

# CARDIOVASCULAR SYSTEM

Belmatt Healthcare Training

## Learning Outcomes

- By the end of this session the student will develop an understanding of:
- Anatomy and physiology of the heart
- Able to safely and competently perform a cardiac assessment.
- Able to identify abnormal cardiac presentations

Belmatt Healthcare Training

## Why Chest Pain?

- Most common chief complaints in the acute care setting
- Ruling out life-threatening causes such as
  - acute coronary syndromes,
  - aortic dissection,
  - pulmonary embolism
  - tension pneumothorax
  - esophageal perforation
- Heart disease is the leading cause of death

Belmatt Healthcare Training

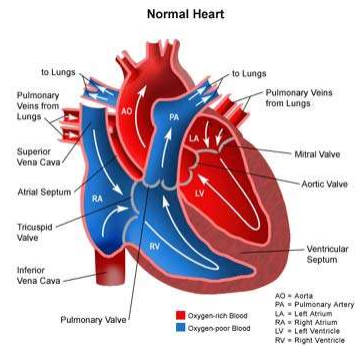
## Causes of Chest Pain

- Cardiac
- Respiratory
- Upper Gastro Intestinal
- Musculoskeletal
- No cause found

Belmatt Healthcare Training

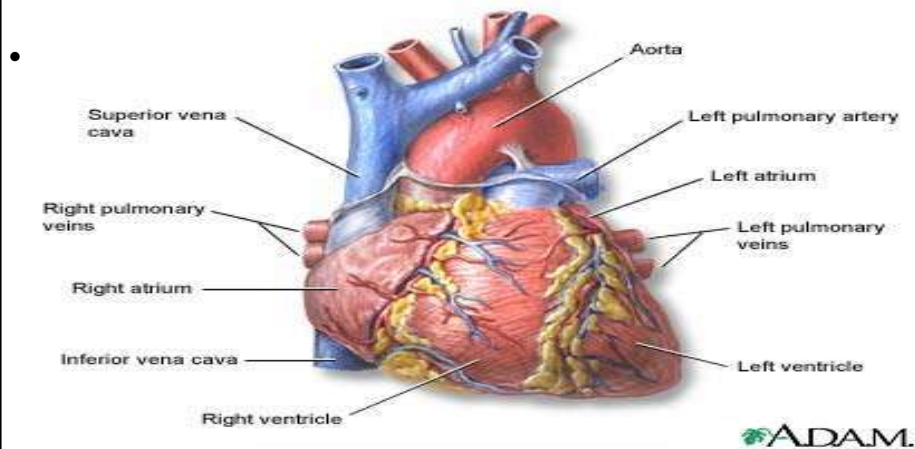
# ANATOMY

- Structure of the Heart
- Vascular System
- Conduction System



Belmatt Healthcare Training

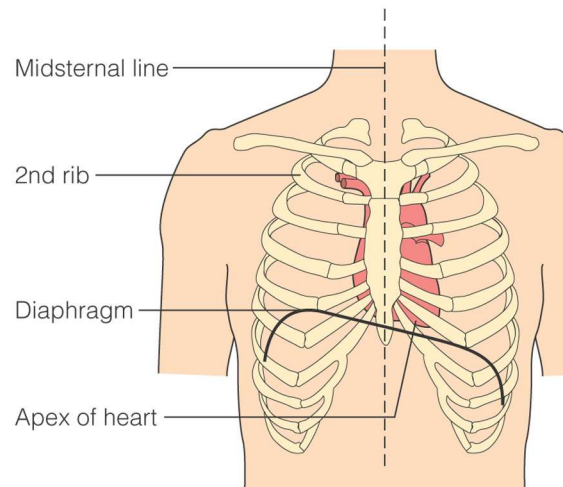
## Views of the Heart



Robert A. Cowles, MD, Assistant Professor of Surgery, Columbia University College of Physicians and Surgeons, New York, NY. Review provided by VeriMed Healthcare Network

