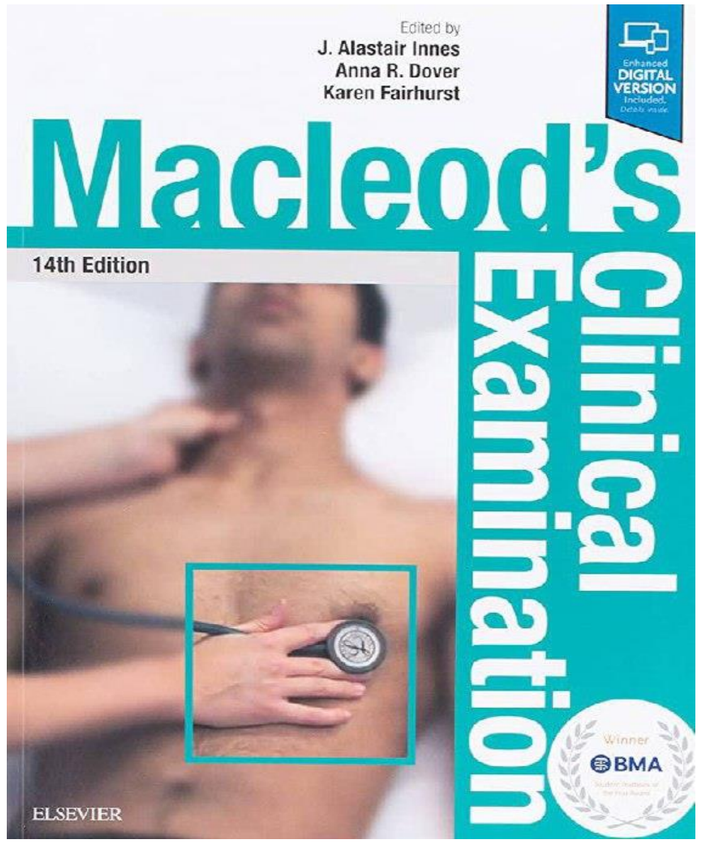

Outlines:

- General Examination
- Arterial Pulses
- Blood Pressure
- Jugular Venous Pressure

Done By: A.O.Alwikhyan , MD.

Introductory: Section 2 CH.4 Cardiovascular System Examination .

Note: This summary contains all Macleod's important notes.

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A-General Examination

The General inspection

- The **sequence** & **extent** of examination **depend on Patient's condition.**
- If the person may be **unstable**, **deteriorating** or **critically unwell** , adopt an **ABCDE approach** initially and defer detailed examination until stabilized.
- In Stable Patients, perform **a detailed** & **comprehensive** examination.
- Look at the **Patient's General Appearance:**

✓ Do they look **unwell**, **distressed**? Are there any signs of **breathlessness** or **cyanosis**? Is the patient **overweight or cachectic?**

✓ Are there any features of conditions associated with cardiovascular disease such as **Marfan's** , **Down's** or **Turner's** syndrome, or **ankylosing spondylitis** ?

✓ Conclude by examining the **entire skin surface** for petechiae, checking the **temperature** and **performing urinalysis** .

✓ **Fever** is a feature of **infective endocarditis** , **pericarditis**, and may occur **after myocardial infarction.**

✓ **Urinalysis** is necessary to check for **haematuria (endocarditis, vasculitis), glucosuria (diabetes)** and **proteinuria (hypertension and renal disease).**

- **Ensure privacy, good light, explain what you are going to do and take permission.**
  - Wash hand, wear gloves
  - Exposure : thorax fully exposed.
  - Position : lie in 45 degrees.

From right side of the patient

General:

- Comment on patient position in bed
- Level of consciousness
- Looks well or ill
- Breathless, cyanosed
- Distressed.

Hands Examination

- The hands usually **Feel** dry and warm at ambient temperature.
- Normal **Capillary Refill** time is 2 seconds or less.

✓ Cool extremities and prolonged capillary refill time signify impaired peripheral perfusion, which may occur in shock or chronic conditions associated with a low cardiac output state (as in severe aortic stenosis, mitral stenosis or pulmonary hypertension).

