

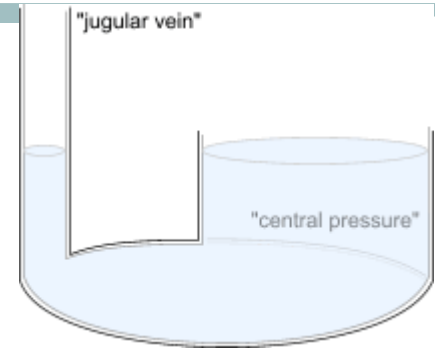
Jugular venous pressure and waveforms

By

Dr .Hazem Samy Matar

Lecturer of internal medicine

- Jugular venous pulse is the oscillating top of the the distended proximal portion of the internal jugular vein and represents volumetric changes that faithfully reflect the pressure changes in the right heart



- Right atrial pressure during systole and right ventricular filling pressure during diastole
- Window into the right heart, providing critical information regarding its hemodynamics.

- “In the study of venous pulse we have often the direct means of observing the effects of systole and diastole of right auricle and systole and diastole of right ventricle.”

James Mackenzie ..1902

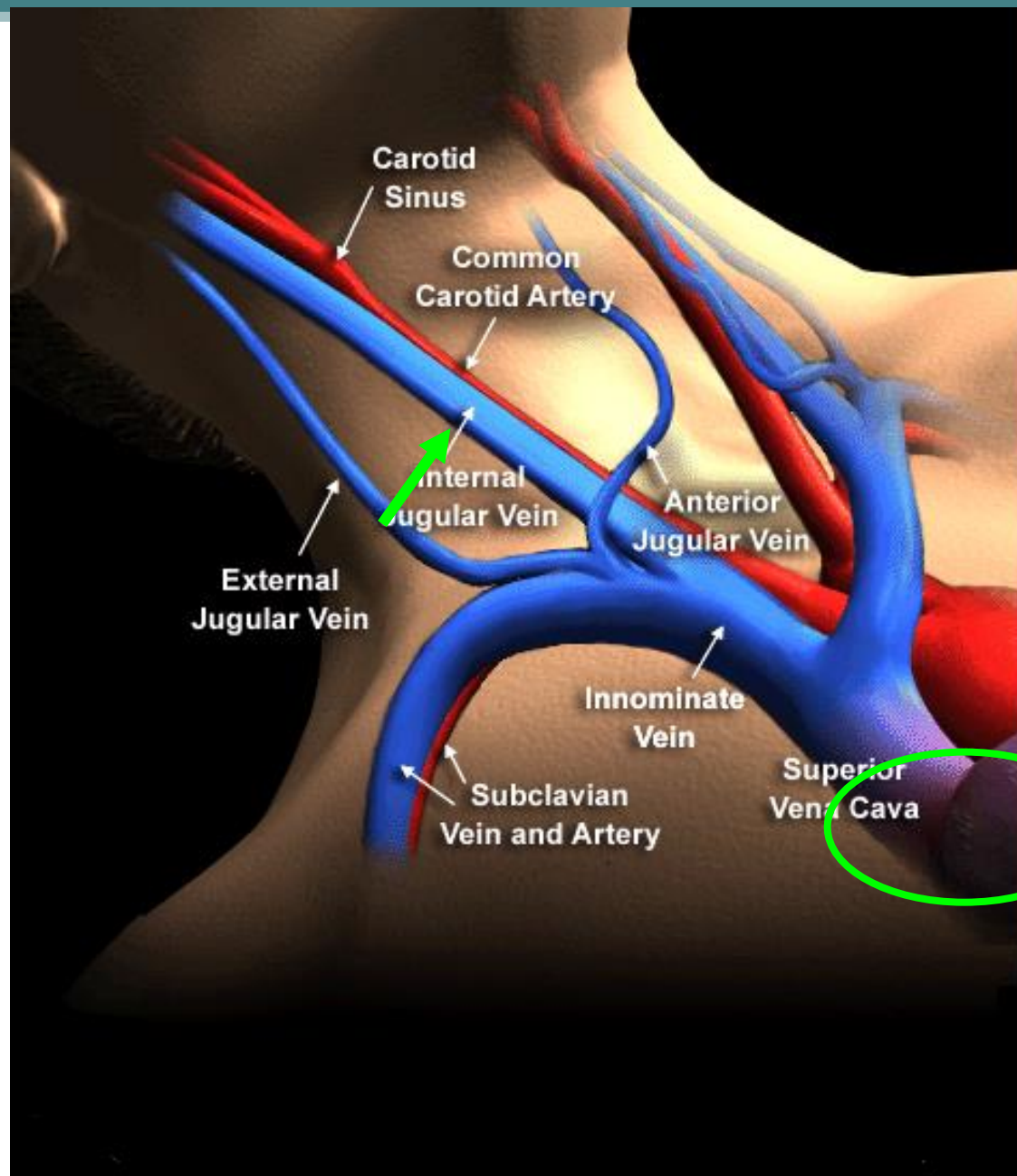
- “Precise analysis of the cervical venous pulse and measurement of the height of each wave is not only possible at the bedside but highly desirable”

Paulwood ..1950

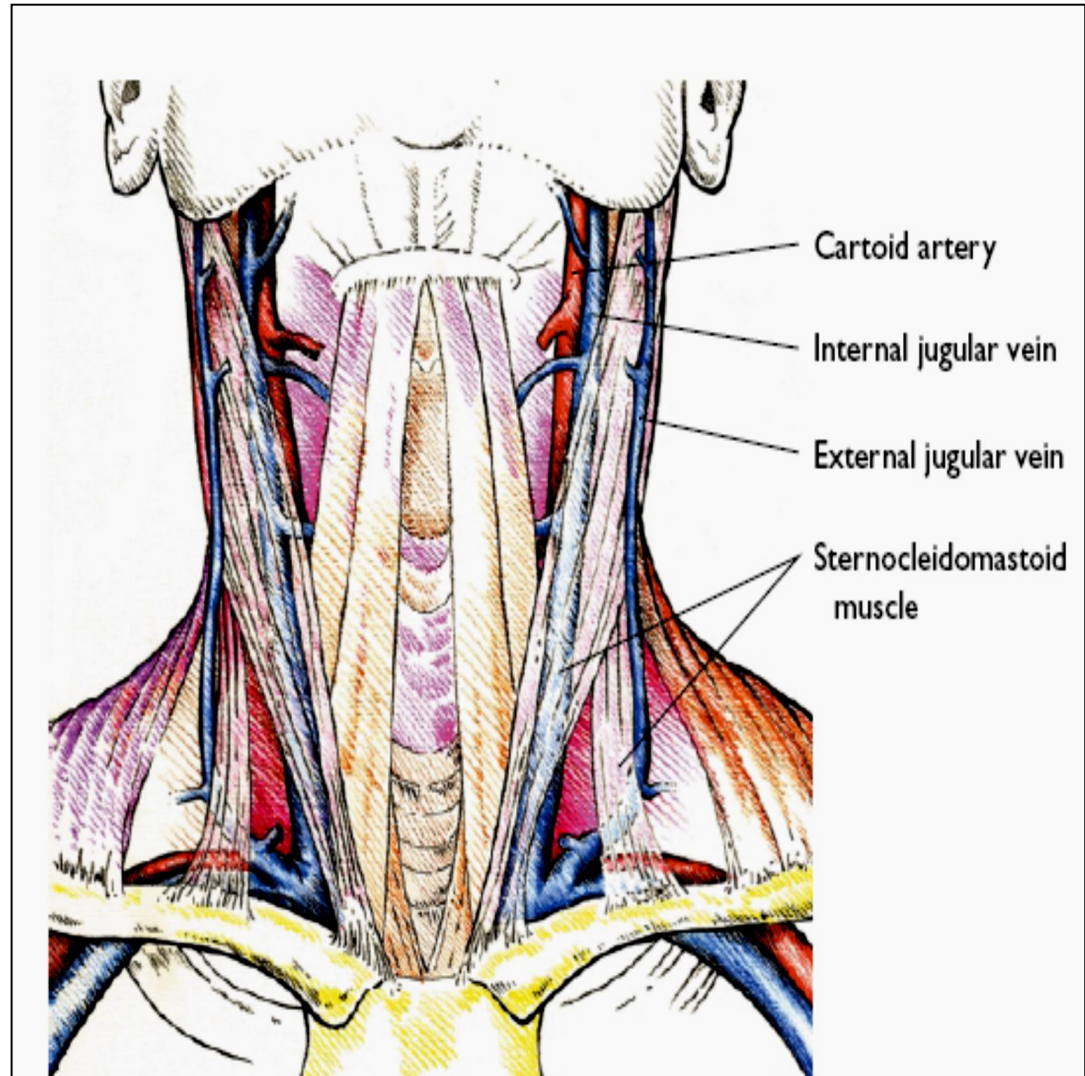
1. Anatomy
2. JV pressure measurement
3. Causes of elevated JVP
4. Normal wave pattern
5. Abnormal wave pattern
6. Kussmaul's sign and hepatojugular reflux
7. Specific conditions