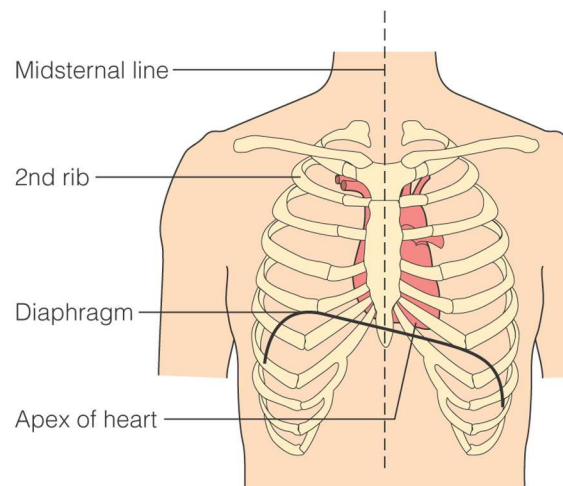
Belmatt Healthcare Training

**Location of the heart within the chest cavity.**



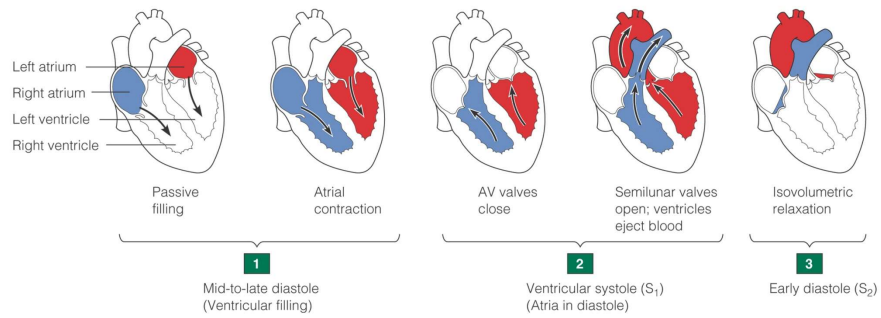
Belmatt Healthcare Training

**Location of the heart within the chest cavity.**



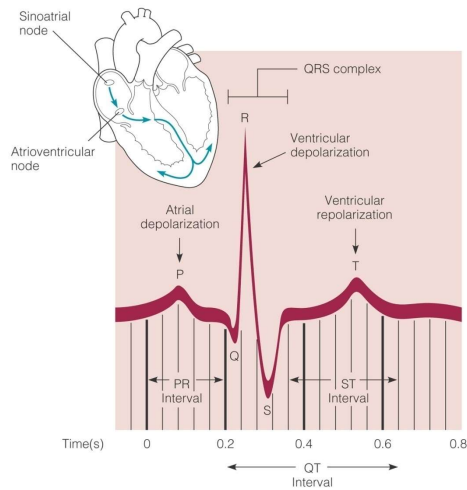
JA 2007 Images Pearsons education  
&St Georges Medical School

## THE CARDIAC CYCLE



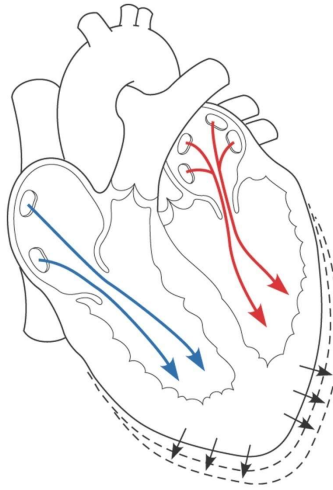
Belmont Healthcare Training

## ELECTROCARDIOGRAM WAVE



Belmont Healthcare Training

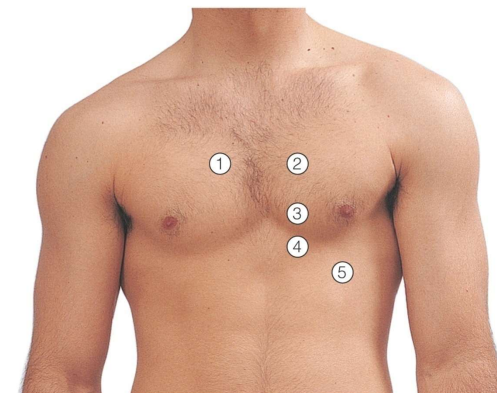
A. Preload is related to the amount of blood and stretching of the ventricular myocardial fibers. B. Afterload is the pressure that the ventricles must overcome in order to open the aortic and pulmonic valvular cusps.