- One or two isolated **Splinter Haemorrhages** from trauma are common in healthy individuals, especially in manual workers.
- Splinter haemorrhages (Fig. 4.5B) are found in infective endocarditis and some vasculitic disorders.
- **A Petechial Rash** (caused by vasculitis), most often present on the legs and conjunctivae (Fig. 4.5E), is a transient finding in endocarditis and can be confused with the rash of meningococcal disease.
- **Janeway lesions** and **Osler's nodes** (Fig. 4.5A and C) are features of endocarditis but are rare in the modern area.
- **Tendon xanthomata** (Fig.4.6) a sign of familial hypercholesterolaemia , a genetic disorder associated with severe elevations in serum cholesterol and premature coronary artery disease.

Hands Examination

- Feel the **temperature** of the hands and measure **capillary refill** time.
- Examine the **hands for tobacco staining** (see Fig. 5.8), **skin crease pallor (anaemia)** or **peripheral cyanosis.**
- Look at the **Nails** for **finger clubbing** and for **splinter haemorrhages:** linear, reddish- brown marks along the axis of the fingernails and toenails (Fig. 4.5B)
- Examine the **Extensor Surface** of the hands for **tendon xanthomata:** hard, slightly yellowish masses over the extensor tendons of the hand from lipid deposits (Fig. 4.6B).
- Examine the **Palmar Aspect** of the hands for:

1- **Janeway lesions:** painless, blanching red macules on the thenar/hypothenar eminences (Fig. 4.5A)

2- **Osler's nodes:** painful raised erythematous lesions, typically on the pads of the fingers (Fig. 4.5C).

Face examination

- Look in the **Mouth For Central Cyanosis**: a purplish blue discoloration of the lips and underside of the tongue .
- Examine the **Eyelids for Xanthelasmata**: soft, yellowish plaques found periorbitally and on the medial aspect of the eyelids.
- Look at the **Iris** for **corneal arcus:** a creamy yellow discoloration at the boundary of the iris and cornea .
- Xanthelasmata and corneal arcus are associated with **hyperlipidaemia** but also occur frequently in **normolipidaemic** patients.
- The presence of xanthelasma is an **independent risk factor for coronary heart disease** and **myocardial infarction** but corneal arcus has **no independent** prognostic value.
- Examine the **Fundi** (p. 164) for features of **hypertension** (p. 165), **diabetes** (p. 165) or **Roth's spots** (flame-shaped retinal haemorrhages with a 'cotton-wool' centre; Fig. 4.5D).
- Cardiac causes of **central cyanosis** include :

  heart failure sufficient to cause pulmonary congestion and oedema impairing gas exchange, or, rarely, **congenital heart disease**, in which case it is associated with right-to-left shunting and **finger clubbing** .

B- Arterial Pulses

- **Palpable pulse:** in an artery **reflects the pressure wave generated by the ejection of blood into the circulation** from the left ventricle.
- When taking a pulse, **Assess**:
  1- **Rate:** the **number** of pulses occurring per minute.
  2- **Rhythm:** the **pattern** or **regularity** of pulses
  3- **Volume:** the **perceived degree of pulsation**
  4- **Character:** an **impression of the pulse waveform** or shape.
- The **Rate** and **Rhythm** of the pulse are determined at the **Radial artery**.
- Use the larger pulses (brachial, carotid or femoral) to assess the pulse **Volume** and **Character**.

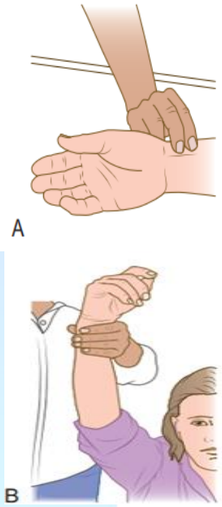
1. Radial pulse:

- On the right wrist, locate flexor carpi radialis tendon.
- Feel **lateral** to the tendon with the **pads of 3 fingers.**
- Count for **1 minute** OR (**15 seconds; multiply by 4**).
- Feel **both sides** simultaneously for **radio-radial delay.**
- Feel **Radial Artery** & **Femoral Artery** simultaneously for **radio- femoral delay.**
- Check for **Collapsing Pulse :**

Ask the patient if he has shoulder or arm pain

Using base of the fingers, elevate the hand above the patient's head.

- Calculate **Pulse Deficit ⬇⬇⬇ .**



Pulse Deficit

- Should have **2 examiners**, one for **palpation** and one for **auscultation**.
- **Palpate** the radial artery and calculate the rate over 1 minute.
- **Auscultate** over the heart apex and calculate the rate over 1 minute.
- **The deficit between HR** by **auscultation** and **pulse rate by palpation should not exceed 10 bpm.**

2. Brachial artery

- Use your **index** and **middle** fingers to palpate the pulse , **In the antecubital fossa**, just **medial** to the biceps tendon.
- Assess the **character** and **volume** of the pulse.

