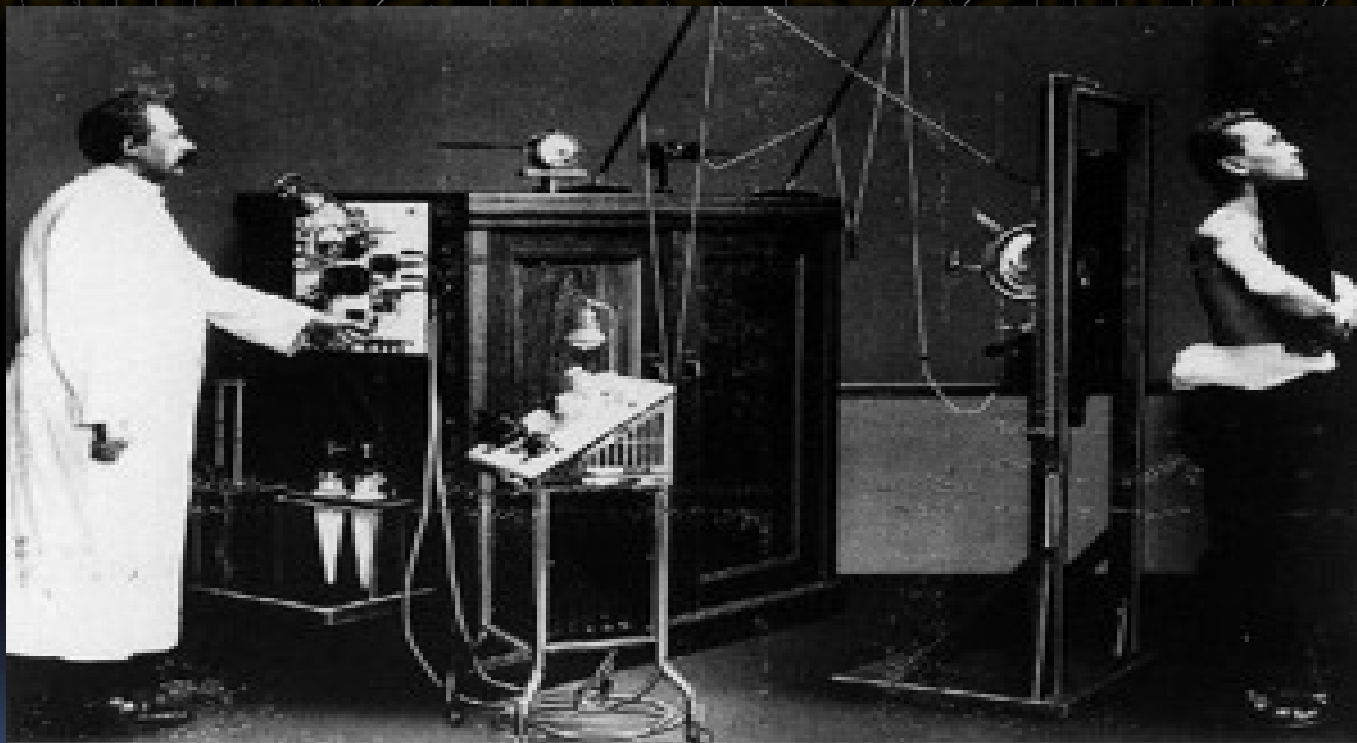


CARDIOVASCULAR PHYSIOLOGY



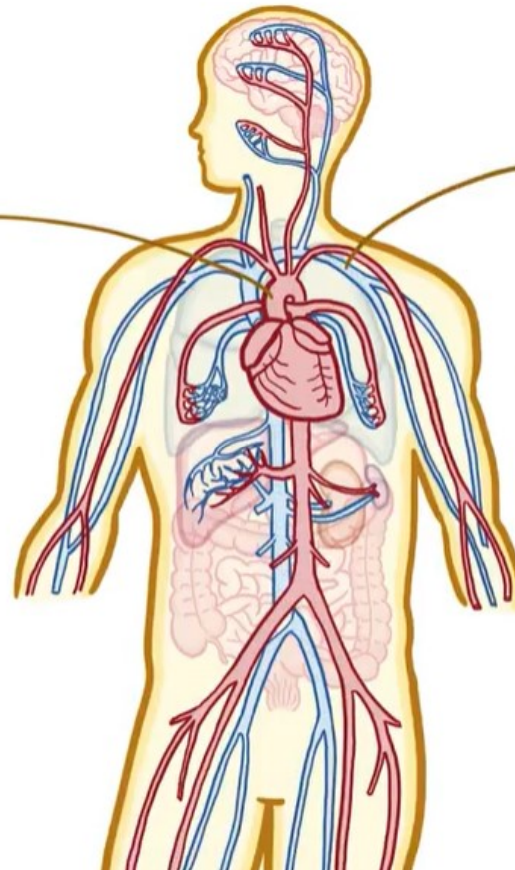
Περικλής Νταβλούρος, Καθηγητής Κ/Δ, Δ/ΝΤΗΣ Καρδιολογικού τμήματος

Patras University Hospital



HEART

PUMP
OXYGENATED
BLOOD
WITH NUTRIENTS
THROUGH
ARTERIES



RECEIVE
DEOXYGENATED
BLOOD
WITH WASTE PRODUCTS
THROUGH
VEINS



ΚΑΡΔΙΑΚΗ ΛΕΙΤΟΥΡΓΙΑ

- Κύρια λειτουργία της καρδιάς: δημιουργία και συντήρηση της αρτηριακής πίεσης (ΑΠ-ΒΡ) και ανα λεπτό παροχής αίματος (ΚΛΟΑ-CO) που χρειάζεται για την επαρκή αιμάτωση των ιστών
- Όγκος παλμού Stroke Volume (SV): όγκος που εξωθείται σε 1 συστολή
- Καρδιακή παροχή (ΚΛΟΑ) Cardiac Output (CO) = SV x HR
- Cardiac index = CO/m² (2.6 to 4.2 L/min/m²)



Φυσική Εξέταση

- Επισκόπηση
- Ψηλάφηση
- Επίκρουση
- Ακρόαση





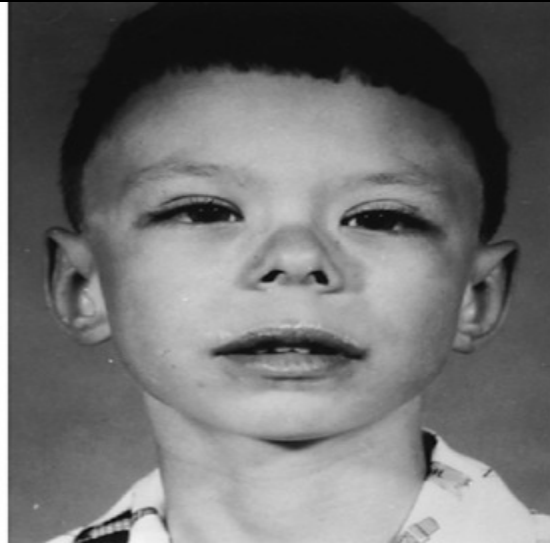
Di George...

1. **Chromosome 22q11 deletion syndrome.**

2. **CATCH 22.**

- **C**ardiac anomalies.
- **A**bnormal facies.
- **T**hymic hypoplasia.
- **C**left palate.
- **H**ypocalcemia.





Υπερβαλβιδική στένωση αορτής (Elfin facies)