A

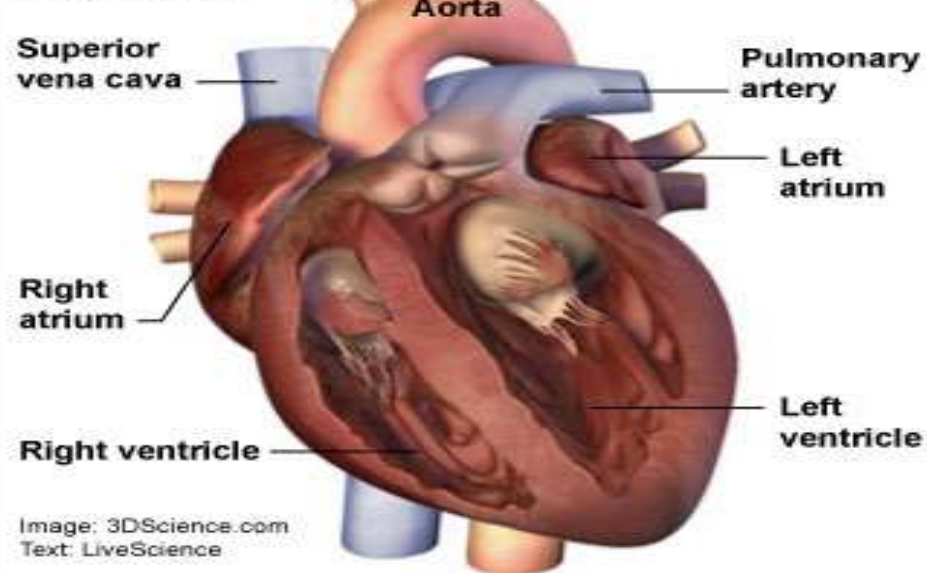
Belmatt Healthcare Training

## 5 KEY LANDMARKS FOR AUSCULTATION

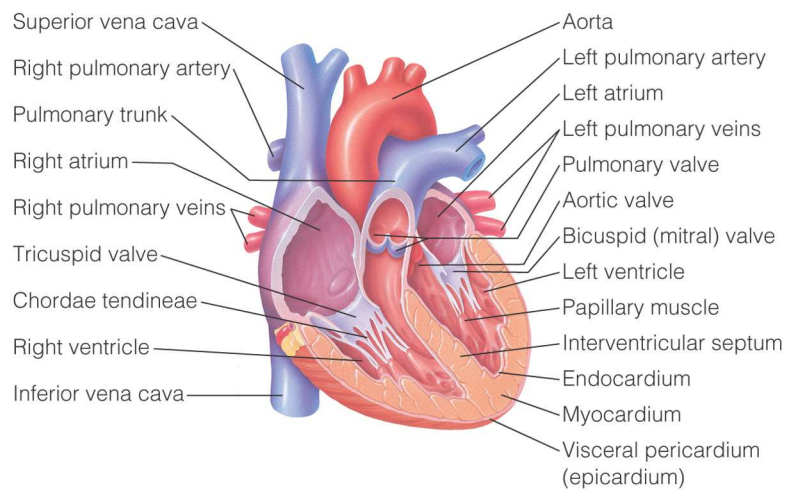


Belmatt Healthcare Training

## Inside the Heart

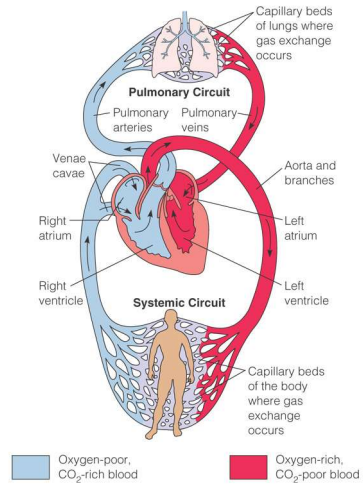


## Internal anatomy of the heart



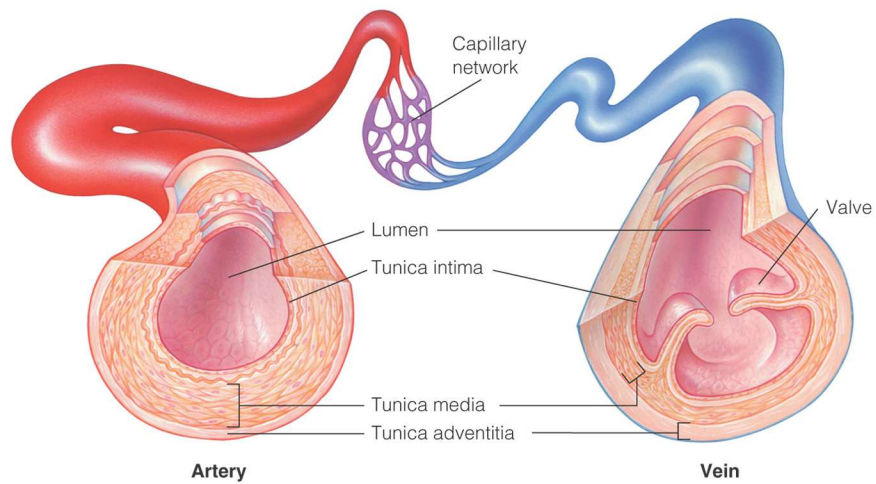
Belmatt Healthcare Training

## Pulmonary and Systemic Circulation.



Belmatt Healthcare Training

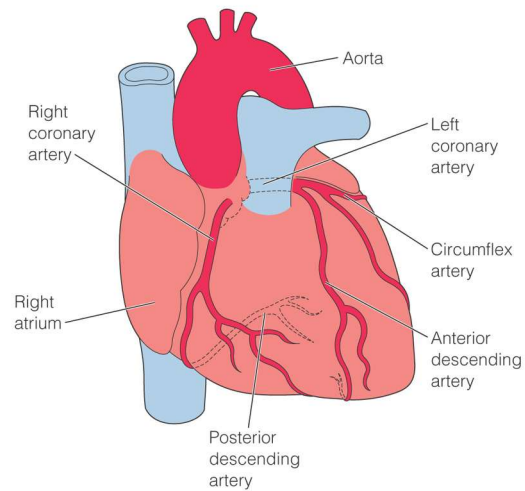
## Structure of Arteries, Veins, and Capillaries