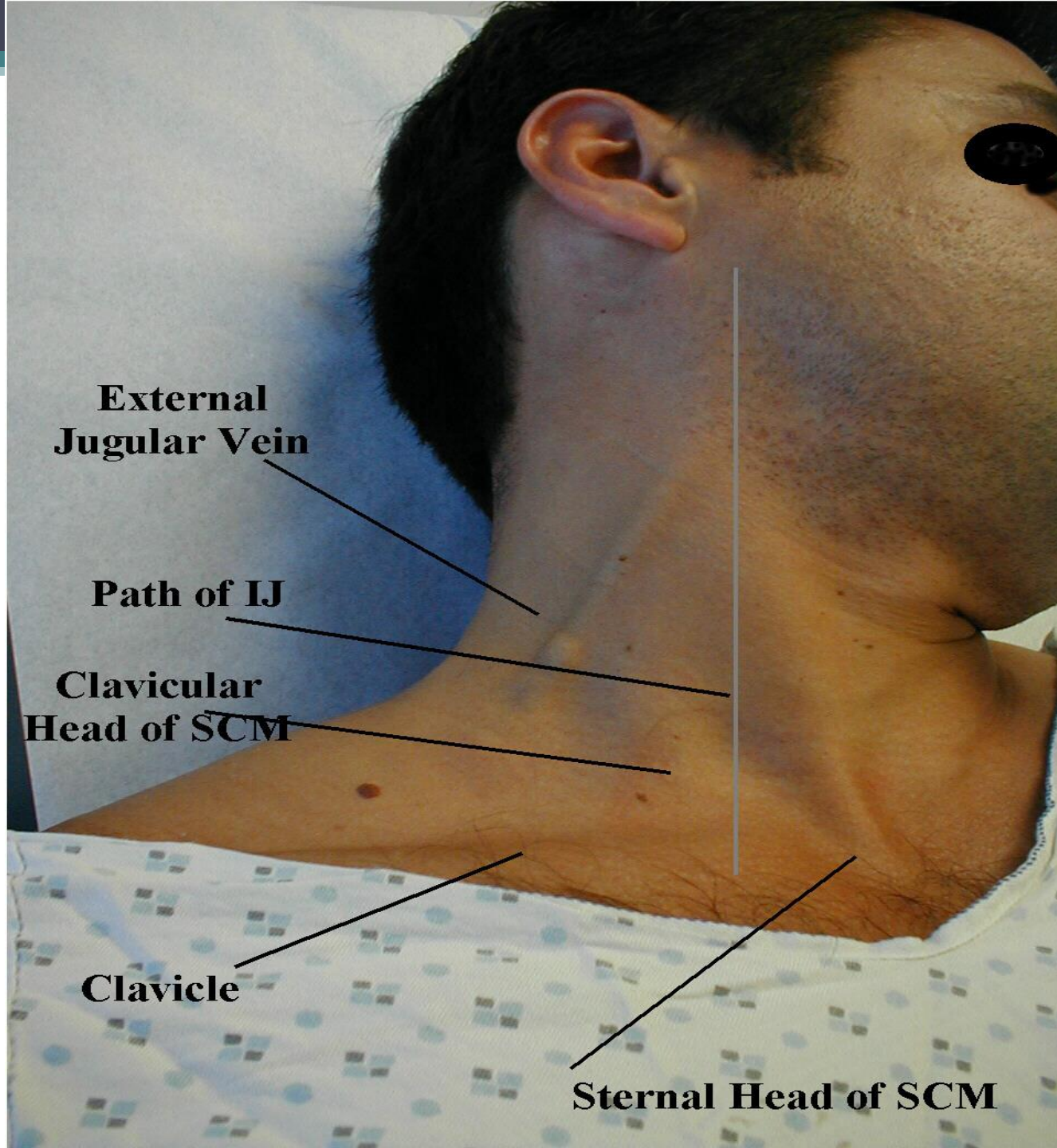
Jugular veins

- Internal jugular vein
- External jugular vein



- **Lateral to carotid artery & deep to sternomastoid muscle.**
- **External jugular is superficial to sternomastoid**





Examination of JVP

- Right IJV is usually assessed both for waveform and estimation of venous pressure
- Transmitted pulsations to overlying skin between two heads of sternocleidomastoid

Right IJV Preferred :Why?

- Straight line course through innominate vein to the svc and right atrium
- Less likely extrinsic compression from other structures in neck

Why not EJV

- No or less numbers of valves in IJV than EJV

Differences between IJV and Carotid pulses

- Superficial and lateral in the neck
- Better seen than felt
- Has two peaks and two troughs
- Descents > obvious than crests
- Digital compression abolishes venous pulse
- Jugular venous pressure falls during inspiration
- Abdominal compression elevates jugular pressure

Deeper and medial in the neck

Better felt than seen

Has single upstroke only

Upstroke brisker and visible

Digital compression has no effect

Do not change with respiration

Abdominal compression has no effect on carotid pulse

Estimation of Venous Pressure

- Measuring jugular venous pressure
- Hepatojugular reflux
- Examining the veins on the dorsum of the hand
- Assessment of jugular venous pressure at bed side reflect mean right atrial pressure

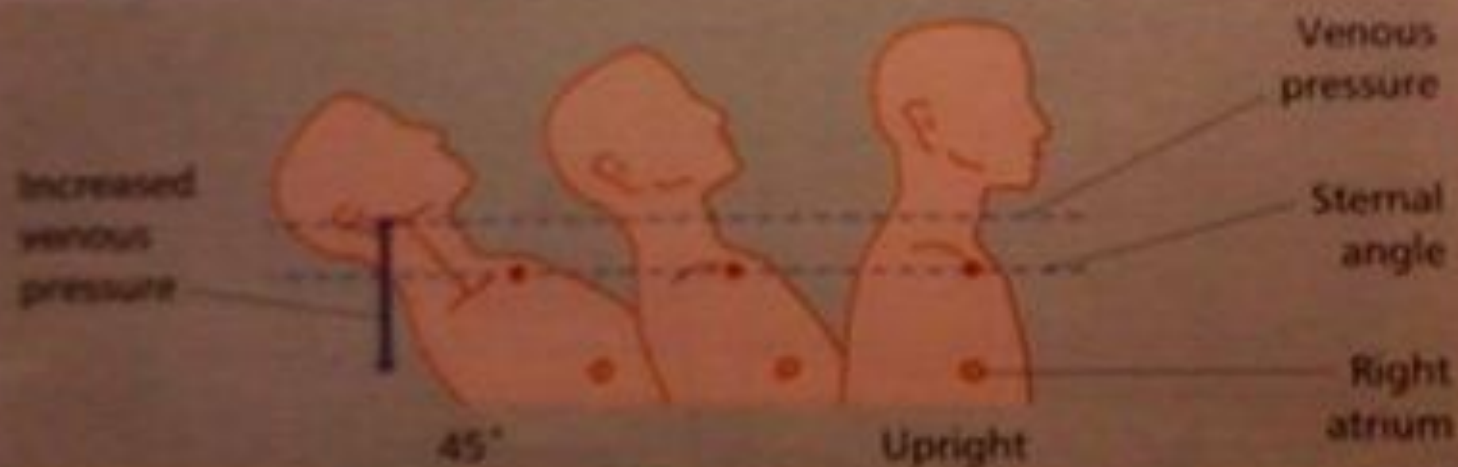
Measurement of JV Pressure

- Sternal angle or angle of Louis - reference point
- Found approximately 5 cm above the center of the right atrium
- Sternal angle – RA Fixed relationship