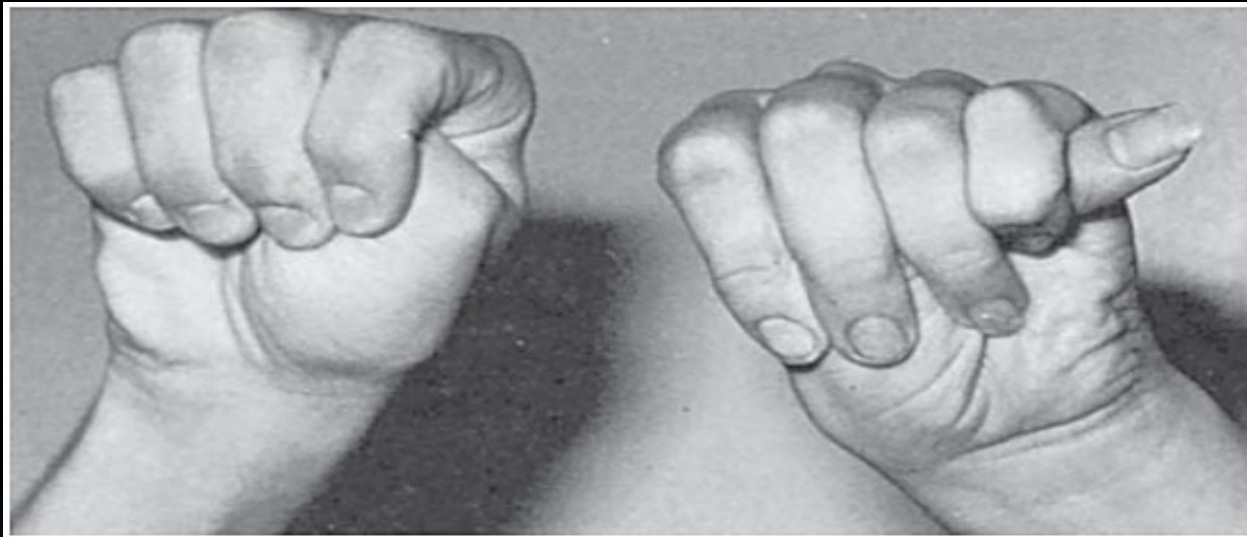
Σύνδρομο Kearns-Sayre





Marfan





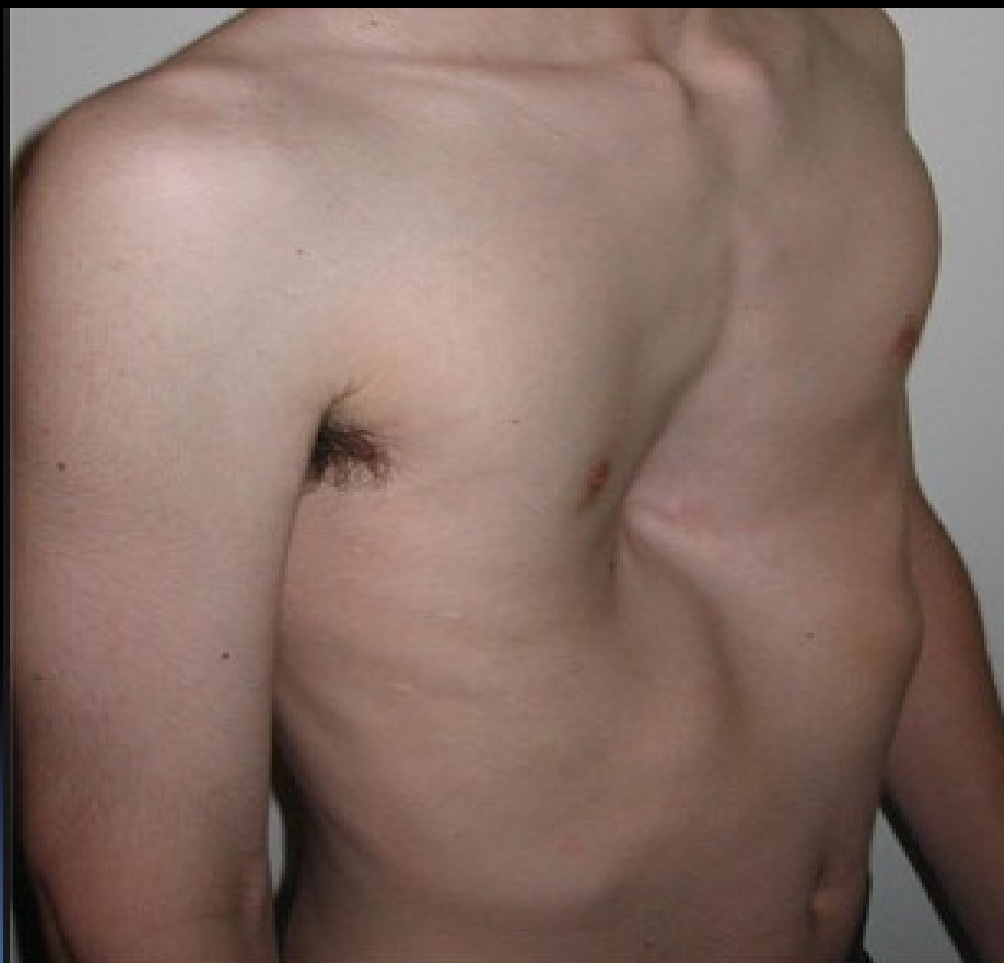
At left is a normal subject, who is unable to protrude his thumb beyond his clenched fingers, as can the patient with the Marfan syndrome at right, who can do this because of a long thumb and lax joints.





The normal patient at left cannot overlap his thumb and little finger around his wrist because, unlike the patient with the Marfan syndrome at right, his fingers are not long relative to his wrist.





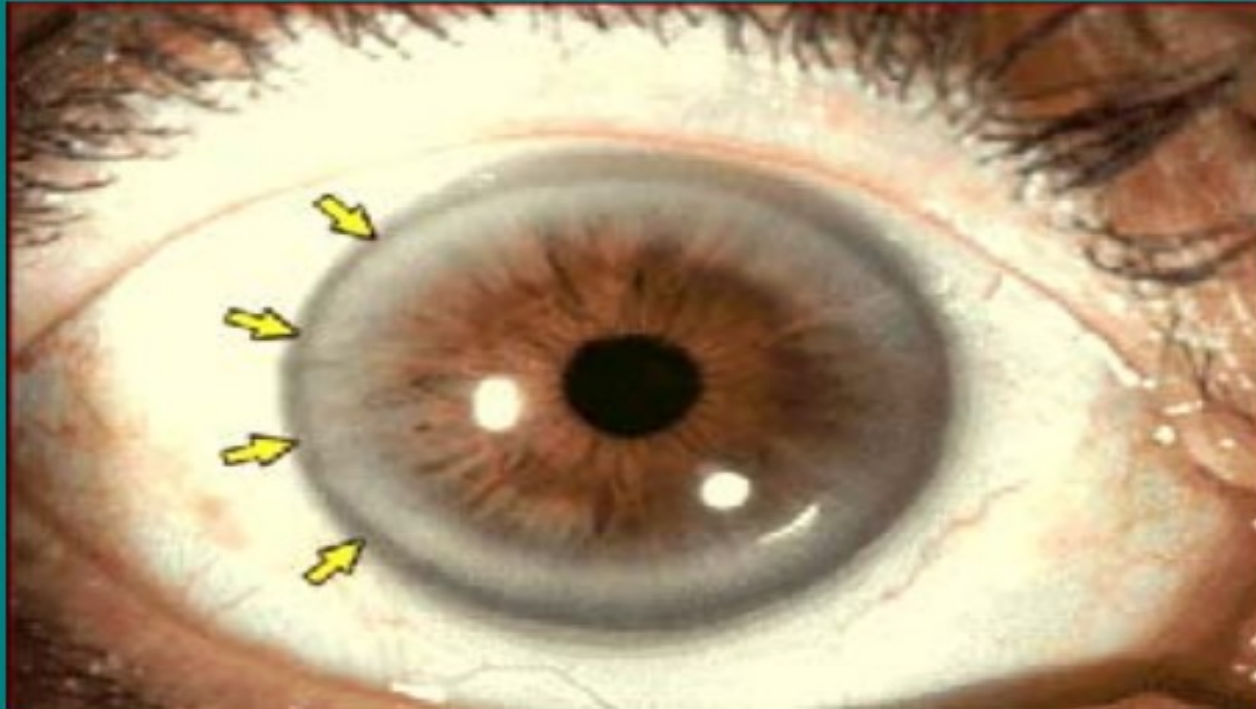


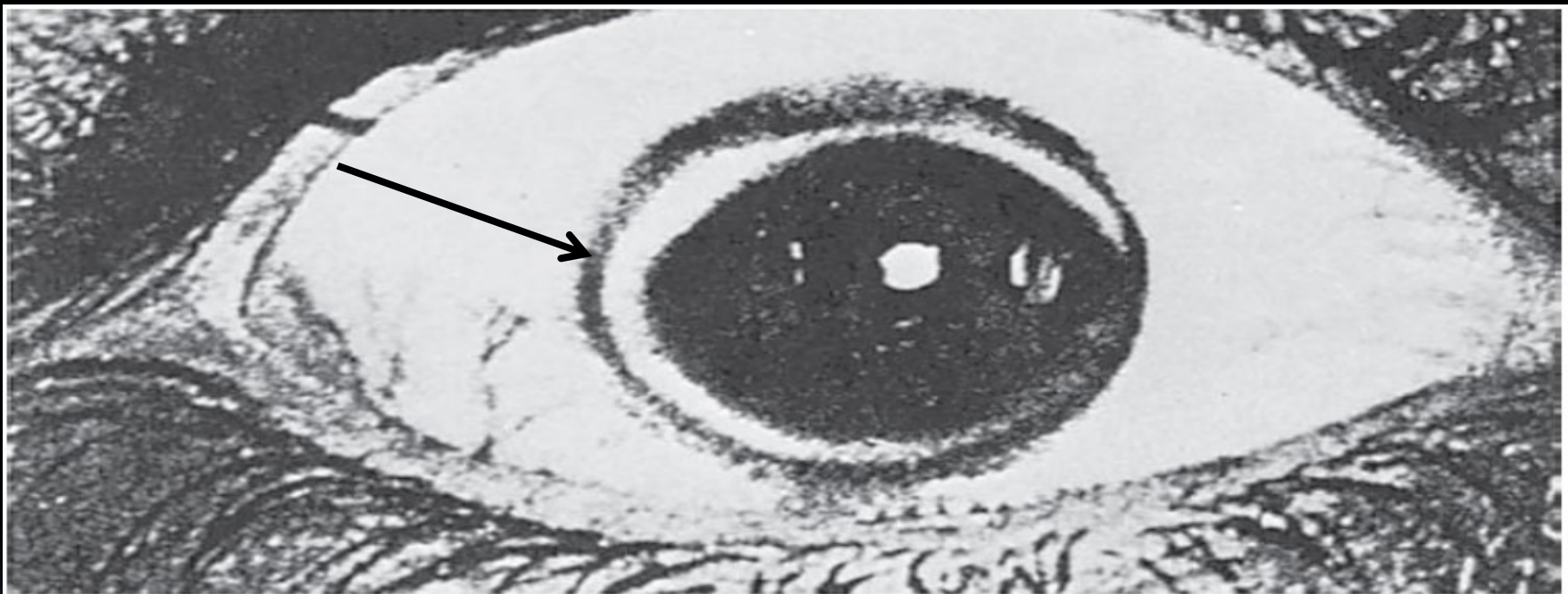


Xanthelasma Yellow plaques are present bilaterally. With permission from Slomovits, TL (Ed), Basic and clinical science courses section, American Academy of Ophthalmology, San Francisco 1996.



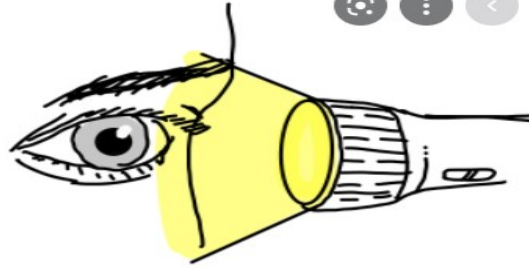
Arcus juvenilis. This ring is associated with premature atherosclerosis



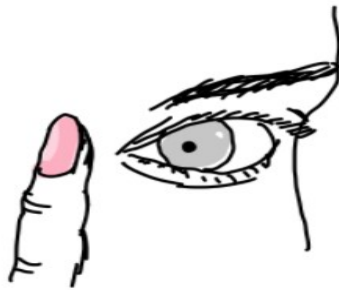
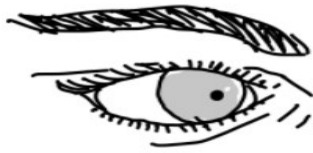


This type of arcus is a thick band of yellowish material surrounded by peripheral pigment and suggests a high serum cholesterol. It is not an arcus senilis, which has little known significance. (Courtesy Ayerst Laboratories.)