Belmatt Healthcare Training

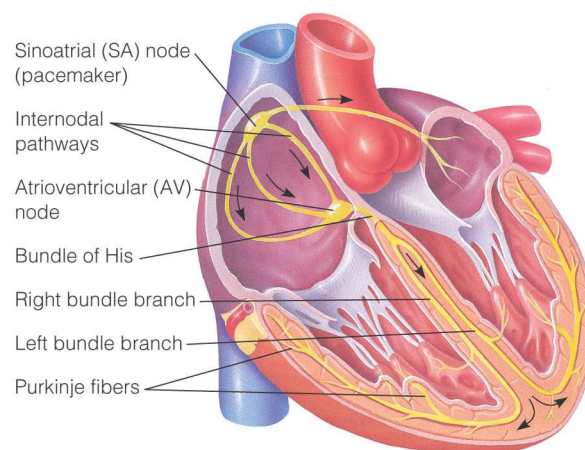


## The Coronary Arteries



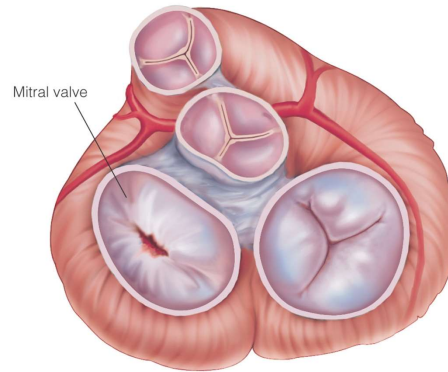
Belmatt Healthcare Training

## The Cardiac Conduction System



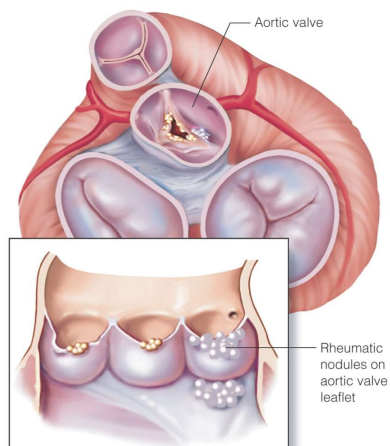
Belmatt Healthcare Training

## MITRAL STENOSIS



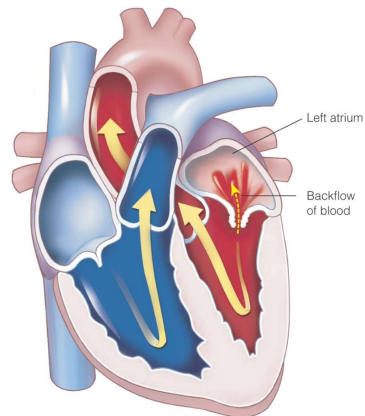
Belmont Healthcare Training

## AORTIC STENOSIS



Belmont Healthcare Training

**Figure 17.27** Mitral regurgitation.



Belmatt Healthcare Training

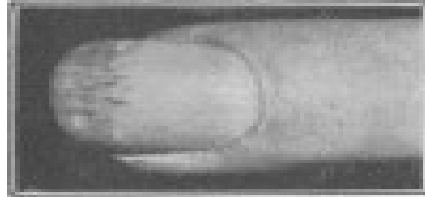
## EXAMINATION

- Position of the patient
- General look
- Start with the hands
- JACCOL
- Inspect, Palpate, Percuss, Auscultate,

Belmatt Healthcare Training

## STARTING WITH A HANDSHAKE

- Splinter haemorrhages
- Clubbing
- Tar Staining
- Radial Pulse



Belmatt Healthcare Training

## PALPATING RADIAL PULSE

- Name conditions that affect:
  1. Rate
  2. Rhythm
- What is a pulse deficit?
- Why compare left and right?
- Check for collapsing pulse.

Belmatt Healthcare Training

## JACCOL

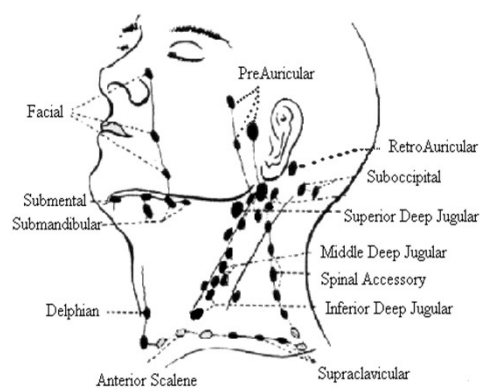
- Jaundice
- Anaemia
- Cyanosis
- Clubbing
- Oedema
- Lymphadenopathy

*Remember malar flush, xanthelasma and corneal arcus*

Belmatt Healthcare Training

## LYMPHADENOPATHY

- Pre auricular
- Post auricular
- Submental
- Cervical chain
- Supraclavicular



Belmatt Healthcare Training

## Jugular Venous Pressure

- Anatomy and Physiology
- Significance
  - Fluid Overload