EXAMINATION

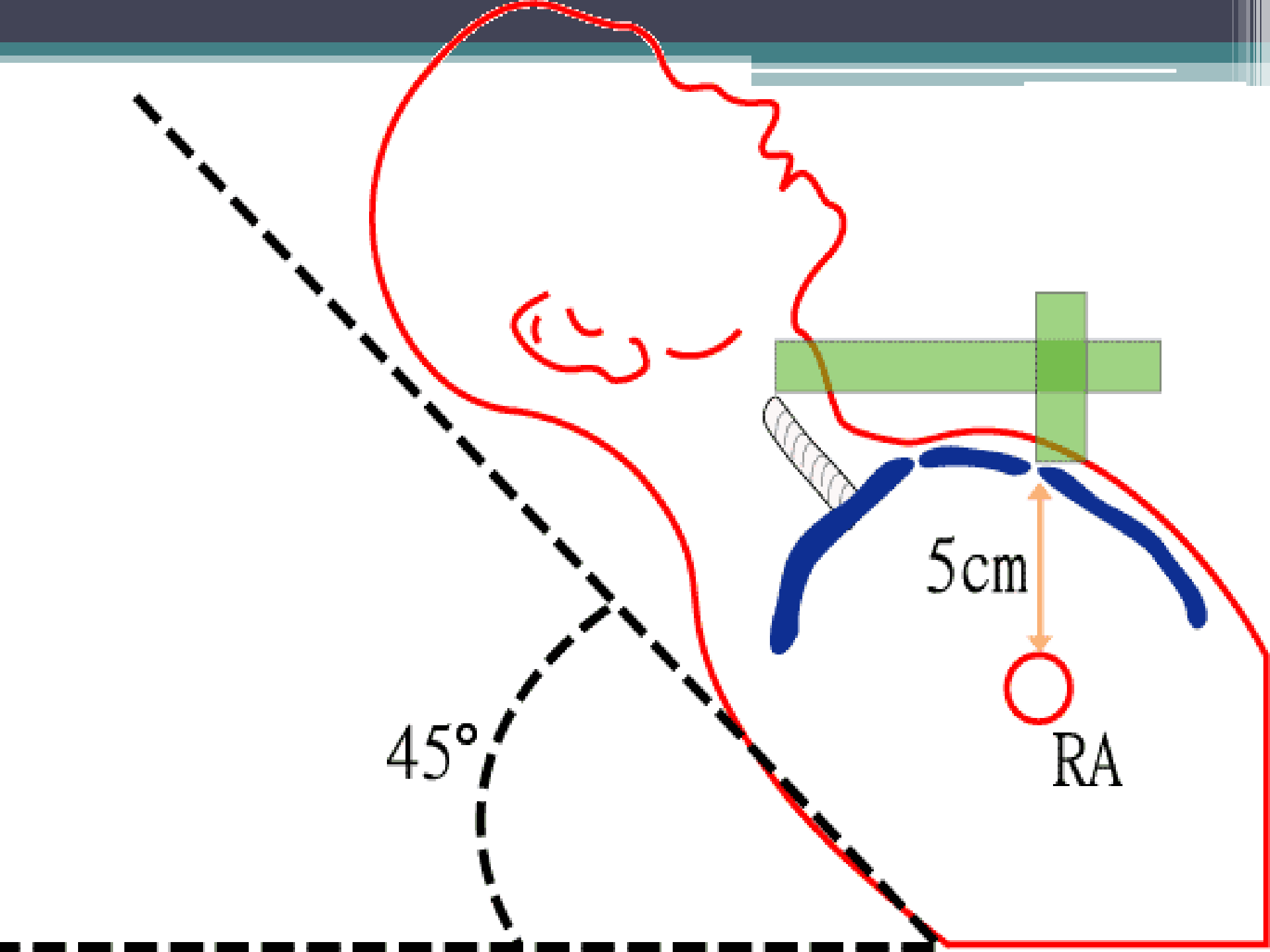


Normal venous pressure



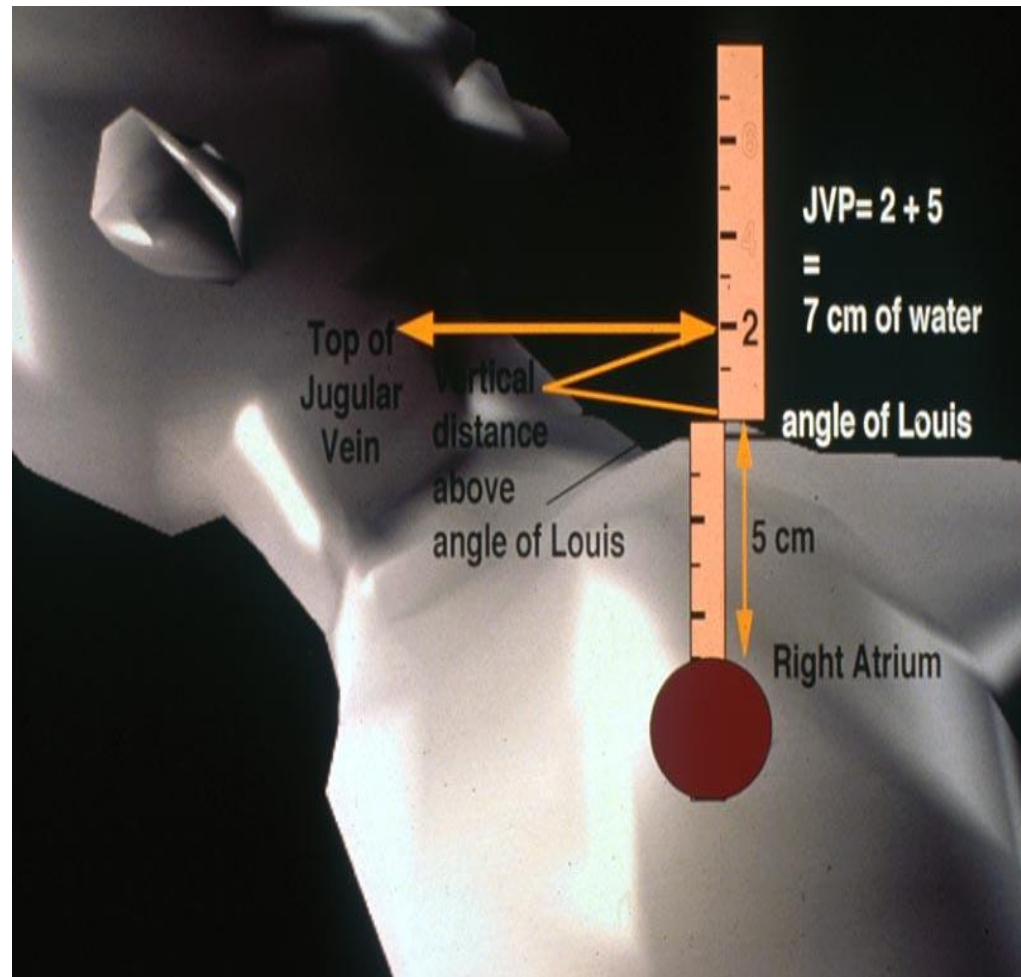
Position of Patient

- Patient should lie comfortably and trunk is inclined by an angle
- Elevate chin and slightly rotate head to the left
- Neck and trunk should be in same line
- When neck muscles are relaxed ,shine the light tangentially over the skin and see pulsations
- Simultaneous palpation of the left carotid artery or apical impulse aids in timing of the venous pulsations in cardiac cycle .



Measurement of JVP

- Two scale method is commonly used
- Normally JV pressure does not exceed 3- 4 cm above the sternal angle
- Since RA is approximately 5 cm below the sternal angle , the jugular venous pressure corresponds to 9 cm
=7mmhg
- Elevated JVP : JVP of >4 cm above sternal angle .



Elevated JVP

- Increased RVP and reduced compliance:
 - Pulmonary stenosis
 - Pulmonary hypertension
 - Right ventricular failure
 - RV infarction
- RV inflow impedance:
 - Tricuspid stenosis / atresia
 - RA myxoma
 - Constrictive pericarditis

Elevated JVP

- Circulatory overload :
 - Renal failure
 - Cirrhosis liver
 - Excessive fluid administration
- SVC obstruction

Kussmaul's sign

- Mean jugular venous pressure increases during inspiration
- Constrictive pericarditis
- Severe right heart failure
- RV infarction
- Restrictive cardiomyopathy
- Impaired RV compliance.