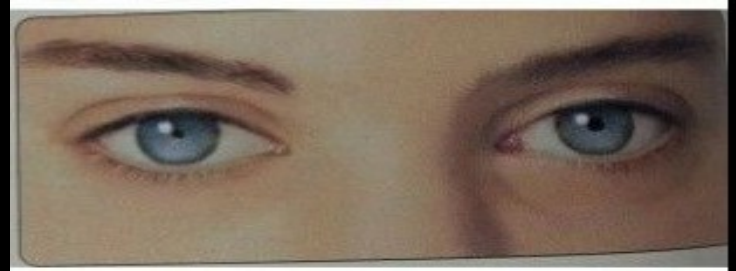


Pupils DO **NOT** constrict when exposed to bright light. ("light reflex")



Pupils DO constrict on a near object. ("accommodation reflex")

1146 x 1280



Argyll Robertson

Luetic aortic aneurysm or luetic AR with coronary ostial stenosis

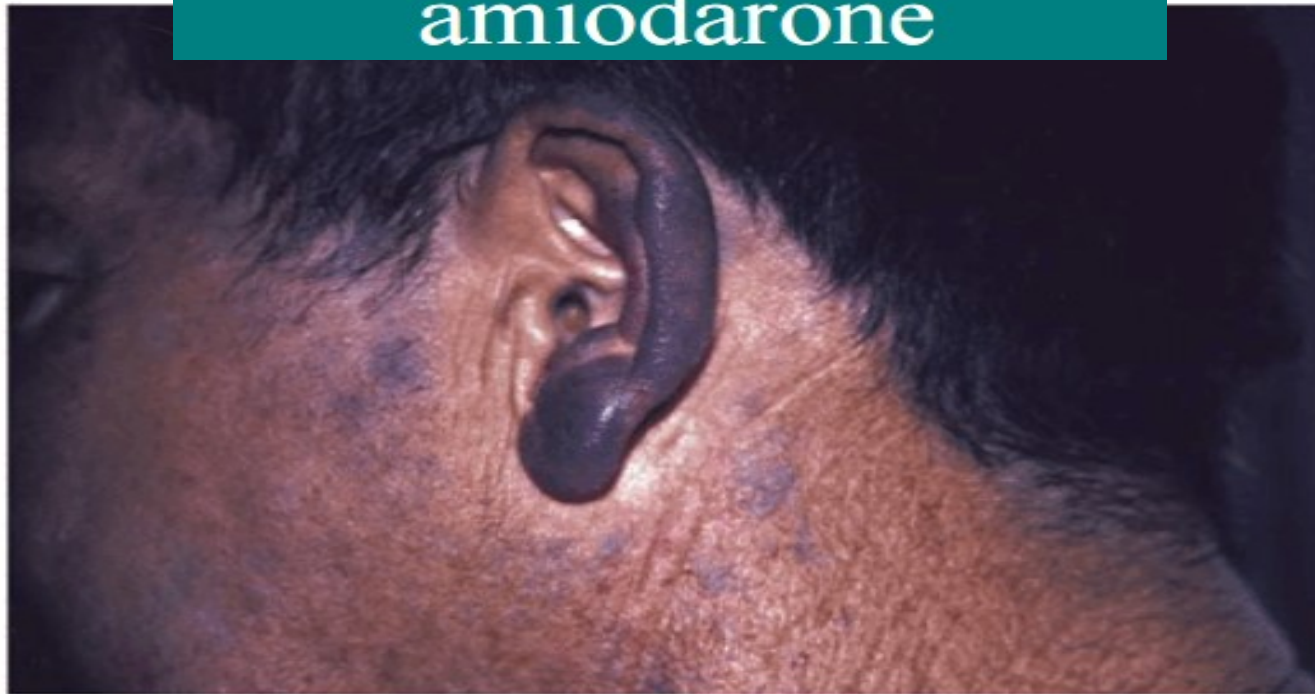




This 47-year-old man had this deep ear crease bilaterally. Although he had no significant coronary disease, his cholesterol-to-HDL ratio was 8 to 1, and he had sinus node dysfunction. He was about 50 lb overweight.



Pigmentation due to amiodarone

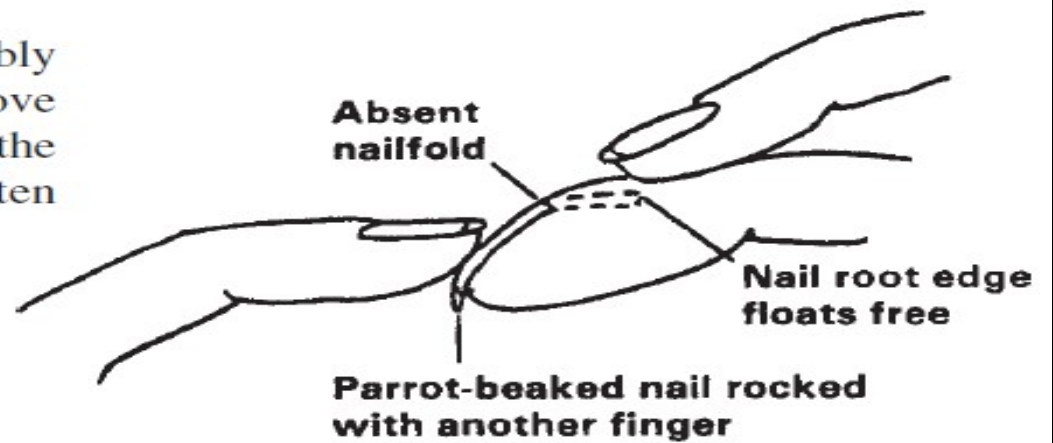


What is meant by cyanosis?

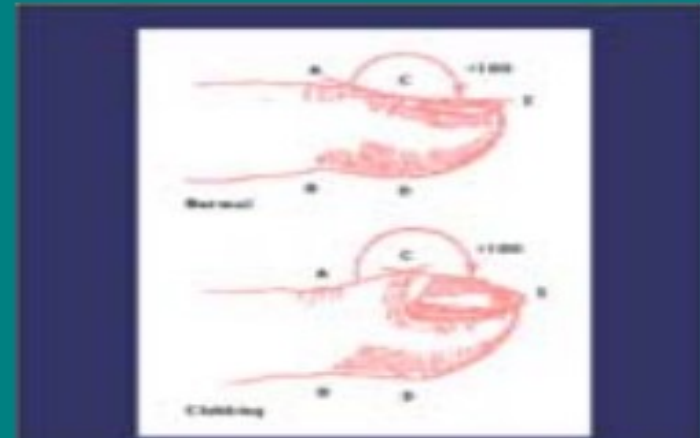
- Bluish or purplish color imparted to the skin and mucous membranes, usually the result of at least 5 mg per dL of reduced hemoglobin in the surface capillaries, but occasionally due to an abnormal hemoglobin such as sulfmethemoglobin.
- Central cyanosis: SAT < 80%
- Peripheral cyanosis: slow flow decreases the amount of hemoglobin in the surface capillaries.



The earliest sign of clubbing is probably the reduction or absence of the groove where the root of the nail slips under the skin. Moist, warm fingertips are often associated signs.

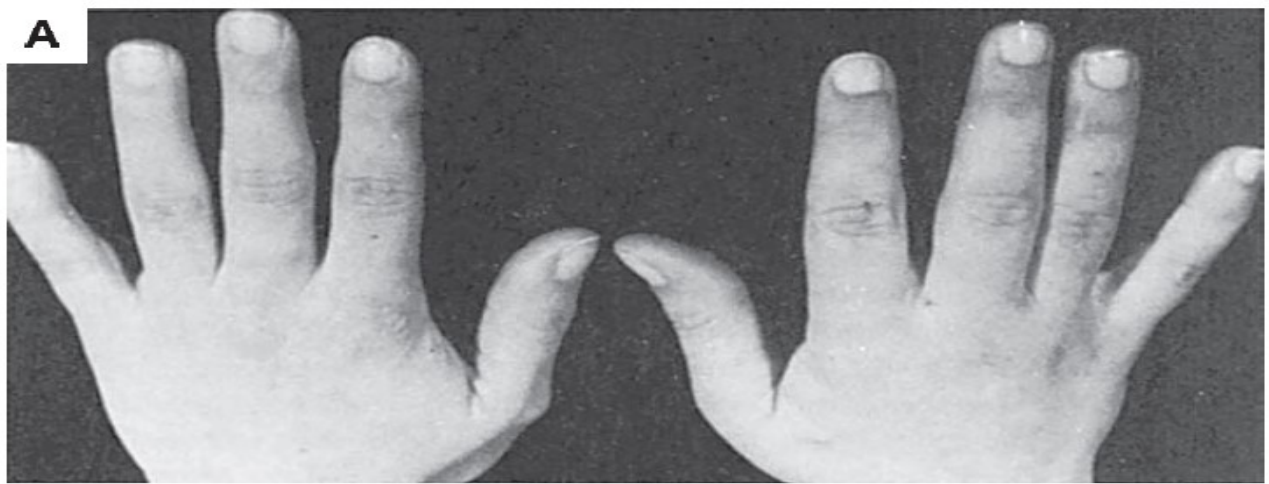


- Cyanotic congenital heart disease
- Lung disease
 - Cystic fibrosis
 - Interstitial fibrosis
 - Malignancy
 - Sarcoidosis
 - Bronchiectasis
- Hyperthyroidism



Clubbing of the fingers In a normal finger, the length of the a perpendicular dropped from point A to point B should be greater than a similar line from C to D. In clubbing, the relationships are reversed – that is, the distance C-D is greater than the distance A-B. The other important change is the angle described by A-C-E. In the normal finger this is usually < 180 degrees whereas in clubbing it is > 180 degrees. Redrawn from DeRemee, RA. Facets of the algorithmic synthesis. In: DeRemee, RA, (Ed). Clinical profiles of diffuse interstitial pulmonary disease, Mount Kisco, NY, Futura Publishing Company, Inc. 1990, pp. 9-44





Eisenmenger PDA



What are the skin signs secondary to the small emboli of IE?

- Clubbing
- Splinter hemorrhages
- Osler's nodes
- Janeway lesions





Splinter hemorrhages in the nails

Most splinter hemorrhages are not embolic and are due to repeated jarring.

Since they are in the nail substance, they move with the nail as it grows and they extend to the distal nail edge.