  - Tricuspid Regurgitation
  - Complete heart Block
  - Superior Vena Cava Obstruction
  - Atrial Fibrillation

Belmatt Healthcare Training

## Examining JVP

- Pt. must be at 30 - 45°. Pt's head tilted upwards and facing away
- Use the internal jugular, not external jugular. External jugular is lateral to SCM and easier to see. Internal jugular is medial/behind the clavicular head of SCM.
- Shine a torch [light] on internal jugular vein at an oblique angle.
- Extend torch out horizontally from highest point of JVP pulsations, use ruler to measure vertical height from sternal notch to torch.
- Height >3cm above sternal angle is pathologic (raised ventricular filling pressure or volume overload often from RHF). Key is **3**cm and **JVP** has **3** letters.
- In normal person, can't see the JVP when pt is at 45°, but can see when pt is flat.
- Optionally: auscultate heart or feel carotid pulse to help identify JVP by its complex waveform

Belmatt Healthcare Training

## JVP KUSSMAUL SIGN

- Place Pt. sitting up at 90°.
- JVP becomes more distended during inspiration (classically constrictive pericarditis, currently severe RHF). This is opposite of what happens in normal pt.
- Usually negative in cardiac tamponade

Belmatt Healthcare Training

## Exam: hepatojugular reflux

- Exert pressure on liver for 15 sec.
- Venous return to right atrium increases.
- JVP will rise transiently in normal person.
- Check if remains elevated (RVF).