3. Carotid pulse

- Explain what are you going to do.
- With the patient **semi-recumbent**, Feel **it between the larynx and anterior border of SCM muscle.**
- Press gently by the **thumb**
- **DON'T FEEL BOTH SIDES SIMULTANOUSLY** and Palpate the pulse **gently** to avoid a vagal reflex.
- **AUSCULTATE FOR BRUIT ON BOTH SIDES WHILE** using the diaphragm of your stethoscope in **held inspiration**.

1-Rate

- Resting heart rate is **normally 50–95 bpm** .
- **Tachycardia > 100 bpm / Bradycardia < 60 bpm.**
- A pulse rate of **40 bpm can be normal in a fit young adult,** whereas a **pulse rate of 65 bpm may be abnormally low in acute heart failure**.
- ***MCCs of bradycardia***: are **medication, athletic conditioning and sinoatrial or atrioventricular node dysfunction**.
- ***MCC of tachycardia*** is **sinus tachycardia.**

4.9 Causes of abnormal pulse rate or rhythm

Abnormality	Sinus rhythm	Arrhythmia
Fast rate (tachycardia, >100 bpm)	Exercise Pain Excitement/anxiety Fever Hyperthyroidism Medication: Sympathomimetics, e.g. salbutamol Vasodilators	Atrial fibrillation Atrial flutter Supraventricular tachycardia Ventricular tachycardia
Slow rate (bradycardia, <60 bpm)	Sleep Athletic training Hypothyroidism Medication: Beta-blockers Digoxin Verapamil, diltiazem	Carotid sinus hypersensitivity Sick sinus syndrome Second-degree heart block Complete heart block
Irregular pulse	Sinus arrhythmia Atrial extrasystoles Ventricular extrasystoles	Atrial fibrillation Atrial flutter with variable response Second-degree heart block with variable response

2-Rhythm

- The pulse may be **Regular** or **Irregular** .

- **Sinus rhythm** is **regular** but **heart rate** varies with the respiratory cycle, particularly in children, young adults or athletes (sinus arrhythmia).

- During inspiration, parasympathetic tone **falls** and the **heart rate increases**; on **expiration**, **the heart rate decreases** .

4.10 Haemodynamic effects of respiration

	Inspiration	Expiration
Pulse/heart rate	Accelerates	Slows
Systolic blood pressure	Falls (up to 10 mmHg)	Rises
Jugular venous pressure	Falls	Rises
Second heart sound	Splits	Fuses

- **Regularly Irregular** With **intermittent extrasystoles** or **second-degree atrioventricular block**, there may be an **underlying regularity to the pulse**, interspersed with **periods of irregularity** .

- **Irregularly Irregular** In **atrial fibrillation** the pulse has no appreciable pattern and is often described as 'irregularly irregular'.

- **The rate in atrial fibrillation** depends on the number of beats conducted by the atrioventricular node. Untreated, the ventricular rate may be very fast (up to 200 bpm).

The variability of the pulse rate (and therefore ventricular filling) **explains why the pulse volume varies** and there may be **a pulse deficit**, with some cycles not felt at the radial artery.

4.11 Common causes of atrial fibrillation

- Hypertension
- Heart failure
- Myocardial infarction
- Thyrotoxicosis
- Alcohol-related heart disease
- Mitral valve disease
- Infection, e.g. respiratory, urinary
- Following surgery, especially cardiothoracic surgery

3-Volume

- The ventricles fill during diastole. **Longer diastolic intervals are associated with increased stroke volume**, which is reflected by increased pulse volume on examination.

4.12 Causes of increased pulse volume

Physiological

- Exercise
- Pregnancy
- Advanced age
- Increased environmental temperature

Pathological

- Hypertension
- Fever
- Thyrotoxicosis
- Anaemia
- Aortic regurgitation
- Paget's disease of bone
- Peripheral atrioventricular shunt

4-Character

a. Slow Rising Pulse

- **Gradual upstroke** with a **reduced peak** occurring late in systole
- Severe **Aortic Stenosis**

b. Collapsing Pulse

- The peak of the pulse wave **arrives early** and is followed by **rapid fall in pressure** as blood flows back into LV, resulting in wide pulse pressure.
- Pulse pressure (systolic Bp- diastolic Bp >80 mmHg)
- Severe **Aortic Regurgitation**

c. Pulsus Bisferiens

- Increased pulse with a **double systolic peak** separated by **distinct mid-systolic dip.**
- Concomitant **Aortic Stenosis** and **Aortic Regurgitation.**

d. Pulsus Alternans

- **Beat-to-beat variation** in pulse volume with normal rhythm
- Advanced **heart failure**

e. Pulsus Paradoxus

- **Exaggeration** of the normal variability of pulse volume with **breathing.**
- Pulse volume normally increase with expiration, decreases during inspiration due to intrathoracic pressure changes affecting venous return to the heart.

