Introduction to cardiovascular examination

History taking:
1- dyspnea
2- chest pain
3- cough
4- haemoptysis
5- syncope
6- palpitation
7- ankle swelling
8- fatigue
9- cyanosis
10- claudication


Clinical examination of cardiovascular system
General appears breathing, body height, anomalies, oedema etc.

1- Face and neck:
   a- pallor, cyanosis, hyperlipidema, oral hygiene
   b- carotid pulse
   c- JVP height, wave front, a, c, x, v, y

2- Hand:
   clubbing, bleeding spots, radial pulse,

3- pericardium:
   inspection, palpitation, listening

4- Abdomen:
   abnormal, (e.g. organomegaly)

5- Chest:
   basal crepitation

6- Leg:
   peripheral pulse, femoral pulsation,

7- Precordium and chest:
   shape of the chest, scar, wide spaced nipples.
   Palpation for apex beat (character), any abnormal pulsation at the left parasternal border. right 2nd intercostal space (dilated aorta), left 3rd space (dilated main pulmonary artery).

8- Types of pulse:
   - Corrigan’s pulse: aortic insufficiency.
   - Pulses parvous: aortic stenosis
   - Bisferiens pulse: aortic incompetence, HOCM
   - Pulses alternans: severe LV- failure.
   - Pulses paradoxus: pericardial tamponade, severe obstructive lung disease
   - Constrictive pericarditis, hypovolmic shock, pregnancy.

9- Auscultation of the heart:
   looking for first and second sounds, any added sounds, murmurs, precordial rub.
Examination of precordium:

1- chest wall abnormalities: (pectus excavatum, pectus carinatum) Marfan’s syndrome
2- Kyphoscoliosis: secondary pulmonary hypertension, right sided failure
3- 2nd right intercostals space, suprasternal notch, aortic pulsation.
4- 3rd left intercostals space: pulmonary area
5- left parasternal region (right ventricle)
6- 3rd and 4th intercostals space (left ventricle)
7- Retraction left parasternal region (LVH)
8- systolic retraction at cardiac apex (constrictive pericarditis).

Characterization of murmurs:

1- Intensity: grade(1-6), 4 is usually palpable.
2- Quality ° blowing, harsh, musical.
3- Frequency (pitch) high or low.
4- Duration short or long.
5- Configuration e.g. crescendo.
6- Timing.
7- Radiation.
**Imaging of the heart:**

Chest x-ray
Cardiac Silhouette.
Lung field.
Mediastinal widening or dilated aorta.
Abnormal calcification at the aortic valve.
Aortic calcification.
Calcification at the pericardium.
Diagnostic tests and procedures in the patient with C.V.D.

**Chest X-ray:**
Configuration of the heart in post – ant view.
1- **cardiac silhouette > of 50% of the diameter of the thorax:**
2- **L. a trial enlargement.**
   - Straightening of the border
   - Widening of the space between main bronchi
   - Double shadow
3- **R.V. enlargement.**
   - Outer border R.V. enlargement.
   - Lateral view R.V. border occupy > one third of the retro sternal space.
4- **L.V. enlargement:**
   - Displaced laterally
   - Rounding of the apex (L.V.H.)

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**Electrocardiography ECG**

**ECG Convention and intervals**
- Depolarization towards electrode: positive deflection
- Depolarization away from electrode: negative deflection
- Sensitivity: 10mm=1mv
- Paper speed: 25mm per second
- Each large square (5mm) = 0.2s
- Each small square (1mm) = 0.04s
- Heart rate = 1500/R-R interval (mm)

(i.e. 300 ÷ number of large squares between beats)

**ECG:**
what the ECG is about.

1. Rate.
2. Rhythm.
3. Shape (any abnormal changes):
   - P-wave = atrial conduction
   - QRS = ventricular depolarization
   - T = ventricular repolarization
   - ECG paper: small square = 0.04 seconds
   - Large paper = 0.2 seconds

**ECG 12 leads:**
- 6 extremities leads
- 6 chest leads

**ECG:**
what the ECG is about
V1-V2 = look at the right ventricle
V3-V4 = look at the septum
V5-V6 = look at the left ventricle
Cardiac axis: the depolarization wave usually spreads toward I, II, III (11 o'clock-5 o'clock) II > I or III (normal)
Right axis deviation °predominantly + ve in lead III > I
Left axis deviation °predominantly + ve in lead I > III > III + II

**Electrocardiography**
- Represent electrical activity of the heart
Small box 1mm = 0.04 sec.
- Horizontal scale speed 25mm/sec.
Large box 5mm = 0.20 sec.

Vertical scale 10mm = 1MV
Heart rate 300/No. of large boxes between R-R interval
- **P** = atrial activation
- **PR** = time taken to travel through A-V node (0.20sec) nodal black

**QRS:**
- Ventricular depolarization by steps < 0.12 sec.
  - 1- IVS left to right
  - 2- Right ventricle + inferior wall of L.V.
  - 3- Apex, centr of L.V.
  - 4- Base + posterier of L.V.