Belmatt Healthcare Training

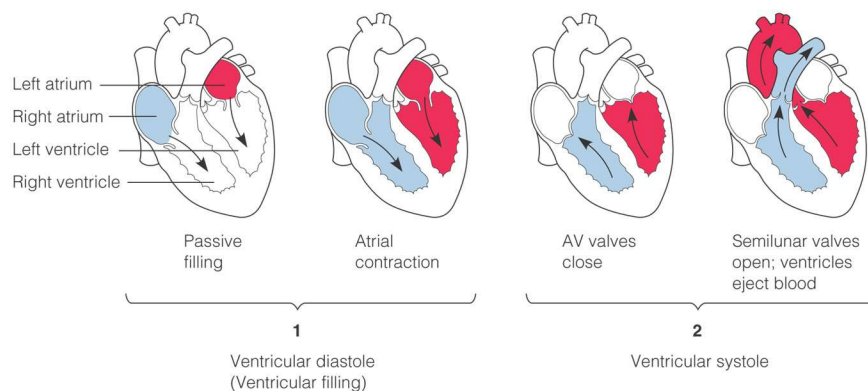
## Causes of elevated JVP

- Too much fluid:
- Fluid overload [esp. IV infusion]
- It's clogging up before gets to heart:
- SVC obstruction
- Can't beat it out of the heart fast enough:
- RVF
- Bradycardia
- Constrictive pericarditis
- Pericardial effusion
- Tricuspid stenosis or regurgitation
- Other:
- Hyperdynamic circulation

Belmatt Healthcare Training

### The Cardiac Cycle

Ventricular filling occurs during diastole (1); blood is pumped out of the heart to the pulmonary and systemic circulation during ventricular systole (2).



Belmatt Healthcare Training



## **CAROTID PULSE**

- Provides valuable info on cardiac function
- Thready or weak in cardiogenic shock
- Delayed upstroke in aortic stenosis
- Thrills – humming vibrations, listen both sides.
- Bruits esp in elderly or CVD. Use bell of stethoscope and ask pt to hold breath
- If above present check brachial pulse

Belmatt Healthcare Training

## **PRAECORDIUM EXAMINATION**

- Praecordial examination – inspection and palpation
- Auscultation of the heart
- Heart sounds 1 and 2
- Splitting of the second heart sound

Belmatt Healthcare Training

## Examination of the Praecordium

### Inspection:

- Scars (previous surgery)
- Pacemakers
- Chest wall deformities
- Apex beat
- Movements

Belmatt Healthcare Training

## Examination of the Praecordium

### Palpation:

- Apex beat – position and character
- Movements (or heaves)
- Thrills (palpable murmurs)

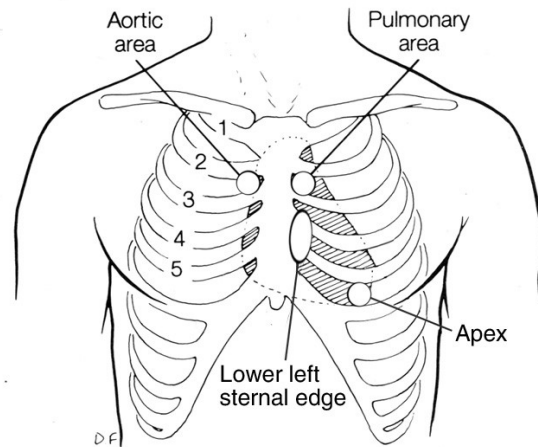
Palpate all areas while the patient is lying inclined to 45°

Palpate for the apex beat and thrills in the left lateral position

Palpate the base of the heart for heaves and thrills while patient is sitting forward