Abdominal -Jugular Reflux

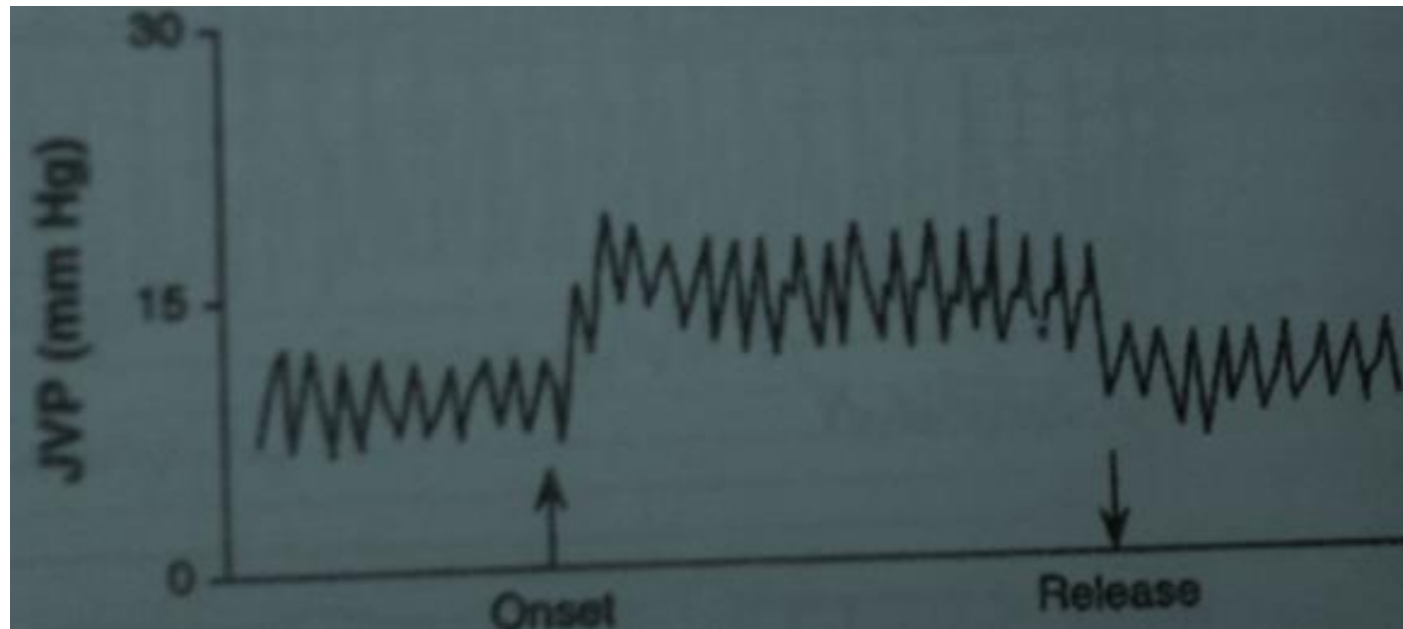
- Hepatojugular reflux – Rondot (1898)
- Apply firm pressure to periumbilical region 30-60 sec
- Normally JV pressure rises transiently to $< 1\text{cm}$ while abdominal pressure is continued
- If JV pressure remains elevated $>1\text{cm}$ until abdominal pressure is continued: Positive AJR.

- Abdominal compression forces venous blood into thorax.
- A failing/dilated RV not able to receive venous return without rise in mean venous pressure.

Positive AJR

- Incipient and or compensated RVF
- Tricuspid regurgitation
- COPD

Hepatojugular reflux

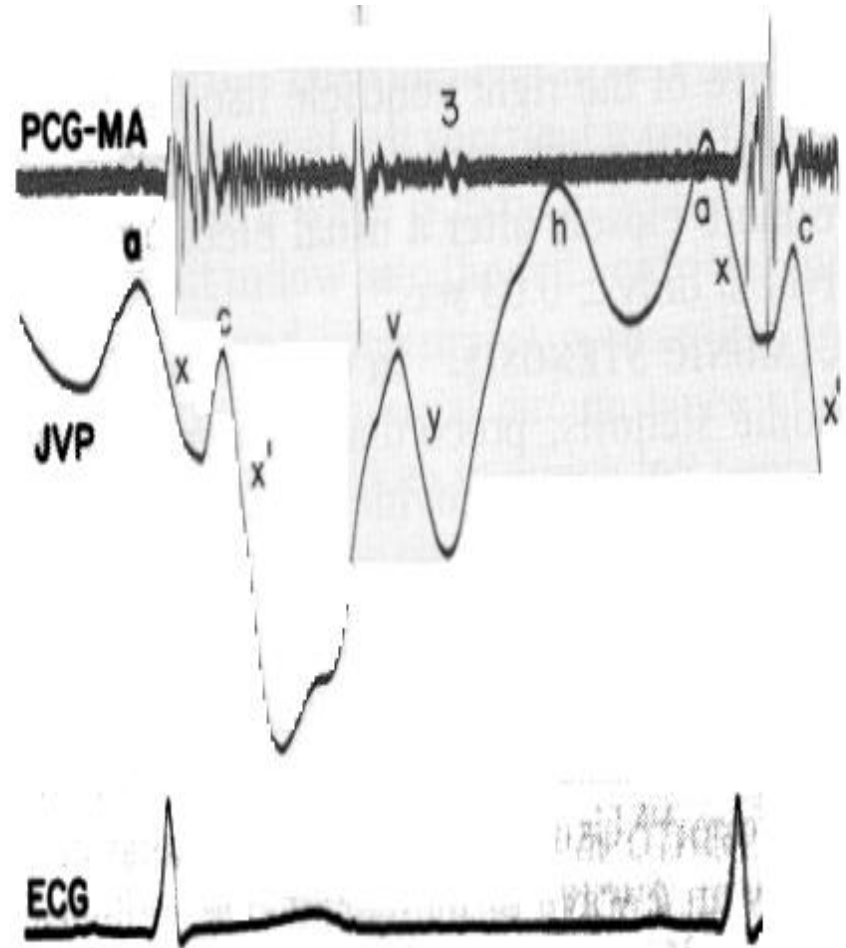


Normal JVP

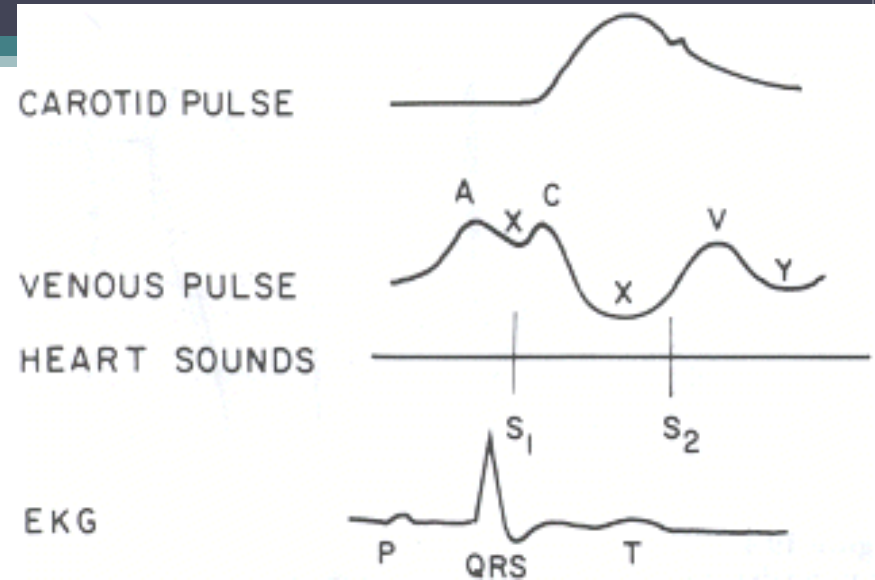
- Normal JVP reflects phasic pressure changes in RA during systole and RV during diastole
- Two visible positive waves (a and v) and two negative troughs (x and y)
- Two additional positive waves can be recorded C wave interrupts x descent and h wave