Osler Node



Janeway Lesion



Osler's nodes (painful, tender, reddish-brown raised areas 3–15 mm in diameter, occasionally with a whitish center, on the palms or

Janeway lesions (painless, circular or oval, pink to tan macules about 5 mm in diameter on the palms and soles that do





Κηλίδες Roth σε ασθενή
με ΛΕ (αιμορραγία με
καθαρό κέντρο)



Πετέχειες σε ασθενή με ΛΕ



LOCATION OF THE HEART

- RESTS ON THE DIAPHRAGM
- NEAR THE MIDLINE OF THE THORACIC CAVITY
- RV IS IN THE FRONT(!), LV IS BACK

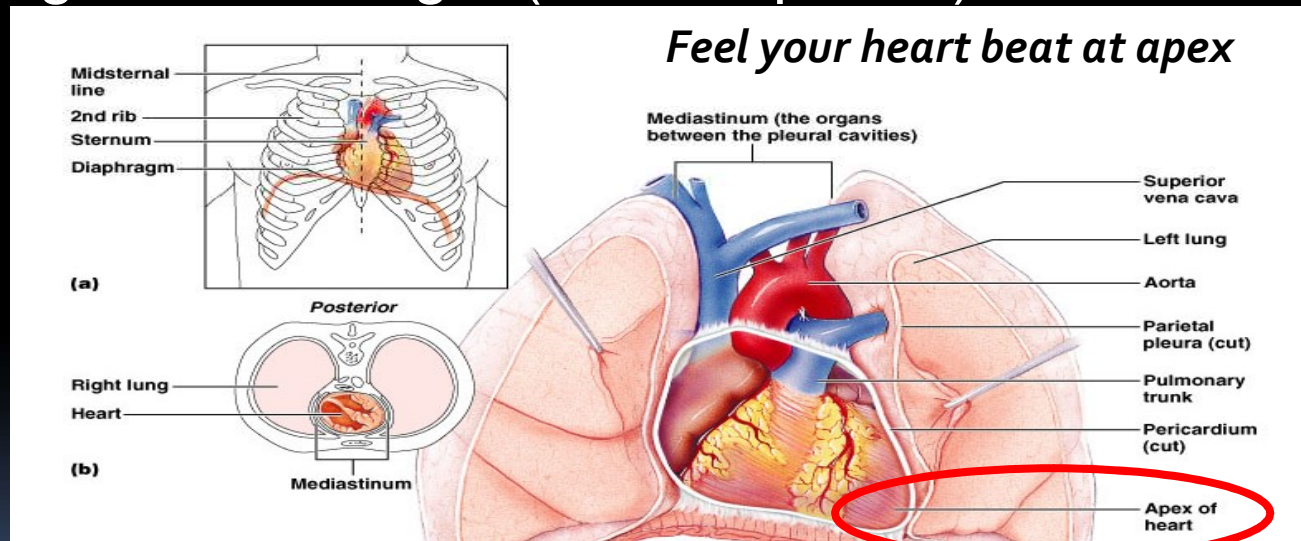


Εκπαιδευτικός Στόχος (ΕΣ): Όρια της καρδιάς στην απλή ακτινογραφία



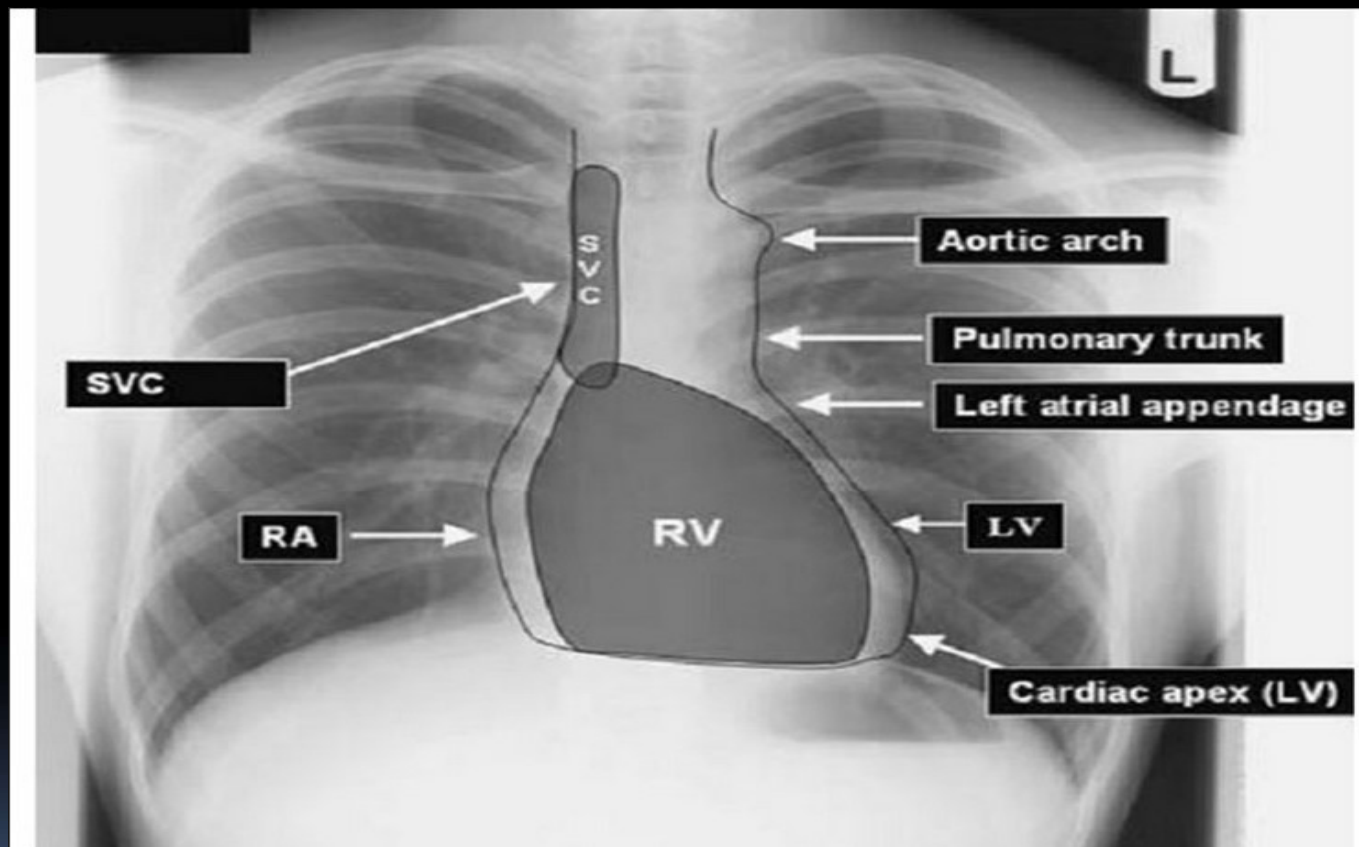
Heart's position in thorax

- In mediastinum – behind sternum and pointing left, lying on the diaphragm
- It weighs 250-350 gm (about 1 pound)



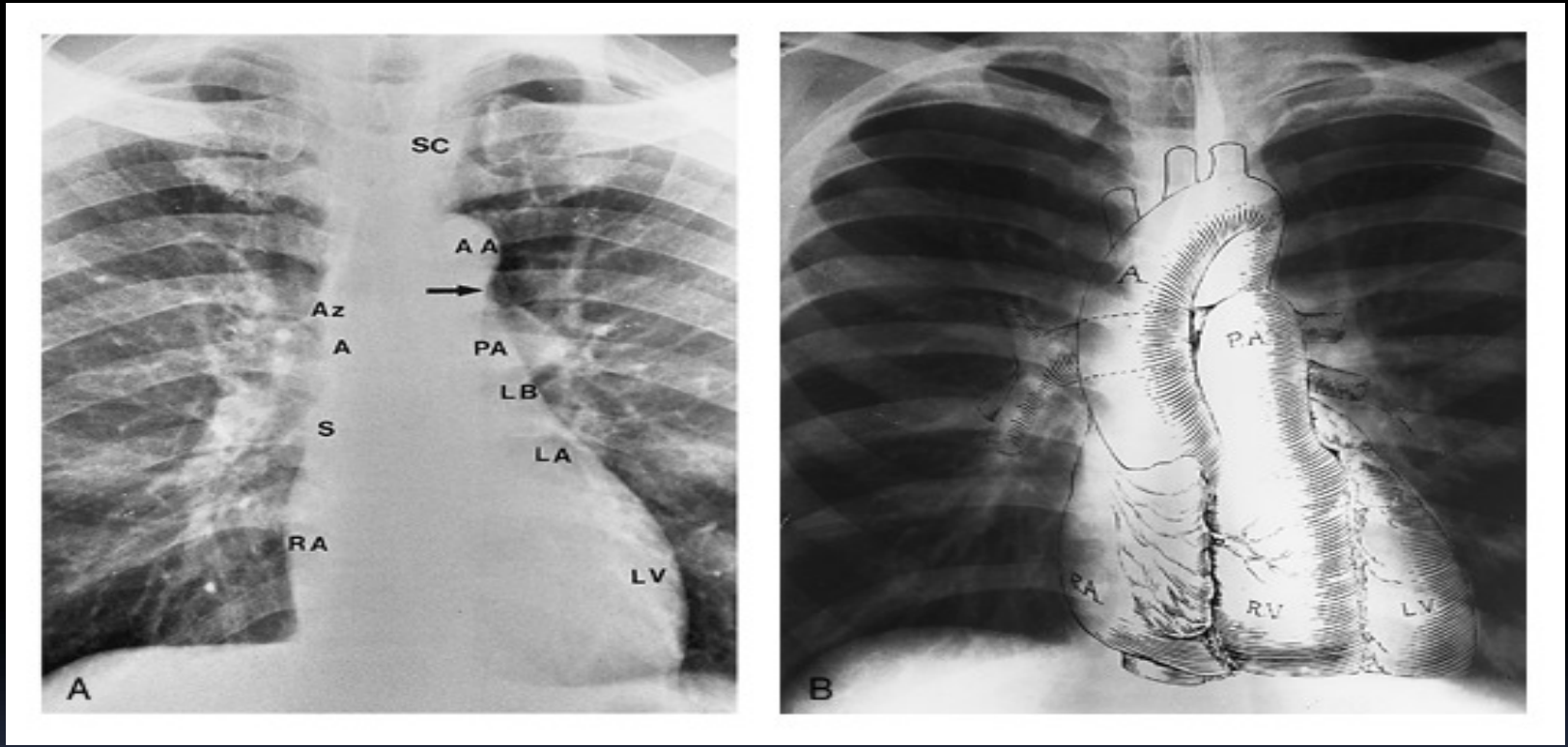
Εκπαιδευτικός Στόχος (ΕΣ): Η δεξιά κοιλία είναι πρόσθια δομή, θέση της καρδιακής ώσης