- **J** wave = junction between QRS complex & ST segment
- **T** wave = V. repolarization
- **QT** wave= duration of V depolarization + V. repolarization = 0.35sec-0.44sec, For heart rate between 60-100/min.
- **QTE** wave= QT (sec./RR interval ½/sec.)
- **U** wave= etiology unknown

**Standard electrocardiogram**
- 12 leads (6 limbs leads + 6 chest precordial leads)
- Electrical activity toward leads is +ve.
- Electrical activity away from leads in -ve.
Rhythm strips showing that the R-R intervals are slightly irregular even during sinus tachycardia (when sinus arrhythmia should not be marked). In addition, ventricular ectopic beats tend to affect (usually accelerate) the first two post-extrasystolic intervals, a phenomenon known as heart rate turbulence onset. VE, ventricular ectopic beats.

Rate-dependent complete left bundle-branch block (LBBB) (lead V1). Negative T waves become manifest when the LBBB disappears in leads showing a predominant negative (S-wave) deflection. The patient has sclerodegenerative conduction system disease with no other evidence of organic heart disease. These changes are attributed to the type of long-term memory effects that become manifest after disappearance of an abnormal sequence of depolarization. BPM, beats per minute.

Nonspecific (nondiagnostic) ST-segment-T wave changes, the most common abnormalities in ECG interpretation.
**Exercise Testing**

**Indication for Exercise Testing**
- To confirm the diagnosis of angina
- To evaluate stable angina
- To assess prognosis following myocardial infarction
- To assess outcome after coronary Revascularization e.g. coronary angioplasty
- To diagnose and evaluate the treatment of exercise-induced arrhythmias

**Exercise tests: High-Risk Findings**
- Low threshold for ischemia (i.e., within stage 1 or 2 of the Bruce protocol)
- Fall in BP on exercise
- Widespread. Marked or prolonged ischemic: ECG changes Exercise-induced arrhythmia

**Contraindication of stress test:**
1. Unstable angina
2. Anterior MI
3. Poorly controlled HT
4. Sever aortic stenosis
5. Significant CHF
**Echocardiography**

*Echocardiography:* good cardiac ultrasound examination include:

- M-mode echocardiography
- Two-dimensional echocardiography
- Doppler ultrasound evaluation of blood flow.
- Colour Doppler flow mapping evaluation of blood flow & velocity.
- Transesophageal echocardiography used to overcome acoustic penetration through the lung tissue so is clearer looking for vegetation & thrombus formation. Stress echocardiography Assessment of regional and global left ventricular function.
- Three dimensional echocardiography allow better evaluating cardiac function, complex heart disease.

**Common Indications For Echocardiography**

- Assessment of left ventricular function
- Diagnosis and quantification of severity of valve disease
- Identification of vegetation in endocarditis
- Identification of structural heart disease in atrial fibrillation
- Detection of pericardial effusion
- Identification of structural heart disease in systemic embolism

![Standard M-mode image through the left ventricle at the level of the mitral valve. See text for discussion of sample tracings.](image-url)
**Other investigation**

1- Computed topographical (CT) imaging  
2- Magnetic resonance imaging (MRI)  
3- Cardiac catheterization (measuring intracavitary pressure)  
4- Radionuclide imaging using gamma camera  
5- Myocardial perfusion imaging injection  
Radioactive isotopes as 201 thallium

**Nuclear cardiology:**

1- Blood pool imaging: RBC labeled with technetium 99m-for getting equilibrium passage of these cells in all four chambers and the rest of circulation, this method can help to measure ejection fraction.  
2- Imaging of myocardial infarcts: technetium pyrophosphate inter myocardial necrotic cells by getting access to intracellular calcium in the infarcted area.

**Nuclear cardiology:**

3- Myocardial perfusion imaging: using Radionuclide like technetium 99m or thallium 201.

4- Methoxy Isobutyl Isonitrile (MIBI) to accumulate in the viable myocardium.

5- Positron emission tomography: linear accelerator to generate glucose or oxygen related analogue isotopes accumulate in the viable myocardial cells irrespective of myocardial perfusion so that planning for thrombolysis, angioplasty or coronary bypass operation.

**Catheterization**

Indications of cardiac catheterization:
1-assessment of the left ventricular functions.
2-haemodynamic assessment of ventricular heart diseases.
3-aortic trauma.
4-massive pulmonary embolism.
5-constrictive pericarditis.
6-post myocardial infarction ventricular septal defect.
7-acute ischemic mitral regurgitation.
8-congenital heart disease.