Normal JVP Waveform

- Consists of 3 positive waves
 - a, c & v
- And 3 descents
 - x, x'(x prime) and y

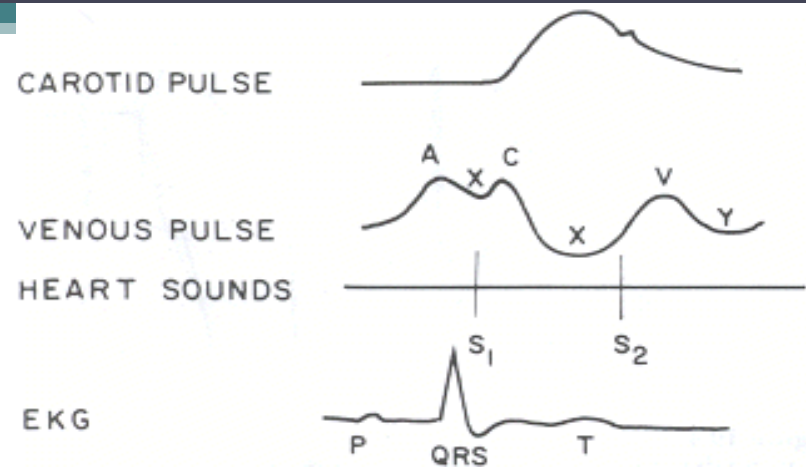


a Wave



- First positive presystolic a wave is due to right atrial contraction
- Effective RA contraction is needed for visible a wave
- Dominant wave in JVP and larger than v
- It precedes upstroke of the carotid pulse and S₁, but follow the P wave in ECG

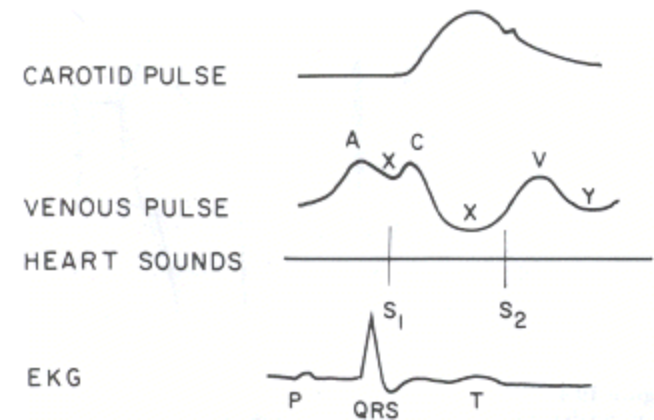
x Descent



- Systolic x descent is due to atrial relaxation during atrial diastole
- X descent is most prominent motion of normal JVP which begins during systole and ends just before S2
- It is larger than y descent
- X descent more prominent during inspiration

C Wave

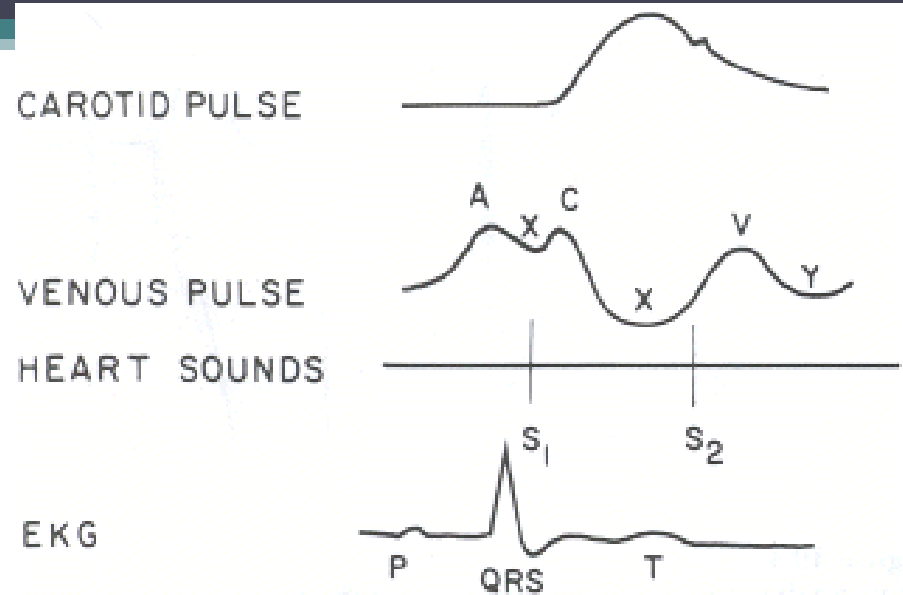
- Not usually visible.
- Two different causes
 - Transmitted carotid artery pulsations.
 - Upward bulge of closed Tricuspid valve in isovolumic systole



x' Descent

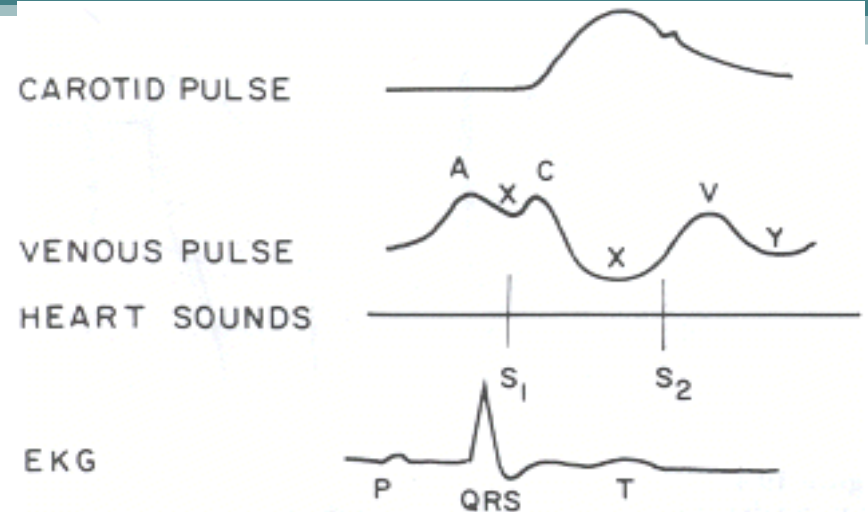
- x' descent is systolic trough after c wave

- Due to
 - Fall of right atrial pressure during early RV systole
- ✓ Downward pulling of the TV by contracting right ventricle
- ✓ Descent of RA floor



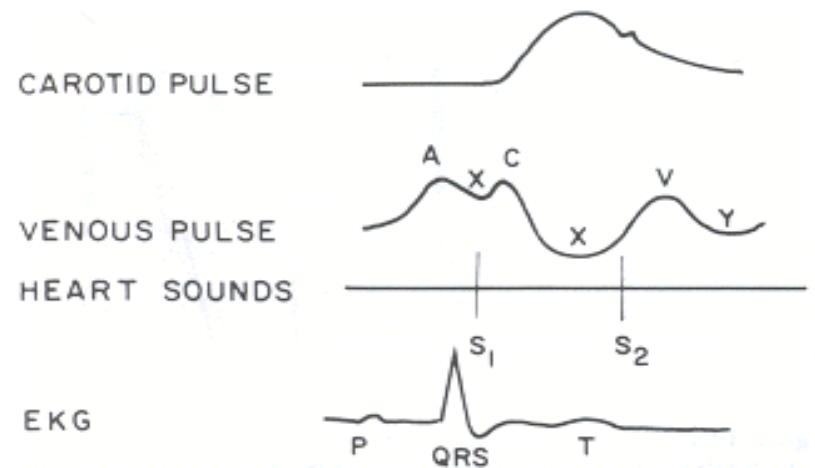
v Wave

- Begins in late systole
ends in early diastole
- Rise in RA pressure due to continued RA filling during ventricular systole when tricuspid valve closed
- Roughly synchronous with carotid upstroke and corresponds S2 .