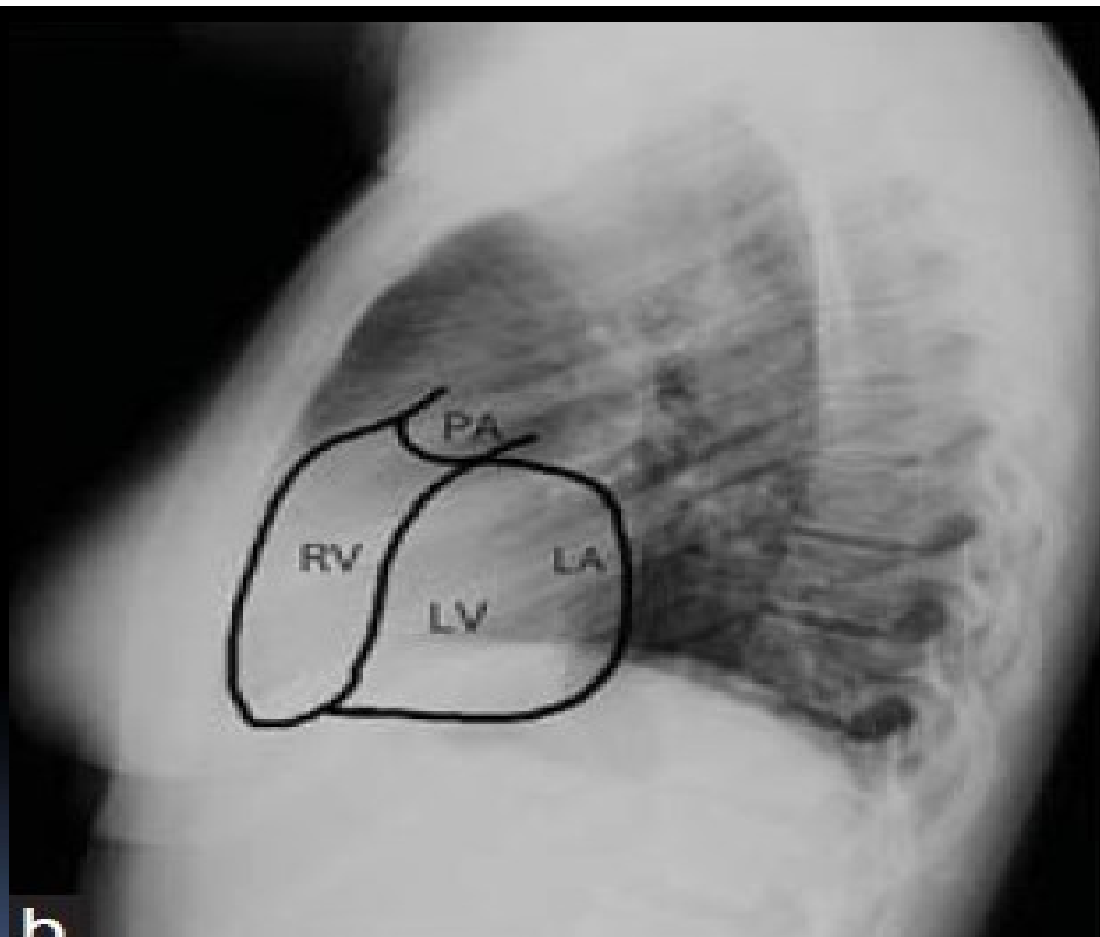
Εκπαιδευτικός Στόχος (ΕΣ): Καρδιακά όρια στην ακτινογραφία





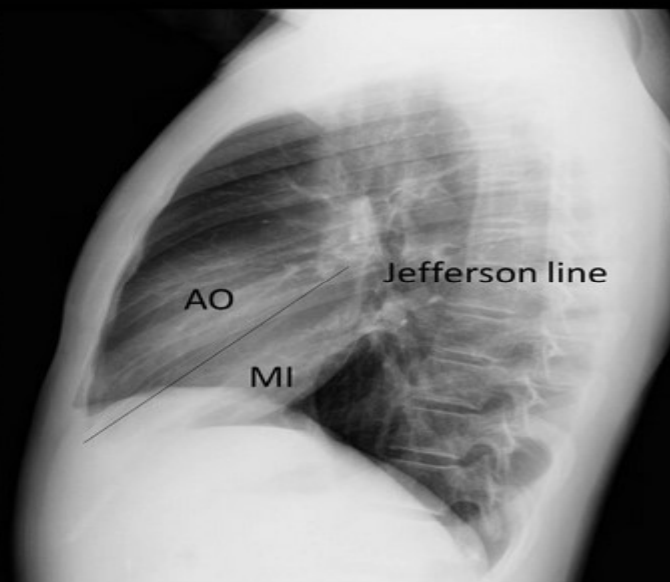
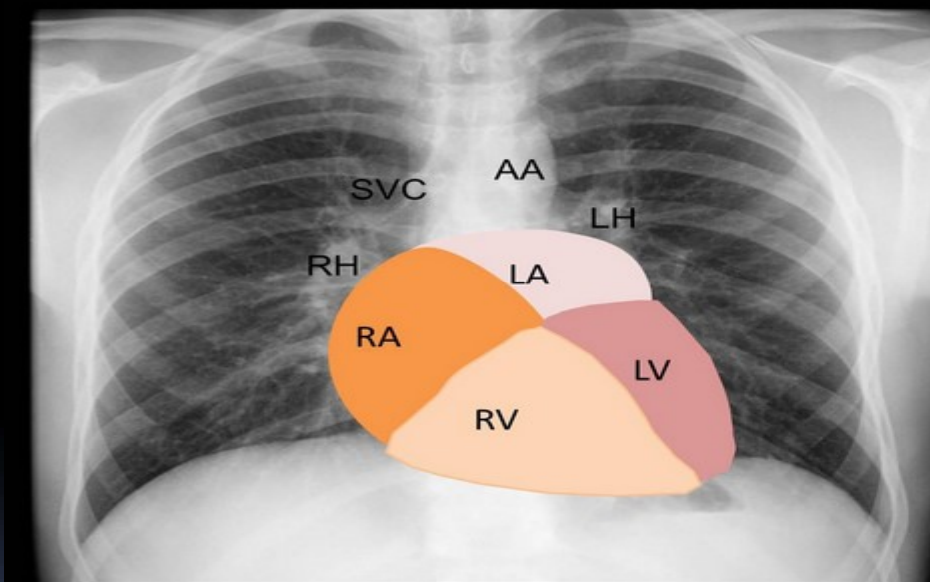
Εκπαιδευτικός Στόχος (ΕΣ): Καρδιακά όρια στην ακτινογραφία





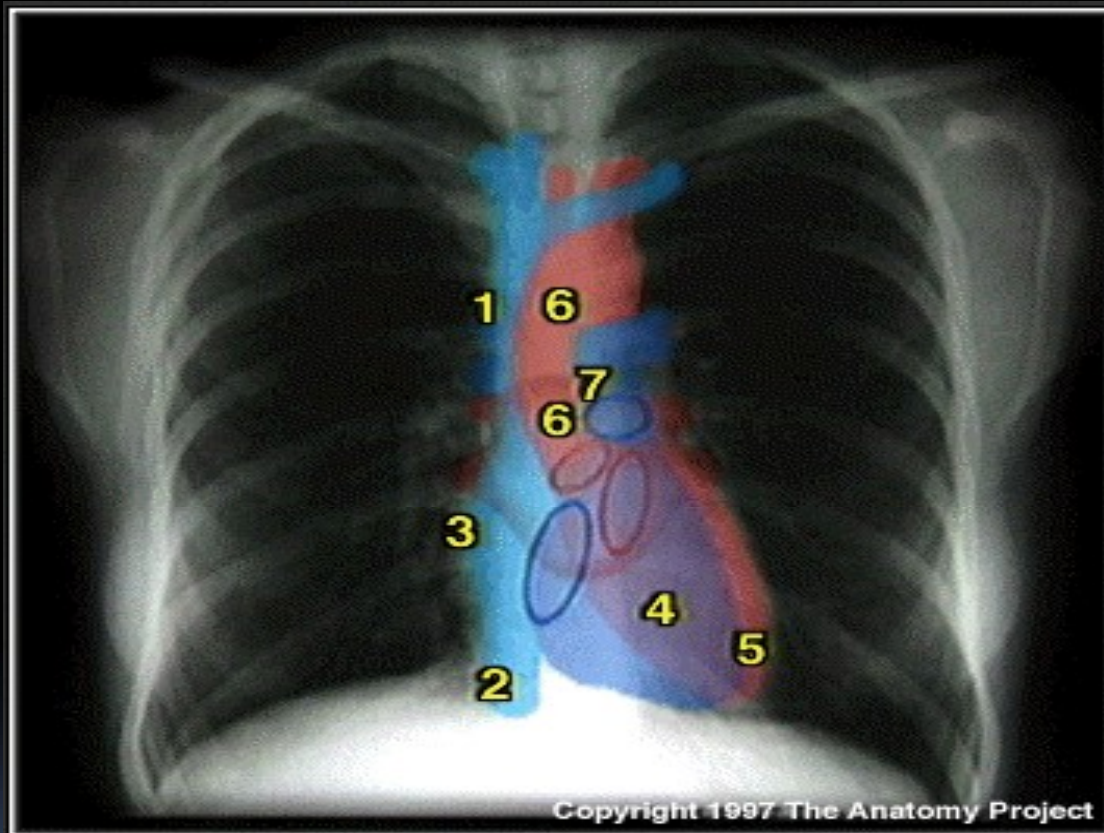
Εκπαιδευτικός Στόχος (ΕΣ): Καρδιακά όρια στην ακτινογραφία