- This variability is exaggerated when ventricular diastolic filling is impeded by **elevated intrapericardial pressure.**

E.g : **Cardiac Tamponade, Pericardial Constriction, Acute Severe Asthma**

C- Blood Pressure

- Blood pressure is the **measure of the pressure** that **the circulating blood exerts against arterial wall.**
  - ✓ **Systolic pressure:** **maximal pressure** that occur **during systole (ventricular contraction).**
  - ✓ **Diastolic pressure:** the **lowest value of pressure** during diastolic filling, which is maintained at **a lower level by elasticity and compliance of the vessel wall.**
- Is measured by **Sphygmomanometer** or invasively by intra-arterial catheter in ICU setting .
- BP provides vital information on the **haemodynamic condition of acutely ill or injured patients.**
- Record the reading as systolic pressure/diastolic pressure with **mmHg as the measurement unit**, note of where and how it was recorded.
  e.g.: 146/92 mmHg, right arm, supine.

Hypertension

- is widely defined as a **systolic pressure of ≥140 mmHg** and/or a **diastolic pressure ≥90 mmHg.**
- It is almost invariably **asymptomatic " SILENT KILLER"** .
- **Associated with:** significant morbidity and mortality from **vascular disease** (Heart Failure, Coronary Artery Disease, Cerebrovascular Disease & Chronic Kidney Disease).
  1. Essential hypertension (1ry) : most cases, without identifiable cause
  2. Secondary hypertension : rare , occurring in less than 1% of hypertensive population.
  3. White coat Hypertension: elevated BP in healthcare setting, while normal away, use ambulatory measurement to diagnose it.

4.13 British Hypertension Society classification of blood pressure (BP) levels

BP	Systolic BP (mmHg)	Diastolic BP (mmHg)
Optimal	<120	<80
Normal	<130	<85
High normal	130–139	85–89
Hypertension		
Grade 1 (mild)	140–159	90–99
Grade 2 (moderate)	160–179	100–109
Grade 3 (severe)	>180	>110
Isolated systolic hypertension		
Grade 1	140–159	<90
Grade 2	>160	<90

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Approach to Hypertension

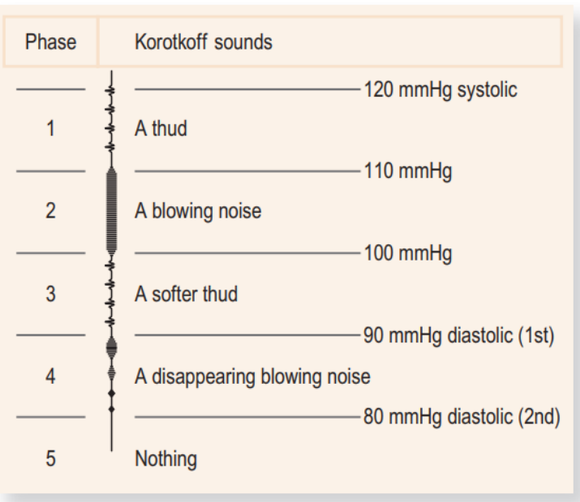
- Assess **symptoms** / Assess for **potential cause** (fig 4.14)
- Assess for **end-organ damage**:
  1. Cardiac : heart failure
  2. Renal : CKD , Proteinuria
  3. Eye : Hypertensive retinopathy

4.14 Clinical clues to secondary hypertension

Clinical feature	Cause
Widespread vascular disease Renal bruit	Renovascular disease, including renal artery stenosis
Episodes of sweating, headache and palpitation	Phaeochromocytoma
Hypokalaemia	Primary aldosteronism
Cushingoid facies, central obesity, abdominal striae, proximal muscle weakness Chronic glucocorticoid use	Cushing's syndrome
Low-volume femoral pulses with radiofemoral delay	Coarctation of the aorta
Bilateral palpable kidneys	Adult polycystic kidney disease (p. 243)

Korotkoff sounds

- **Snapping sound** that is produced when the cuff pressure is between systolic and diastolic because the artery collapses completely and reopen with each heartbeat.
- **First sound APPEARANCE (phase 1) indicate systole.**
- When the **sounds muffle (phase 4) and then disappear (phase 5) indicate diastole.**



How to measure blood pressure?