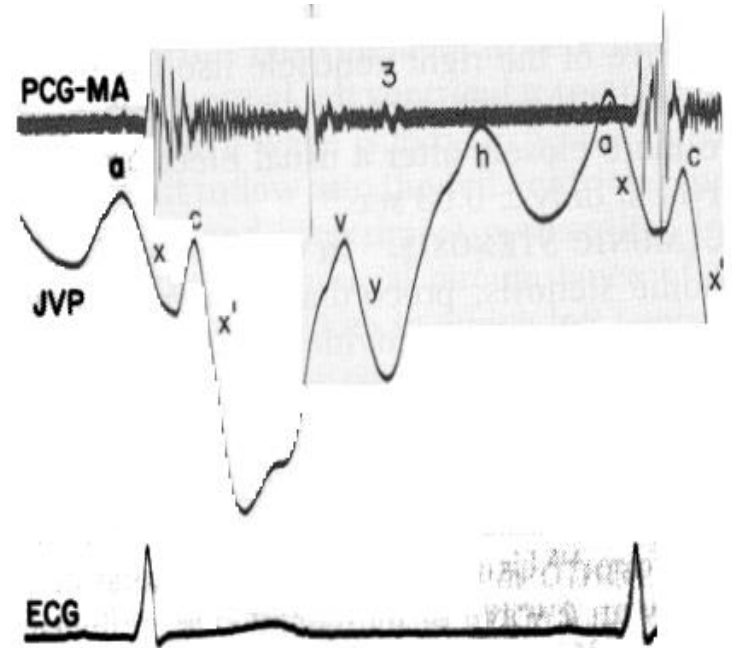
y Descent

- Diastolic collapse wave (down slope v wave)
- It begins and ends during diastole well after S2
- Decline of RA pressure due to RA emptying during early diastole when tricuspid valve opens



h wave

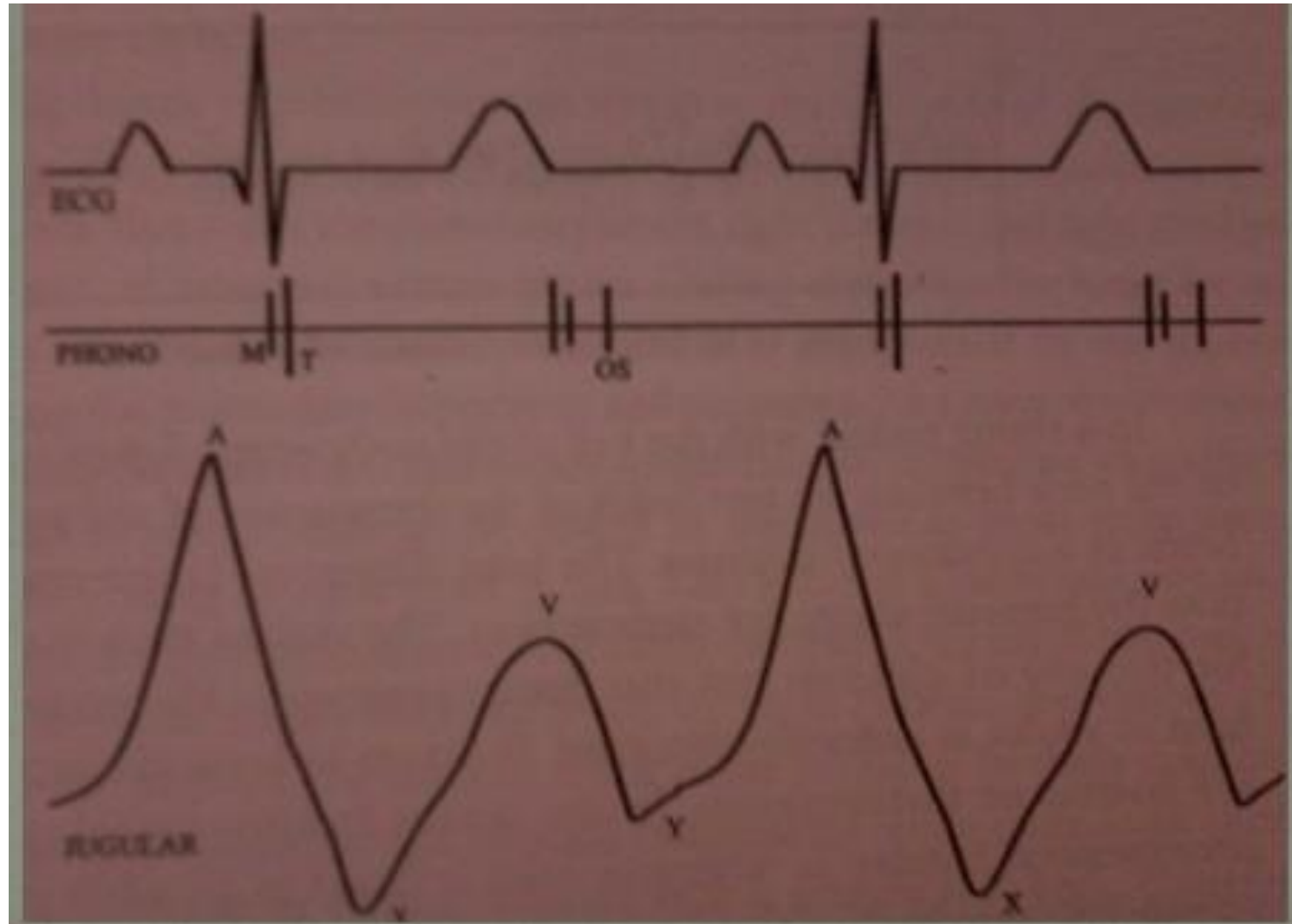
- Small brief positive wave following y descent just prior to a wave
- Described by Hieschfelder in 1907
- It usually seen when diastole is long
- With increasing heart rate, y descent immediately followed by next a wave .



Prominent a Wave

- Forceful atrial contraction when there is resistance to RA emptying or increased resistance to ventricular filling
- RV inflow obstruction:
 - Tricuspid stenosis or atresia
 - RA myxoma
- Decreased ventricular compliance:
 - Pulmonary stenosis
 - Pulmonary hypertension of any cause
 - RV infarction
 - RV cardiomyopathy (HOCM)
 - Acute pulmonary embolism

