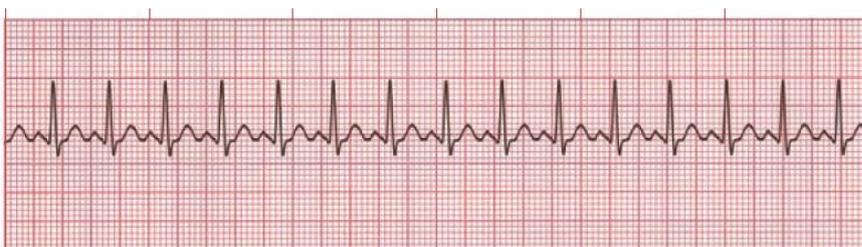
Table 3: Causes of Sinus tachycardia

Physiological	Pathological
- Anxiety - Fear - Exertion	- Fever - Anemia - Hypovolemia - Hypotension - Heart failure - Hyperthyroidism - Phaeochromocytoma - Sympathomimetic drugs (Beta adrenoceptor agonists)

Treatment includes
- Treating the underlying cause
- Beta blockers

4. Atrial Fibrillation (AF) - AF is the most common arrhythmia in elderly. It can be
A) Paroxysmal - Refers to episodes terminate spontaneously.
B) Persistent - Refers to episodes sustained for more than 7 days, or AF that terminates only with cardioversion.
c) Chronic or continuous AF is the one that is unresponsive to cardioversion.
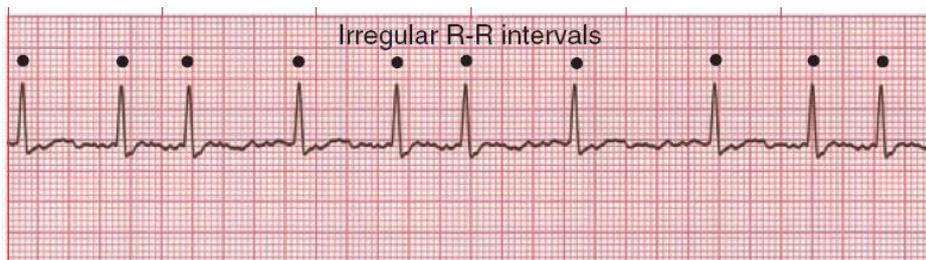
Rate: Atrial: 350bpm or greater; Ventricular: slow or fast
Rhythm: Irregular
P Waves: No true P waves; chaotic atrial activity
PR Interval: None
QRS: Normal (0.06-0.10 sec)
- Rapid, erratic electrical discharge comes from multiple atrial ectopic foci.
- No organized atrial contraction are detectable.

Table 4: Etiology of AF

Emotional stress Following surgery Exercise Excessive caffeine use Smoking Acute alcoholic intoxication	Rheumatic Heart disease (mitral valve disease) Hypertension Heart failure Hyperthyroidism COPD Cardiomyopathy Pericardial disease Pulmonary embolism Idiopathic (Lone AF)

Clinical Features
Symptoms
- Can be asymptomatic and detected incidentally in some patients.
- Anxiety
- Palpitations
- Fatigue
- Dyspnea

Signs
- Irregularly irregular pulse which is usually 100-150
- Variable volume of pulse
- Variable intensity of S1
- Sign of cardiac failure
- Features of underlying disease causing AF

Complications
- Syncope
- Thromboembolism
- Cardiac failure
- Angina
- Hypotension
- Pulmonary edema

Investigations
- ECG shows varying RR interval with absent P waves.
- Echocardiogram can detect underlying condition such as mitral stenosis, atrial dilatation and clot formation.
- Other test includes CBC (to identify Anemia)
- Thyroid function test (to identify hyperthyroidism)
- Serum electrolytes (to identify electrolyte imbalance)
- Chest X-ray (to identify pneumonia, COPD)

Treatment
Goals of treatment
- Control of ventricular rate – By Beta blockers (Esmolol, metoprolo) or calcium channel blocker (verapamil or diltiazem) or Digoxin
- Restoration of sinus rhythm
- Prevention of embolic complications
- Correction of underlying cause

Anticoagulation in elderly should be balanced against the increased risk of bleeding. If hemodynamically unstable – DC shock is the treatment of choice. If precipitating factor such as alcohol intoxication, fever, thyrotoxicosis, etc., it should be treated.

Key messages:
- Atrial fibrillation is the commonest arrhythmia in elderly

Case studies:
1. An elderly male aged 78 years presents to you with a blood pressure of 180/100 mm Hg. How would you approach and manage this patient at a primary and a secondary level?
2. An elderly female aged 88 years presents to you with chest pain. How would you approach and manage this patient at a primary and tertiary level?
3. An elderly lady aged 85 years presents to you with a complaint of palpitations. Her children report that she suffered from breathlessness and occasional syncopal attacks. How would you approach and manage this patient at a primary and tertiary level?
4. An elderly gentleman presents to you with breathlessness, more so on lying down. His family reports that he has been feeling low and has a decreased appetite lately. He also has been reportedly suffering from urinary incontinence over the last 3 days. How would you approach and manage this patient at a primary and tertiary level?