- Rest for **5 minutes.**
- **No tight** clothing.
- With patient seated or lying down , Support **the arm at the heart level.**
- Proper **cuff size.**

1. Apply **the cuff to the upper arm**, with the **center of bladder over brachial artery.**
2. **Palpate** brachial artery.
3. Inflate cuff until the pulse is **impalpable around 30 mmHg above**.
4. Put the diaphragm of stethoscope on brachial artery & deflate slowly.
5. **First sound to hear is systolic pressure**.
6. When the sounds completely disappear this is diastolic pressure.
7. **If the muffled sounds persist (phase 4)** and **do not disappear, use the point of muffling as diastolic pressure.**
8. measure BP in **both arms** , **the higher of the two is closest to central aortic pressure** & should be used to determine treatment.

Common BP measurement problems

a) **Difference > 10 mmHg** in each arm (suggest aortic or subclavian artery disease)

b) **Wrong cuff size:** the bladder should be 80% of the length and 40% of the width of upperarm

c) **Auscultatory gap:** 20% of elderly hypertensive patients, when Korotkoff sounds appearat systolic BP and disappear for an interval between systolic and diastolic pr. Avoid by palpating the systolic BP

d) **Pt's arm at the wrong level**: elbow should be at the level of the heart

e) **Postural change:** check for postural hypotension , Check the BP after a patient has been standing for 2 minutes; a drop of >20 mmHg on standing is postural hypotension

f) Atrial fibrillation: stroke volume and BP vary from beat to beat ,take average

D- Jugular venous pressure

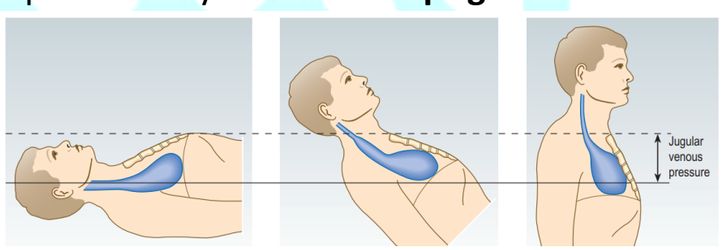
- Estimate the jugular venous pressure (JVP) by **observing the Level of pulsation in the internal jugular vein**.
- The vein runs **deep to the sternomastoid** muscle and enters the thorax between the sternal and clavicular heads.
- The normal waveform has **2 main peaks per cycle,** which helps to distinguish it from the carotid arterial pulse (Box 4.15).
- The external jugular vein is **more superficial, prominent and easier to see.**
- It can be kinked or obstructed as it traverses the deep fascia of the neck but, when visible and pulsatile, can be used to estimate the JVP in difficult cases.
- **The JVP level reflects right atrial pressure (normally > 7 mmHg/9 cmH2O).**
- The sternal angle is approximately 5 cm above the right atrium, so the **JVP in health should be**

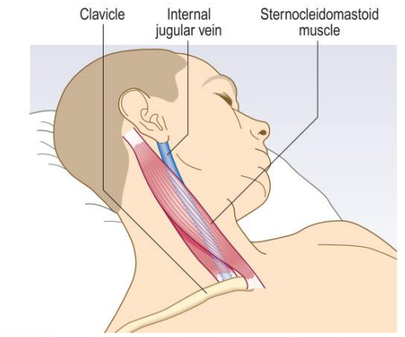
≤4 cm above this angle when the patient lies at 45 degrees (see Fig. 4.15B later).

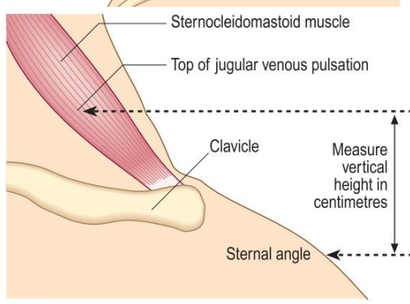
- If right atrial pressure is **low**, the patient may have to **lie flat for the JVP** to be seen; if **high**, the patient may need to **sit upright** .