Belmatt Healthcare Training

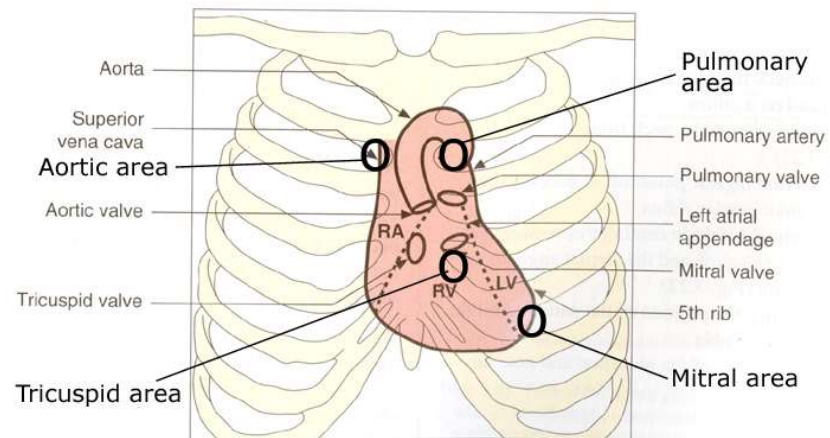
## Palpation of the Praecordium



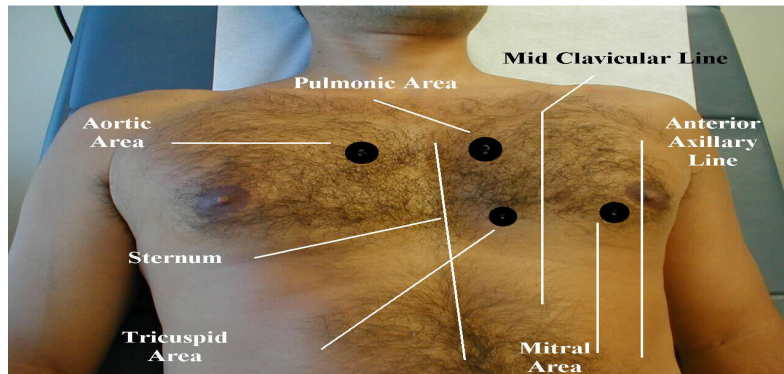
1 Harvey Learner Manual 2 Talley & O'Connor, Clinical Examination 3 Macleod's Clinical Examination 4 Mosby's Guide to Physical Examination

Belmatt Healthcare Training

## Auscultation of the heart



Belmatt Healthcare Training



Belmatt Healthcare Training

## Auscultation of the Heart

- Listen to the heart sounds at the mitral area with the bell and diaphragm
- Listen to the heart sounds at the tricuspid, pulmonary and aortic areas with the diaphragm

Belmatt Healthcare Training

## CVS CSLU Session 3

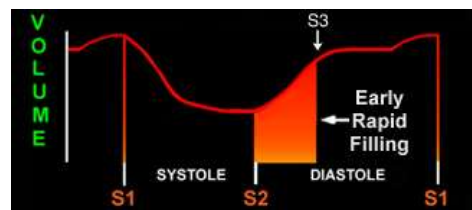
### Added sounds and murmurs

- Third heart sound
- Fourth heart sound
- Murmurs – mechanisms, characteristics, manoeuvres
- Classification of murmurs – systolic, diastolic and continuous

Belmatt Healthcare Training

### Third heart sound

- Occurs at the end of early diastolic filling
- Believed to be caused by vibrations in the ventricular wall or tensing of the chordae tendinae/papillary muscles by abrupt deceleration of blood



Belmatt Healthcare Training

## Third heart sound

- Low pitched early diastolic sound – causes a triple or gallop rhythm<sup>1</sup>
- Sounds like - lub du bub lub du bub<sup>1</sup>
- Listen with bell at apex, may be only heard when listening in left lateral position
- Physiological: children and adults (<40 years). Due to very rapid early diastolic filling (increased volume)<sup>1,2</sup>
- Pathological: due to exaggerated early diastolic filling (increased volume) into a ventricle (which may have reduced compliance). This occurs when there is heart failure or valvular regurgitation<sup>1</sup>

Belmatt Healthcare Training

## Fourth heart sound

- Late diastolic filling sound
- Due to rapid flow during atrial contraction into a ventricle with reduced compliance – eg. disorders characterised by ventricular hypertrophy, myocardial ischaemia<sup>1</sup>



Belmatt Healthcare Training

## Fourth Heart Sound

- Late diastolic sound, also low pitched (but higher pitched than S3)<sup>1,2</sup>
- Also sounds like a gallop rhythm.
- Listen with the bell, may only be heard when listening in left lateral position
- Sounds like – be lub dup be lup dup<sup>1</sup>
- Always pathological
- Always absent in atrial fibrillation

Belmatt Healthcare Training

## Heart Sounds

- The first heart sound occurs when the mitral and tricuspid valves close
- The second heart sound occurs when the aortic and pulmonary valves close. It is higher pitched than the first heart sound
- The first heart sound is usually louder than the second at the apex
- The second heart sound is usually louder than the first at the base