Εκπαιδευτικός Στόχος (ΕΣ): Καρδιακά όρια στην ακτινογραφία

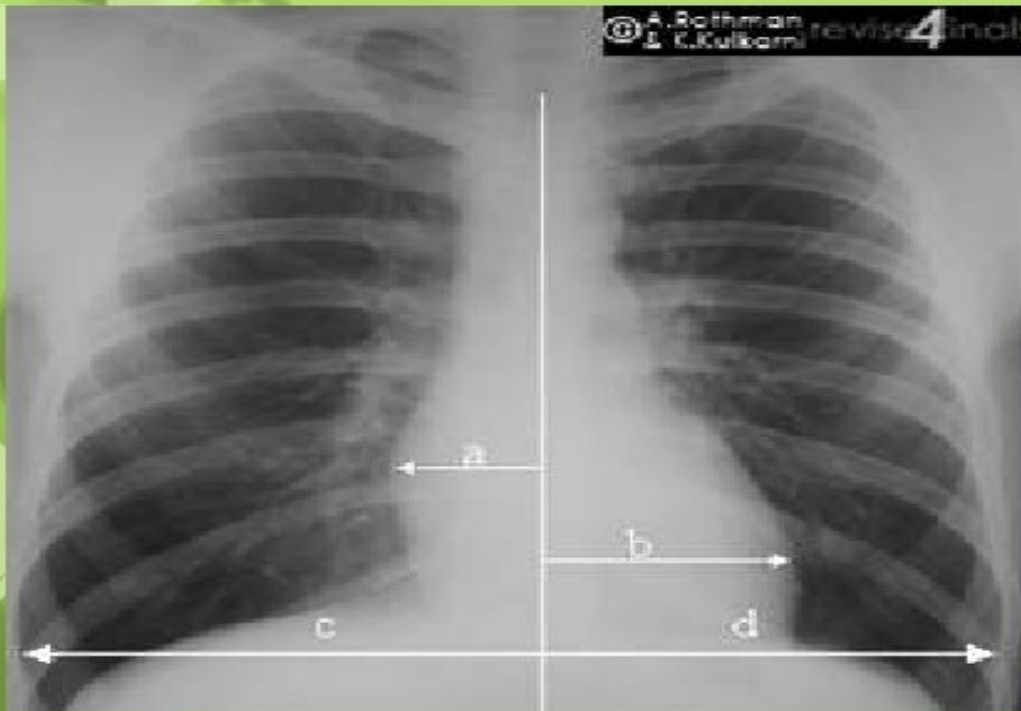




Εκπαιδευτικός Στόχος (ΕΣ): Θέσεις βαλβίδων στην ακτινογραφία



Cardiac shadow



Heart Size

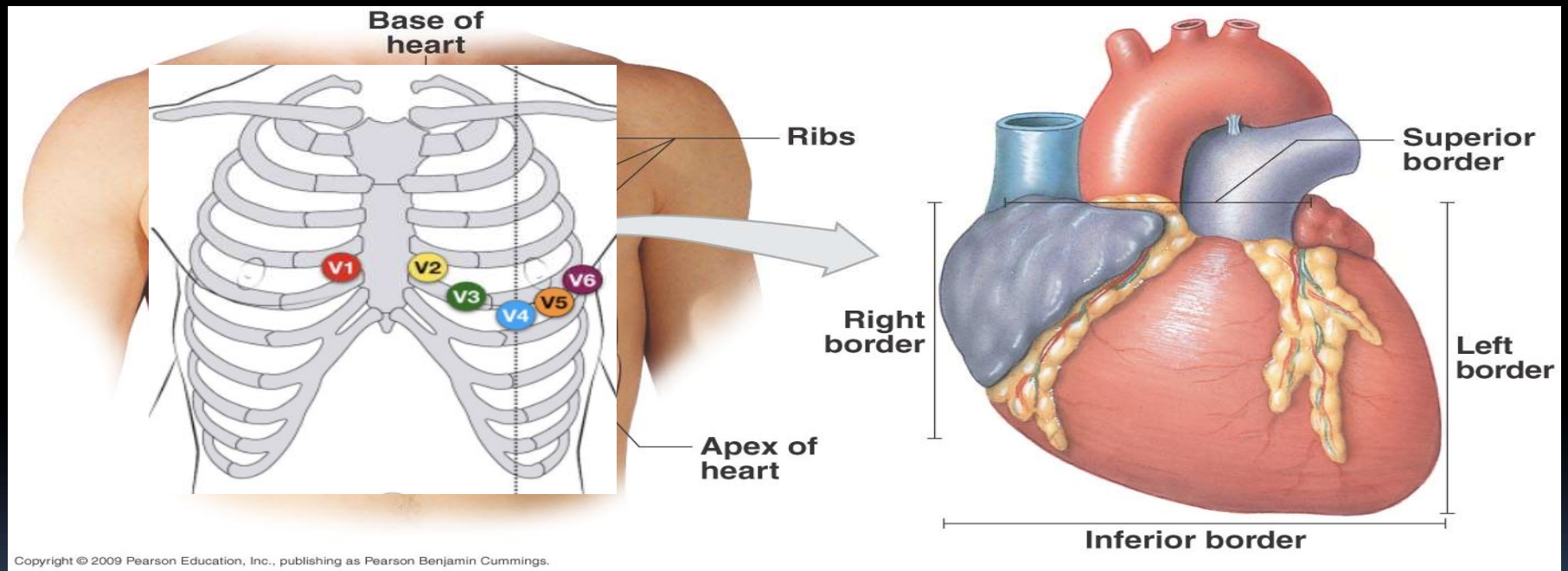
- Cardiac Transverse Diameter (CTD) = $a+b$
< 15.5cm (males)
< 15.0cm (females)

- Cardio-Thoracic Ratio (CTR) = $a+b \div c+d$
< 0.5

Εκπαιδευτικός Στόχος (ΕΣ): ΚΘΔ δείκτης (Πότε η καρδιά είναι διατεταμένη;)



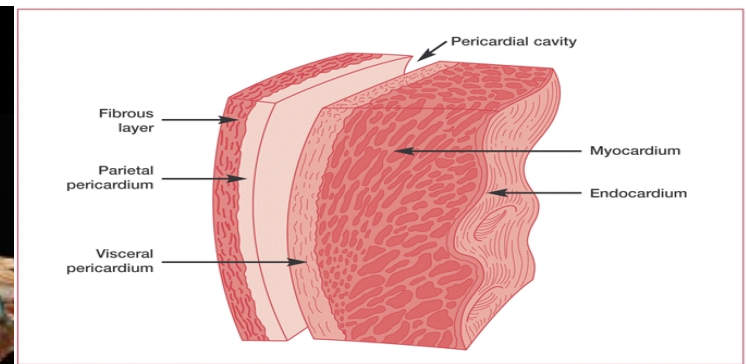
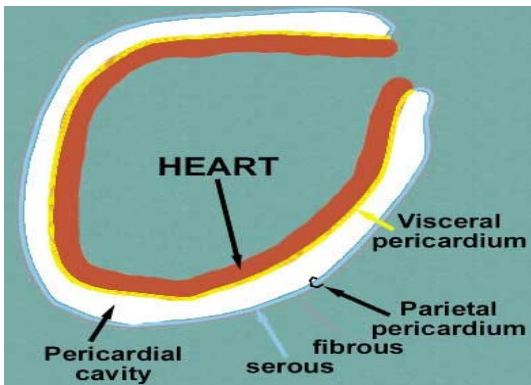
Heart's position in thorax



Εκπαιδευτικός Στόχος (ΕΣ): Όρια της καρδιάς στην απλή ακτινογραφία, θέσεις ηλεκτροδίων στο ΗΚΓ

Patras University Hospital





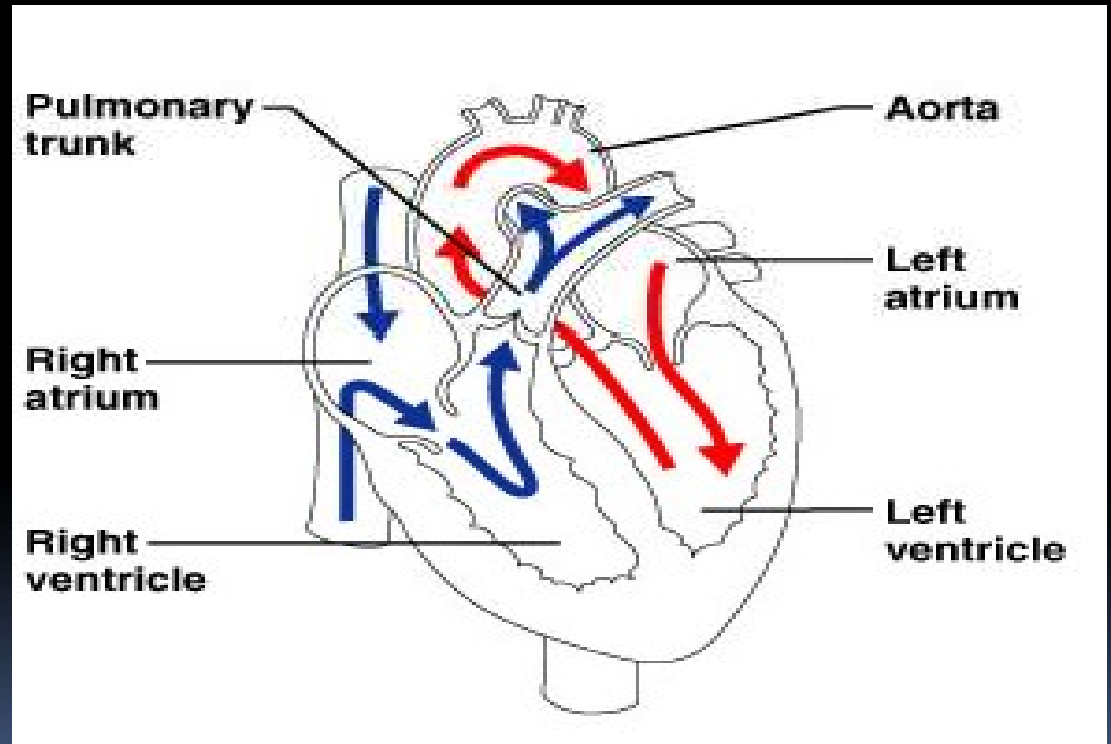
Εκπαιδευτικός Στόχος (ΕΣ): Ρόλος περικαρδίου. Περικαρδίτιδα, ΠΚ συλλογή



Chambers of the heart *divided by septae:*

οι κοιλότητες του πνεύμονα και της καρδιάς

- Two atria-divided by *interatrial* septum
 - Right atrium
 - Left atrium
- Two ventricles-divided by *interventricular* septum
 - Right ventricle
 - Left ventricle

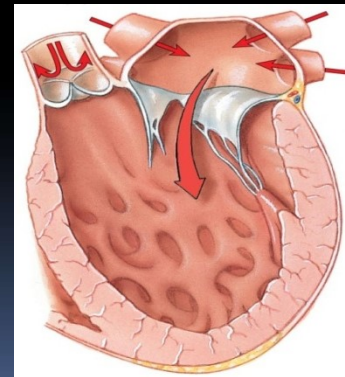
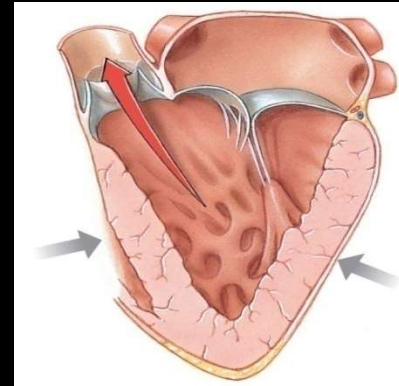


ΕΣ: Μεσοκοιλιακή (ASD) και μεσοκοιλιακή (VSD), επικοινωνία



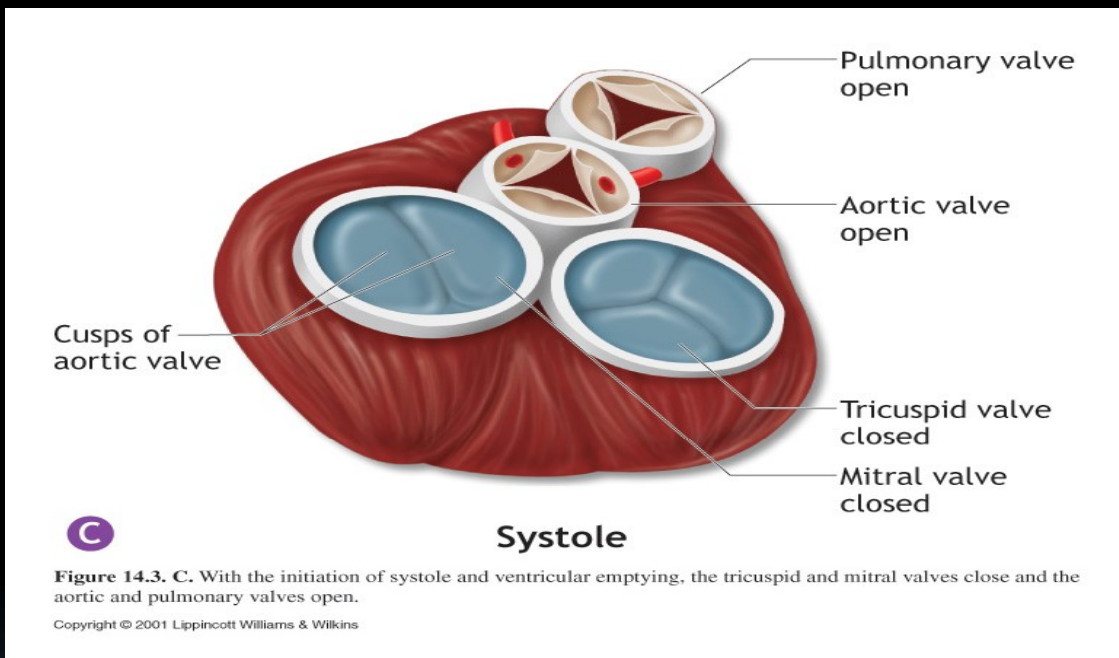
Functional Anatomy of the Heart Valves

- Function is to prevent backflow
 - Atrioventricular Valves
 - Prevent backflow to the atria during systole
 - Prolapse is prevented by the chordae tendinae
 - Tensioned by the papillary muscles
 - Semilunar Valves
 - Prevent backflow into ventricles during diastole
 - No chordae
 - Commisures