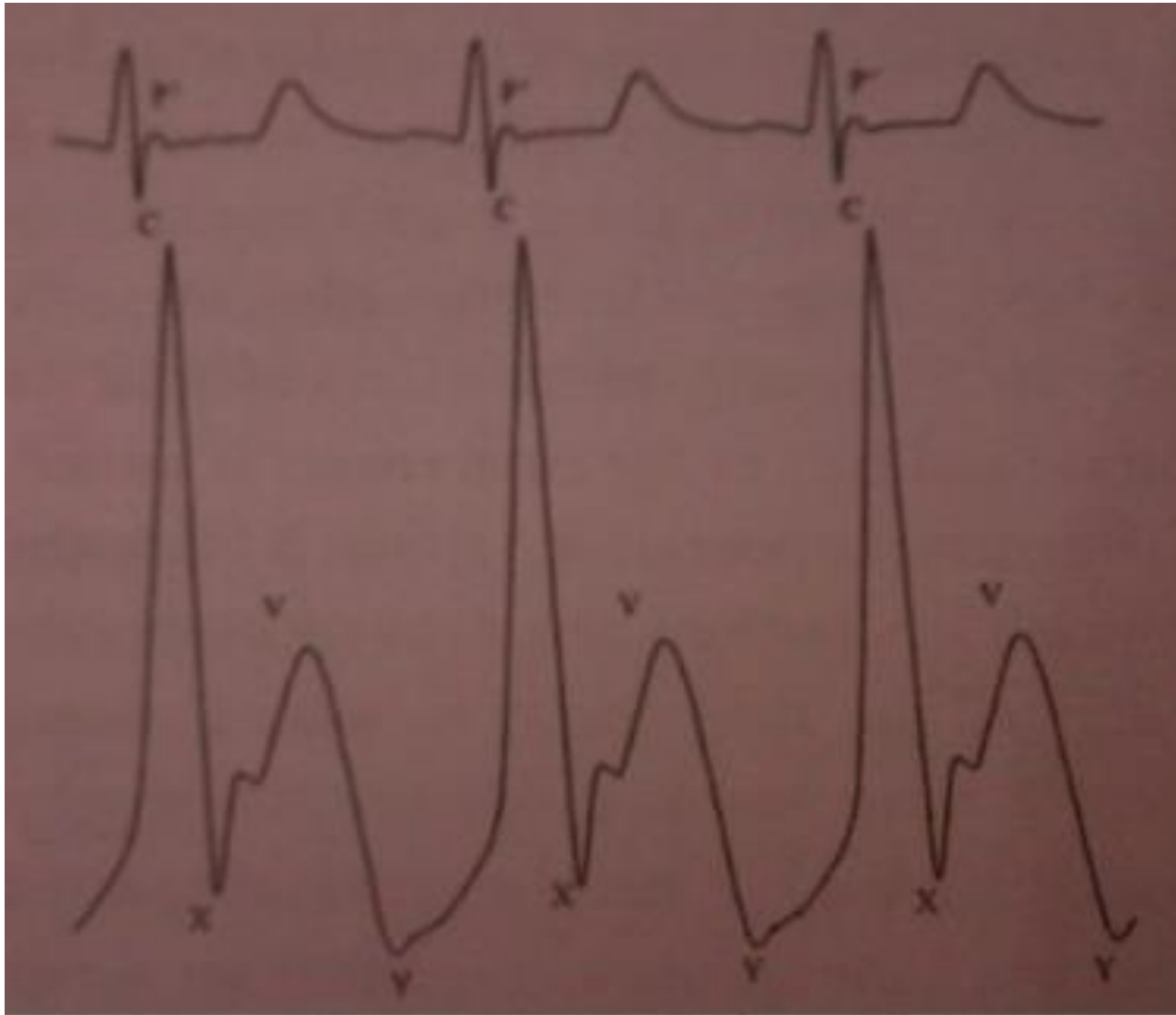
Large a wave



Cannon Waves

- Whenever RA contracts against closed TV valve during RV systole
- Regular cannon waves:
 - Junctional rhythm
 - VT with 1:1 retrograde conduction
 - Isorhythmic AV dissociation
- Irregular cannon waves :
 - Complete heart block
 - Ventricular tachycardia
 - Ventricular pacing or ventricular ectopics .

Regular cannon waves

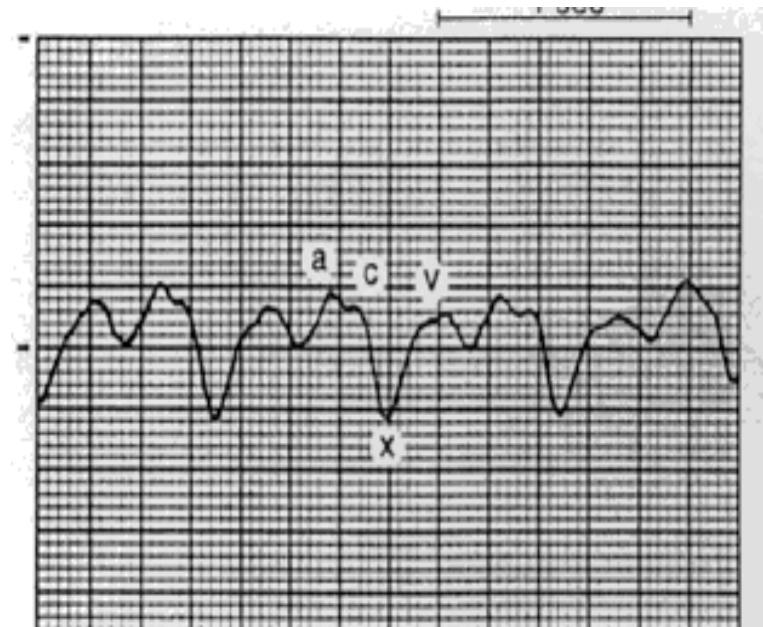


Absent a Wave

- When no effective atrial contraction as in atrial fibrillation

Prominent x descent

- Presence of atrial relaxation with intact tricuspid valve and good RV contraction
- Causes :
 - Cardiac tamponade
 - Constrictive pericarditis

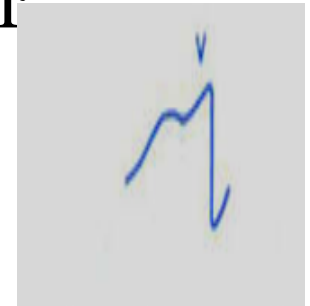


Reduced x descent

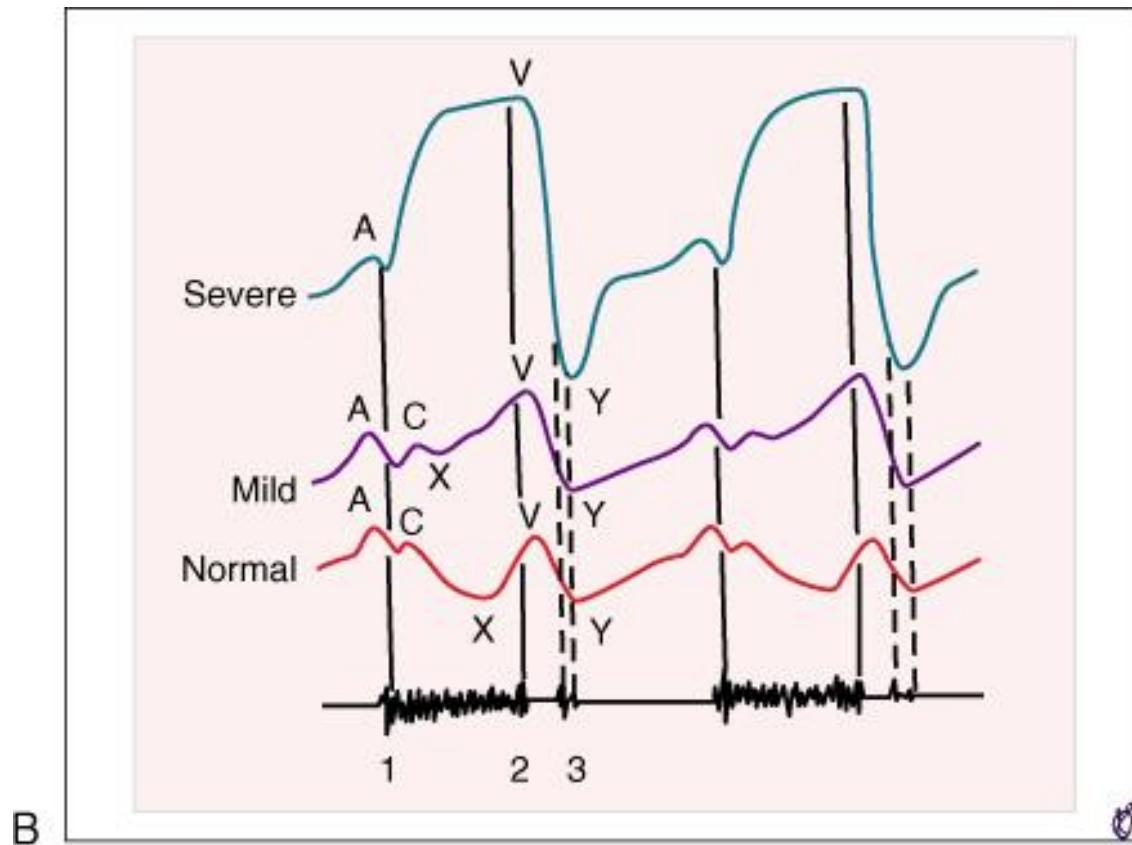
- Moderate to severe TR: early sign
- Atrial fibrillation