4.15 Differences between carotid artery and jugular venous pulsation

Carotid	Jugular
Rapid outward movement	Rapid inward movement
One peak per heart beat	Two peaks per heart beat (in sinus rhythm)
Palpable	Impalpable
Pulsation unaffected by pressure at the root of the neck	Pulsation diminished by pressure at the root of the neck
Independent of respiration	Height of pulsation varies with respiration
Independent of the position of the patient	Varies with the position of the patient
Independent of abdominal pressure	Rises with abdominal pressure



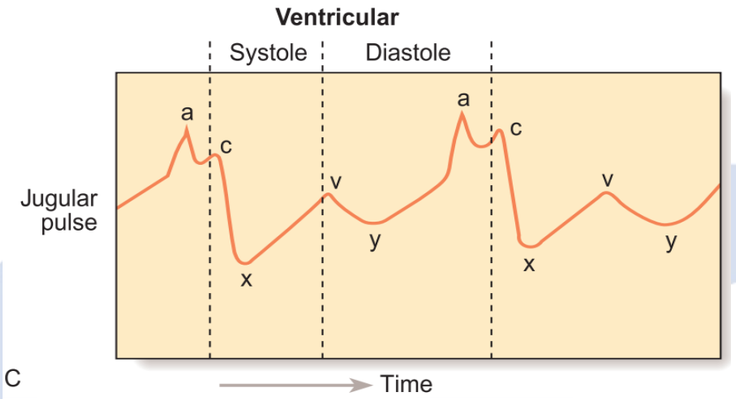




Patient lying at 45 degrees

Waveform:

- the normal JVP waveform has 2 distinct peaks per cardiac cycle (Fig. 4.15C):
  - The **'a'** wave corresponds to **right atrial contraction** and occurs just before the first heart sound. **In atrial fibrillation the 'a' wave is absent.**
  - The **'v'** wave is caused by **atrial filling** during **ventricular systole when the tricuspid valve is closed**.
  - Rarely, **a third peak ('c' wave)** may be seen due to **closure of the tricuspid valve.**



C

Jugular venous pressure examination

- Be on the **right side of the patient.**
- Position the patient **supine**, **reclined on 45 degrees**, with pillow below the head and slightly turned to the left with **adequate exposure.**
- Use the **light**
- Identify **Jugular venous pulsation**

1. Special maneuvers

I. Varies with respiration **(decreases with inspiration).**

II. Ask patient to lie flat **(increase with lying flat).**

III. **Abdominojugular reflux :** press firmly over the abdomen, This increases venous return to the right side of the heart temporarily and the **JVP normally rises.**

2. Measure JVP height

Between tip of visible pulsation and **the sternal angle Unit: cmH2O.**

Abnormalities in JVP :

- The JVP provides a guide to **Central Venous Pressure**.
- It is **elevated in states of fluid overload,** particularly **heart failure.**

Examine the patient for **pulmonary oedema** or **pleural effusions** , **ascites** and/or **peripheral oedema** .

- **Elevated** in any condition that leads to **high right ventricular filling pressures**, such as pulmonary embolism, chronic pulmonary Hypertension, cardiac tamponade or pericardial constriction .
- **Prominent 'a' waves** are caused by delayed or restricted right ventricular filling, as in **Pulmonary Hypertension** or **Tricuspid Stenosis.**
- **Cannon waves (giant 'a' waves)** occur when the right atrium contracts against a closed tricuspid valve.
  - ✓ **Irregular** cannon waves are seen in **Complete Heart Block** & are due to atrioventricular dissociation.
  - ✓ **Regular** cannon waves occur during junctional rhythm and with some ventricular and **supraventricular tachycardias.**
- **Tricuspid regurgitation** results in **Prominent Systolic 'V' Waves**, which can fuse with the 'c' wave to produce 'cv' waves; there may be an associated **Pulsatile Liver.**

✓ Superior Vena Cava Obstruction

- Mechanical obstruction of the superior vena cava (most often caused **by lung cancer**) may cause **extreme**, **Non-Pulsatile** elevation in JVP.
- **Negative** abdominojugular reflux
- **DOESN'T** reflect right atrial pressure

✓ Kussmaul's sign

- **Paradoxical** elevation of JVP with **inspiration**
- **Differential diagnosis:**

  1. Pericardial constriction. 2. Severe right ventricular failure.
  3. Restrictive cardiomyopathy.