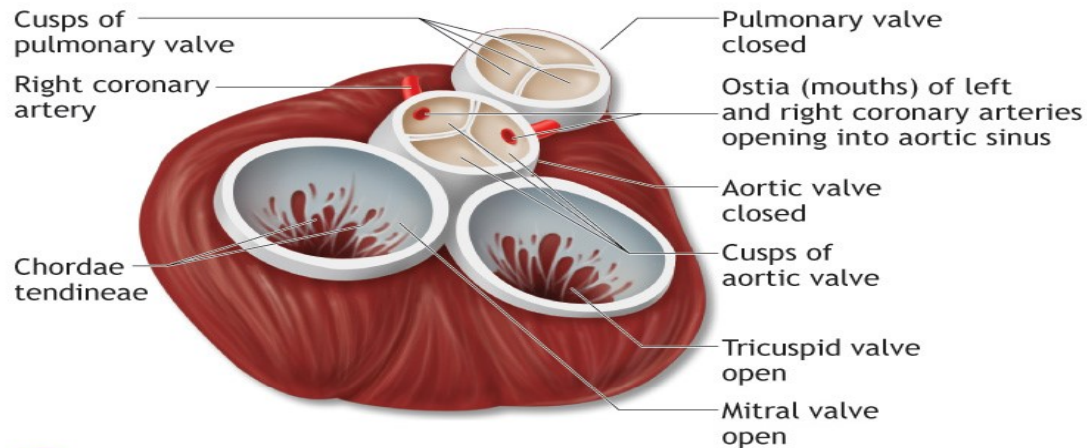
Εκπαιδευτικός Στόχος (ΕΣ): ANATOMIA- ΛΕΙΤΟΥΡΓΙΑ ΒΑΛΒΙΔΩΝ





Εκπαιδευτικός Στόχος (ΕΣ): Ανατομική σχέση των βαλβίδων. Σημασία για τις θέσεις ακρόασης, **ΚΑΡΔΙΑΚΟΣ ΚΥΚΛΟΣ: ΣΥΣΤΟΛΗ ΑΝΟΙΓΟΥΝ ΟΙ ΜΗΝΟΕΙΔΕΙΣ ΚΛΕΙΝΟΥΝ ΟΙ ΚΟΛΠΟΚΟΙΛΙΑΚΕΣ → ΠΡΩΤΟΣ ΤΟΝΟΣ S1 (M1T1).**





B

Diastole

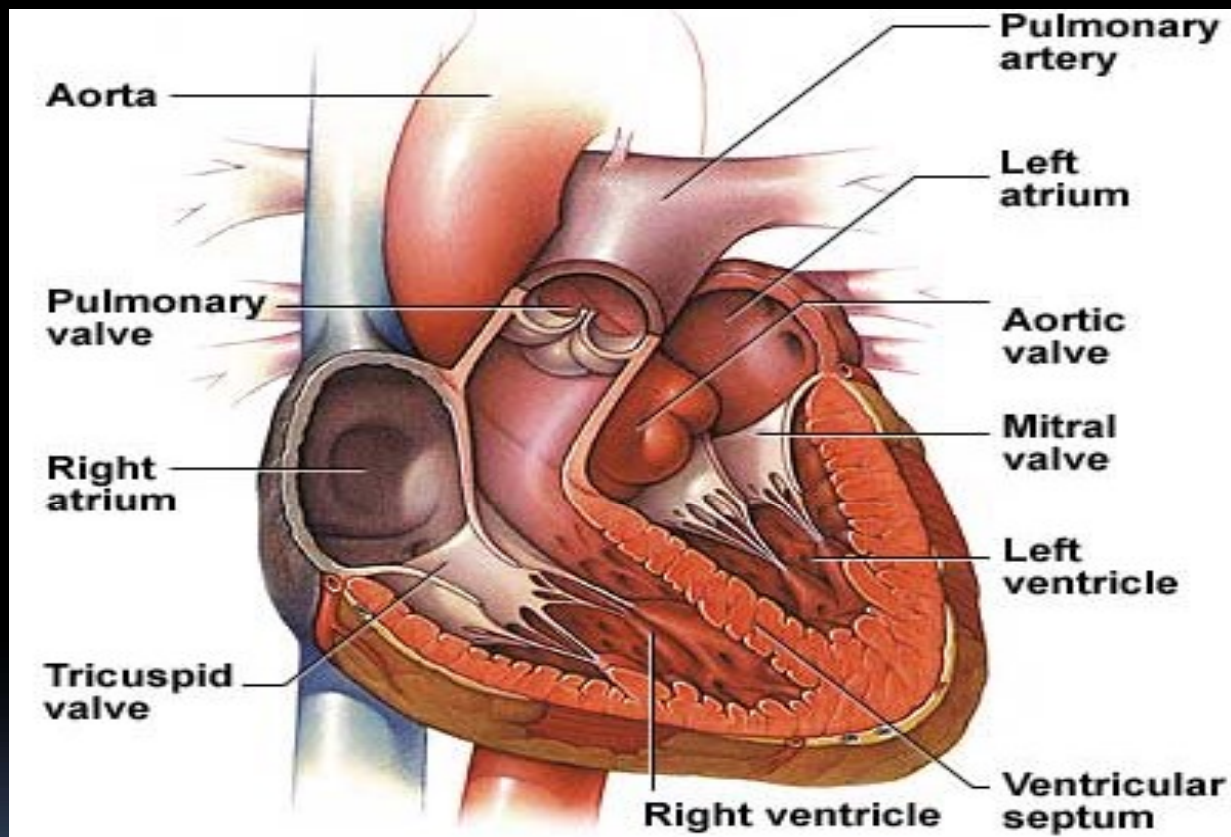
Figure 15.3. B. In diastole, the aortic and pulmonary valves snap close; shortly thereafter, the mitral and tricuspid valves open and blood flows into the ventricular cavities.

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Εκπαιδευτικός Στόχος (ΕΣ): Ανατομική σχέση των βαλβίδων. Σημασία για τις θέσεις ακρόασης, **ΚΑΡΔΙΑΚΟΣ ΚΥΚΛΟΣ: ΔΙΑΣΤΟΛΗ ΚΛΕΙΝΟΥΝ ΟΙ ΜΗΝΟΕΙΔΕΙΣ (Α2Ρ2) S2 ΔΕΥΤΕΡΟΣ ΤΟΝΟΣ, ΑΝΟΙΓΟΥΝ ΟΙ ΚΟΛΠΟΚΟΙΛΙΑΚΕΣ.**

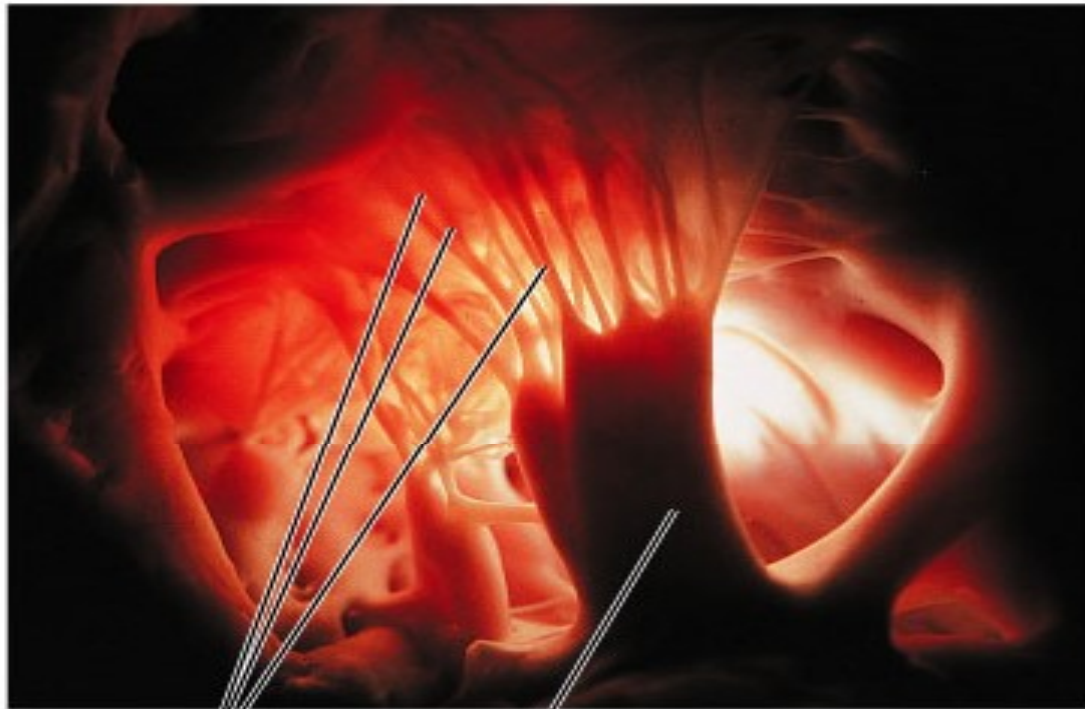
Patras University Hospital





ΕΚΠΑΙΔΕΥΤΙΚΟΣ ΣΤΟΧΟΣ (ΕΣ): Ανατομική σχέση των μεγάλων αγγείων και των βαλβίδων. Σημασία για τις θέσεις ακρόασης.