Prominent v wave

- Increased RA volume during ventricular systole produce prominent v wave
- Severe TR : giant v wave
- Giant v wave sometimes causes :
 - systolic movement of ear lobe
 - head bobbing with each systole
 - systolic pulsation of liver
 - pulsatile exophthalmos



cv wave



PROMINENT V WAVE

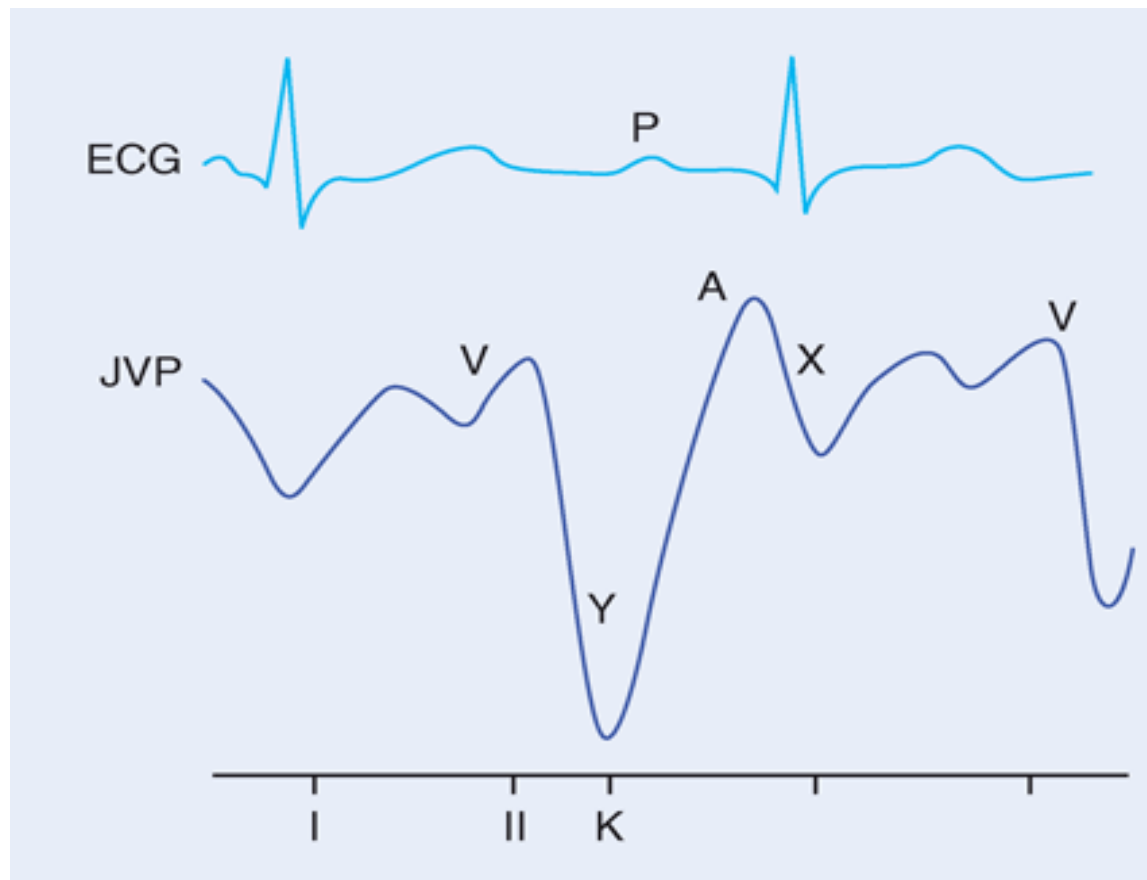
- ASD with mitral regurgitation
- VSD of LV to RA shunt (Gerbode's defect)
- RV failure



Rapid y Descent

- Severe TR
- C .Pericarditis (Friedreich's sign): Early rapid ventricular filling
- Severe RV failure
- ASD with mitral regurgitation





Slow y Descent

- When RA emptying and RV filling are impaired
y descent is slow and gradual
 - Tricuspid stenosis
 - Right atrial tumours
 - Pericardial tamponade(y descent may even be absent).

Respiratory influences

- Inspiration – increased visibility of venous pulse.

Mean venous pressure falls , but the wave forms are accentuated during inspiration.

- Waves more prominent during inspiration
- X descent more brisk
- Increased venous return augment RA contraction and hence relaxation >> brisk x
- Also increased venous return augment RV volume and contraction > increased systolic descent of floor of RA>>brisk x'

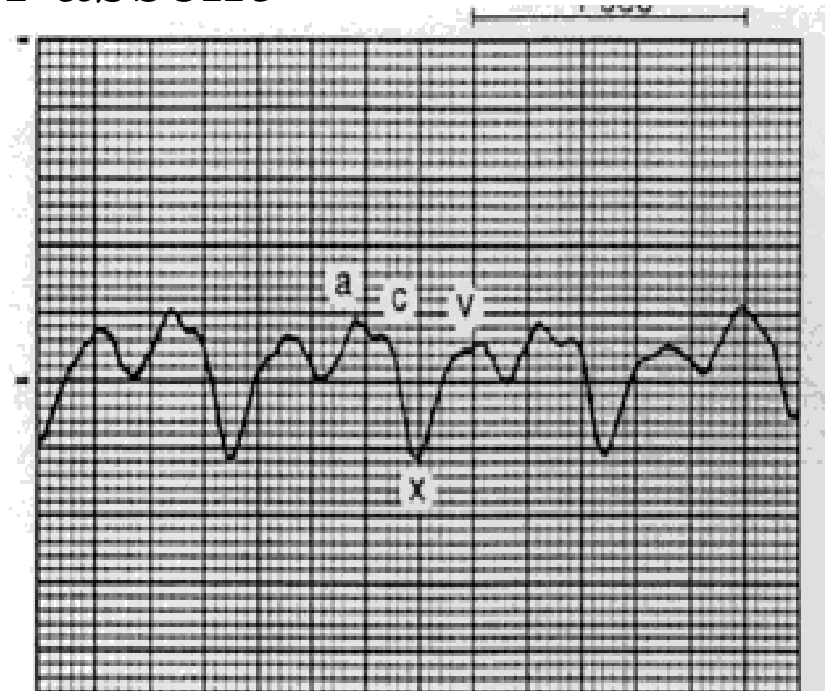
JUGULAR VENOUS PULSE IN ARRHYTHMIAS

- 'a' & 'v'/c (carotid pulse correlates with P & QRS complex in ECG).
- Normal sinus rhythm is characterized by sequential a & v waves.
- Any disturbance in this wave form indicates rhythm abnormality.

Rhythm		Cannon waves
Sinus	a - v regular	Absent
I AV block	Prolonged AC interval	Absent
Wenckebach's	Gradual prolongation of A-C interval	Absent
Mobitz II block	Constant AC interval followed by sudden skipping of carotid pulse	Absent
CHB	Variable	Present & irregular
VPC JPC	Early cycle	Present
APC	Early cycle	Absent
VT	Variable	Present & irregular
Atrial tachycardia	Normal	Absent

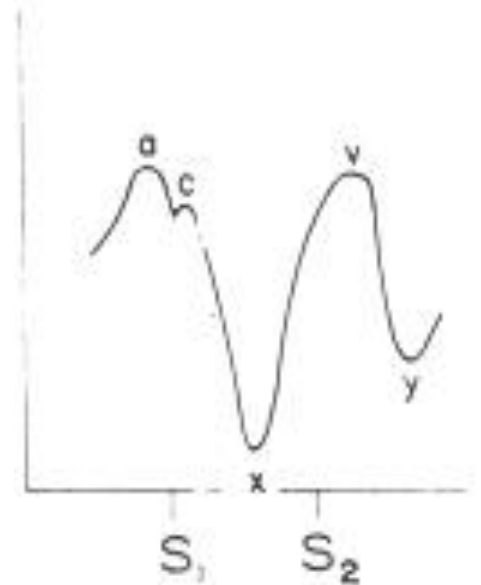
Cardiac tamponade

- JVP is usually elevated
- y descent is diminished or absent
- x wave is normal
- Kussmaul's sign usually negative



Constrictive pericarditis

- JVP is elevated
- a wave is usually normal
- v wave is usually equal to a wave
- x descent –prominent
- y descent – rapid descent
- Kussmauls sign is usually positive



Restrictive cardiomyopathy

- JVP is usually elevated
- Both a and v wave equal
- Kussmaul's may be positive

Pulmonary Hypertension

- Early RV decompensation :

JVP may be elevated

a wave is prominent

Decompensated RVF:

a and v wave prominent ,

v wave larger than a wave

x descent is diminished or absent

Rapid y descent due to TR

JVP in ASD



- JVP is normal and equal a and v waves
- Elevated JVP may be seen in severe PAH and in RVF
- Prominent a wave with PS and MS
- Prominent v wave with PAH and RVF with TR
- Rapid y descent with RVF or TR

JVP in VSD

- Elevated JVP with CHF
- Prominent v wave with Gerbode's shunt
- In Eisenmenger complex :
 - JV Pressure usually normal
 - Normal a and v waves

Ebstein Anomaly

- JVP is usually normal
- Attenuated x descent and systolic v wave are not reflected in jugular pulse despite appreciable TR
- Damping effect of large capacitance RA and thin, toneless atrialized RV

Thank you ...