<sup>1</sup> Harvey Learner Manual

Belmatt Healthcare Training

## Heart Murmurs

- Due to turbulent blood flow.
- Heart Murmurs arise when: <sup>1</sup>
  - A valve is thickened and fails to open properly (stenosis)
  - A valve fails to shut properly and leaks (incompetence or regurgitation)
  - There is an abnormal communication between the heart chambers due to a congenital abnormality (eg atrial septal defect) or acquired abnormality (eg post infarct ventricular septal defect)
  - An abnormally large amount of blood flowing past a normal valve such as in pregnancy.
  - Some people (commonly children and young adults) have a systolic flow murmur, typically heard in the pulmonary area, but no structural abnormality. This is called an "innocent murmur" and is possibly caused by vigorous ventricular contraction. <sup>2</sup>

<sup>1</sup> Gray and Toghill <sup>2</sup> Mosby

Belmatt Healthcare Training

## Characteristics of murmurs

- Timing of the murmur in the cardiac cycle – systolic, diastolic or continuous.
- Loudness – reflects the degree of turbulence
- Pitch or frequency – low or high
- Location on chest wall – depends on site of origin of the murmur (that is the site of the abnormal valve etc)
- Radiation of the murmur - depends on the direction of the blood flow through the turbulent valve.

Belmatt Healthcare Training



## Manoeuvres for detecting murmurs

- Move the patient to the left lateral position and listen at the mitral area (or apex) with the bell and diaphragm
- Sit the patient forward, ask the patient to hold their breath after expiration, and listen at the left sternal edge and aortic areas with the diaphragm
- (If the patient has a murmur, listen in other areas to find the site of maximum loudness and radiation)



Belmatt Healthcare Training

## Apex beat

- The apex beat is the point of maximum impulse and is normally in the fifth intercostal space, midclavicular line
- It may be impalpable if the chest wall is too thick, or the patient has emphysema or a pericardial effusion <sup>2</sup>
- The apex beat may be displaced laterally or inferiorly with enlargement of the heart, displacement of the heart or chest wall deformity <sup>3</sup>
- The character of the apex beat is altered with some abnormalities of the heart eg. forceful and/or sustained (LV hypertrophy) or dyskinetic (LV dysfunction) <sup>2,4</sup>

Belmatt Healthcare Training

# CASE STUDY

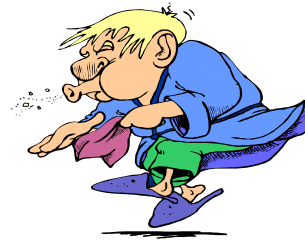
A 58-year-old man presents to the cardiology department with an eight-month history of progressive dyspnea and ankle edema. He is unable to climb a flight of stairs or walk across a room without stopping. He denies chest pain or palpitations, but reports two episodes of light-headedness in the past 6 months. He is white, non-diabetic, and admits to drinking three units of whisky a day. His past medical history includes a peptic ulcer in his twenties and a road traffic accident at age 35 which fractured his right tibia and fibula. He also suffers from systolic hypertension and hypercholesterolemia. He is a bar owner, and is married with two children. Physician examination reveals no peripheral stigmata of chronic liver disease. He is afebrile with an irregular pulse of 88 bpm, and blood pressure 170/90 mmHg. Jugular venous pressure is elevated by 4 cm. The apex beat is not palpable, and on auscultation there is a grade 2/6 pansystolic murmur at the apex and an audible third heart sound. There are no signs of hepatomegaly or ascites. He has mild pedal edema. Auscultation of the lung bases reveals fine end-inspiratory crackles and neurologic examination reveals sensory peripheral neuropathy affecting his feet.

**What is the most likely unifying diagnosis to explain this man's symptoms?**

- A Dilated cardiomyopathy secondary to alcohol
- B Cardiomyopathy secondary to ischaemic heart disease
- C Hypertensive cardiomyopathy
- D heart failure secondary to chronic mitral regurgitation

**What are the two most important initial investigations**

- 1. Blood investigations
- 2. Resting ECG
- 3. Chest X ray
- 4. Echocardiogram
- 5. Coronary angiography



Belmatt Healthcare Training