Indications of coronary angiography:
1-diagnosis of coronary artery diseases.
2-angina uncontrolled by medications.
3-assessment of susceptibility for coronary intervention.
4-recurrence of angina following coronary angioplasty or by pass grafting.
5-strongly positive exercise test and poor blood pressure response to exercise.
6-preoperative assessment in patient undergoing surgery for valvular heart diseases.
Certain cardiac Therapeutic procedures
1- ballooning and stenting via catheterization
2- dilation as in aortic narrowing
3- closure of septum
4- pacemaker for correction of arrythmia
5- automatic implantable defilations (ICD)
6- transcatheter radiofreqeuning ablation

CT Scan and MRI:
1- aortic diseases (aortopathy, dissection).
2- pericardial diseases.
3- pulmonary hypertension (pulmonary embolism).
4- adult congenital heart disease.
5- cardiomyopathy (hypertrophic & restrictive).
6- cardiac tumors.

Endomyocardial biopsy:
Usually used to assist in the diagnosis of cardiomyopathy

Canadian cardiovascular society (CCS):

Classification of angina:
1- class 1: angina on strenuous exercise.
2- class 2: mild limitation due to angina on normal activity.
3- class 3: marked limited ordinary activity due to angina.
4- unable to undertaken any activity with angina at rest.

New York heart association (NYHA)
1-class 1: cardiac disease but without dyspneea during normal activity.
2-class 2: cardiac disease resulting in mild/moderate dyspneea on normal exertion.
3-class 3: marked dyspneea on ordinary exertion.
4-class 4: dyspneea at rest by any exertion.

Antiarrythmic drugs
The drugs used to treat arrhythmias are potentially toxic and should be used carefully according to the following principles:

- Many arrhythmias are benign and do not require specific treatment
- Precipitating or causal factors should be corrected if possible. These may include excess alcohol or caffeine consumption, myocardial ischemia, hyperthyroidism, acidosis, hypokalaemia and hypomagnesaemia
- If drug therapy is required it is best to use as few drugs as possible
In difficult cases programmed electrical stimulation (electrophysiological study) may help to identify the optimum therapy. When dealing with life-threatening arrhythmias it is essential to ensure that prophylactic treatment is effective. Ambulatory monitoring, exercise testing and programmed electrical stimulation may be of value. Patients on long-term anti-arrhythmic drugs should be reviewed regularly and attempts made to withdraw therapy if the factors which precipitated the arrhythmias are no longer operative. Patients who do not respond to drug therapy may benefit from other forms of therapy such as ant tachycardia pacing, radiofrequency ablation or arrhythmia surgery.

**Class I** - membrane-stabilising agents
(*fast sodium channel blockers*)

a- Block Na+ channel and prolong action potential Quinidine – disympromide

d- Block Na+ channel and shorten action potential Lidocaine (lignocaine) - mexiletine

C- Block Na+ channel with no effect on action potential Flecainide – propafenone

**Class II** - β-adrenoceptor antagonists (β-blockers) Atenolol – bisoprolol – metoprolol, l-stalol

**Class III** - drugs whose main effect is to prolong the action potential
Amiodarone, d-sotalol

**Class IV** - slow calcium channel blockers Verapamil, diltiazem

Some drugs (e.g. digoxin and adenosine) have no place in this classification while others have properties in more than one class e.g. (amiodarone, which has action in all four classes)
### Vaughan Williams classification

<table>
<thead>
<tr>
<th>Vaughan Williams classification</th>
<th>Intravenous dose</th>
<th>Oral therapy/ mg</th>
<th>Therapeutic plasma level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1 A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disopyramide</td>
<td>2mg/kg up to 1500mg</td>
<td>600-400</td>
<td>5-2</td>
</tr>
<tr>
<td>Procainamide</td>
<td>Up to 1000 N/A</td>
<td>1000-3000</td>
<td>8-4</td>
</tr>
<tr>
<td>Quinidien</td>
<td></td>
<td>1000-900</td>
<td>6-3</td>
</tr>
<tr>
<td>Class 1 B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lignocaine</td>
<td>2mg/kg up to 150mg</td>
<td>N/A</td>
<td>5-2</td>
</tr>
<tr>
<td>Mexiletin</td>
<td>2mg/kg up to 150mg</td>
<td>720-400</td>
<td>0.8-0.2</td>
</tr>
<tr>
<td>Class 1 C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flecarnide</td>
<td>2mg/kg up to 150mg</td>
<td>200</td>
<td>0.8-0.2</td>
</tr>
<tr>
<td>Propafenone</td>
<td>N/A</td>
<td>900-450</td>
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**Extra-cardiac manifestations**

- Anorexia, nausea, vomiting
- Diarrhoea
- Altered colour vision (xanthopsia)

**Cardiac manifestations**
Bradycardia
Multiple ventricular ectopics
Ventricular bigemny (alternate ventricular ectopics)
Paroxysmal atrial tachycardia
Ventricular tachycardia
Ventricular fibrillation

**Management**
- Stop digoxin
- Check urea, electrolytes and plasma digoxin level
- Correct hypokalaemia and/or dehydration
- Correct bradycardia using atropine (0.6 mg i.v.) and/or temporary pacing
- Treat atrial tachycardia with β-adrenoceptor antagonists
- Treat ventricular tachycardia with lignocaine
- In overdose, specific antidigoxin antibodies may be of value

**N.B.** Cardioversion carries an increased risk of provoking ventricular fibrillation.