Chordae
tendineae
attached to
tricuspid
valve flap

Papillary
muscle

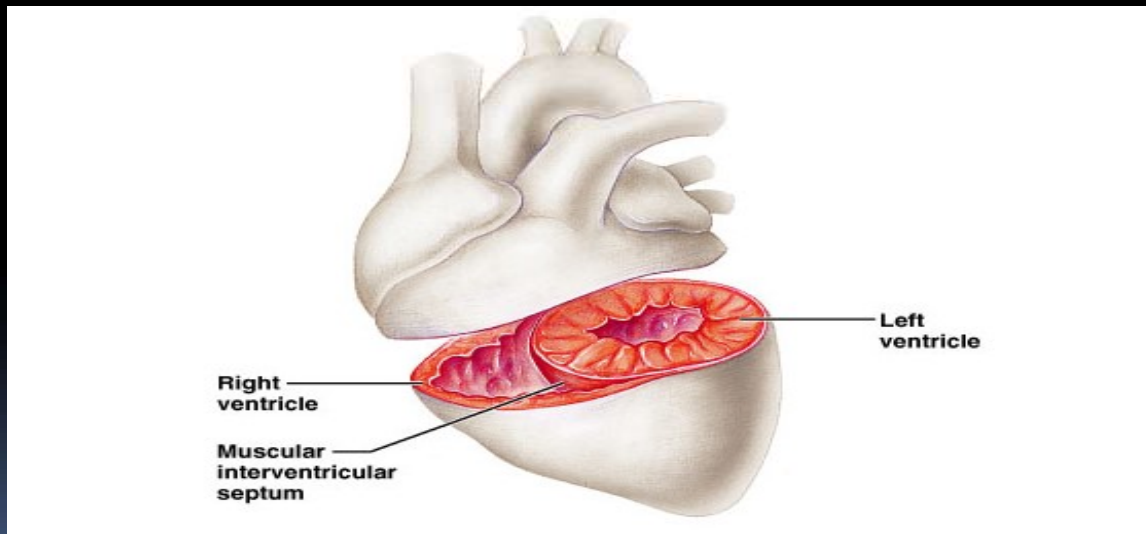
Εκπαιδευτικός Στόχος (ΕΣ):
Ανατομία μιτροειδικής συσκευής



Relative thickness of muscular walls

LV thicker than RV because it forces blood out against more resistance; the systemic circulation is much longer than the pulmonary circulation

Atria are thin because ventricular filling is done by gravity, requiring little atrial effort



ΕΣ: Η αρ κοιλία προωθεί, η δεξ κοιλία αναρροφά

Αν η δεξ κοιλία

«καταρρεύσει» π.χ.

επιπωματισμός, έμφραγμα

δεξιάς, πνευμονική εμβολή →

Καρδιογενές shock



	RV infarction	PTE	Tamponade
Pathologic Anatomy	Necrosis of RV muscle	Embolus in pulmonary circulation	Fluid in pericardial cavity
Functional disorder	Damaged RV systole → Unable to inject blood → Drop in BP → Increase in HR (SNS) Increased EDP → Increased JVP	Sudden resistance to RV systole → Unable to eject blood → Drop in BP → Increase in HR (SNS) Increased EDP → Increased JVP	RV compression → Unable to fill with blood → Reduction of ejected blood → Drop in BP → Increase in HR (SNS) Increased EDP → Increased JVP
Clinical Picture	Syncope, SoB Chest pain	Syncope, SoB Chest pain	SoB
Physical Examination	Low BP, high HR, elevated JVP	Low BP, high HR, elevated JVP	Low BP, high HR, elevated JVP
Diaagnosis	History, ECG	History, CTPA	History, ECHO

Cardiac Cycle (Cycle of Wiggers)



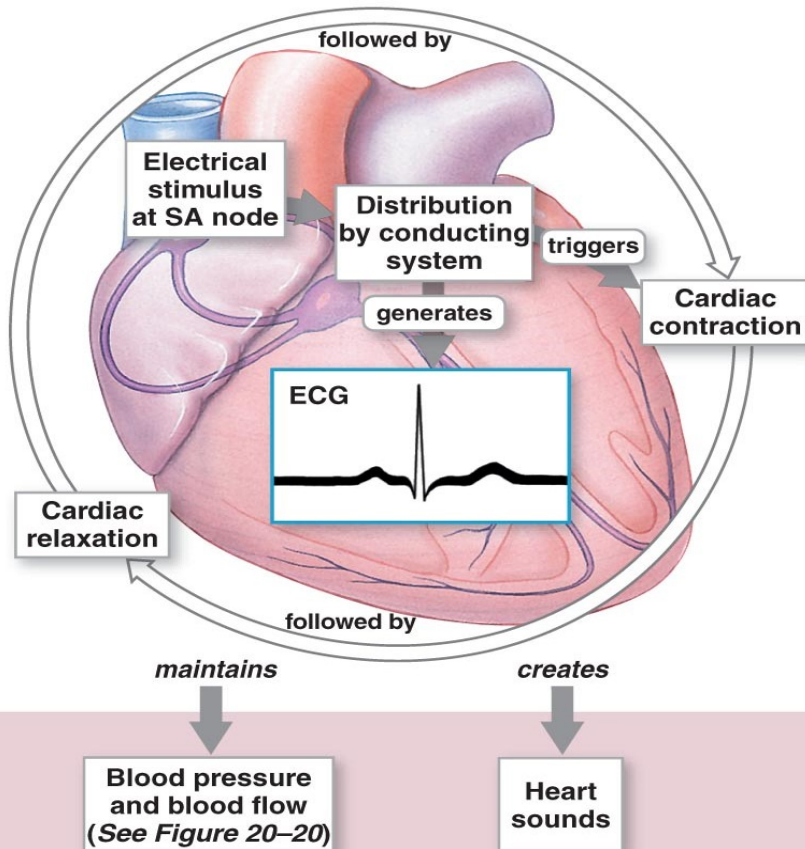
The Cardiac Cycle

THE CARDIAC CYCLE

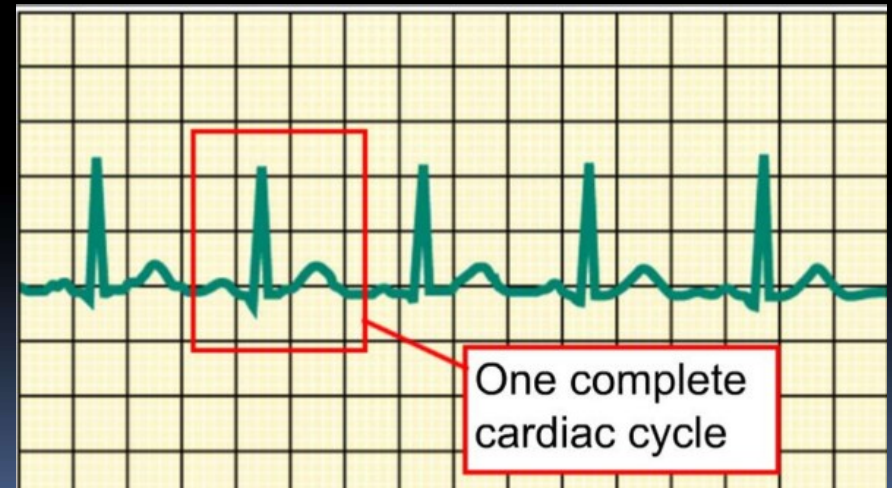
- Cardiac cycle = The period between the start of one heartbeat and the beginning of the next
- Includes both contraction and relaxation

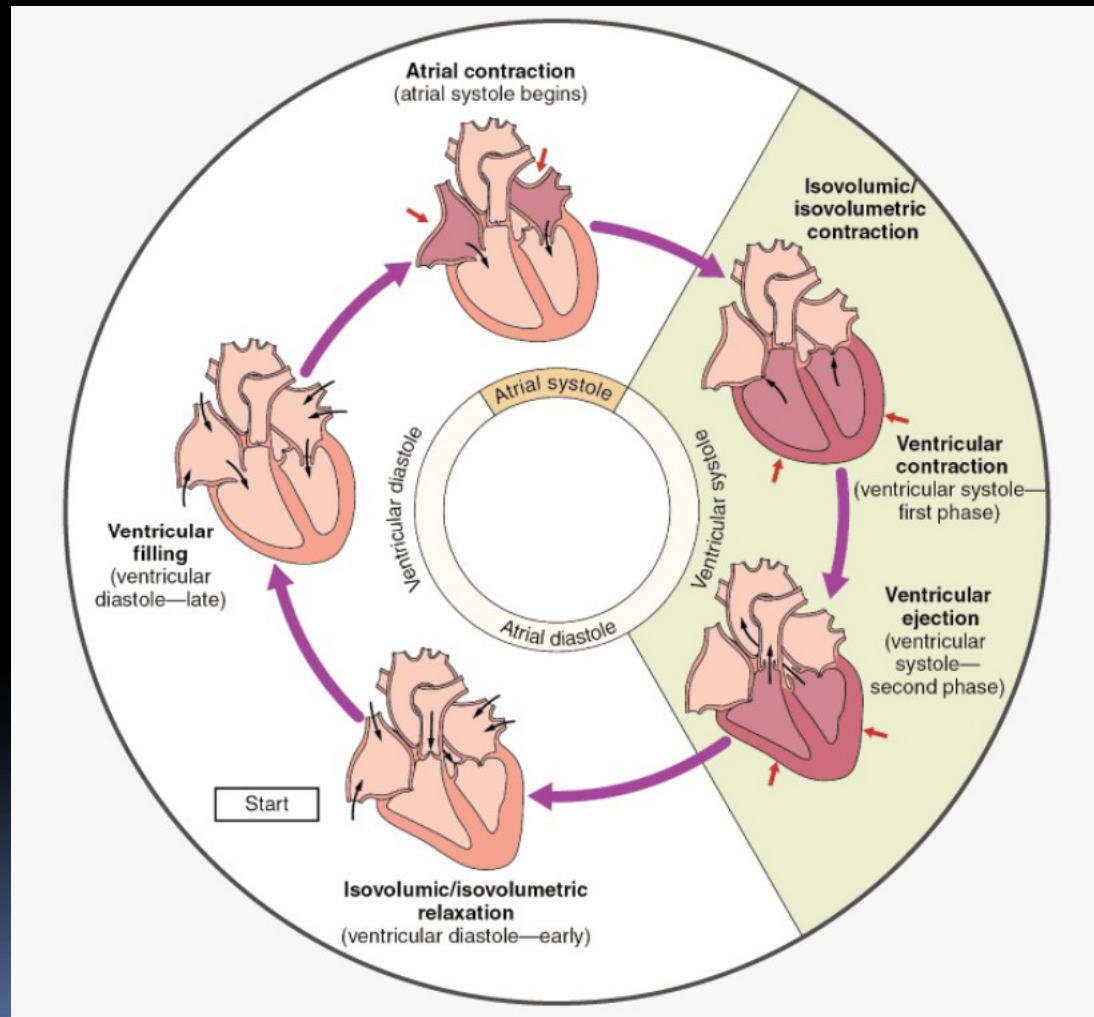


CARDIAC CYCLE



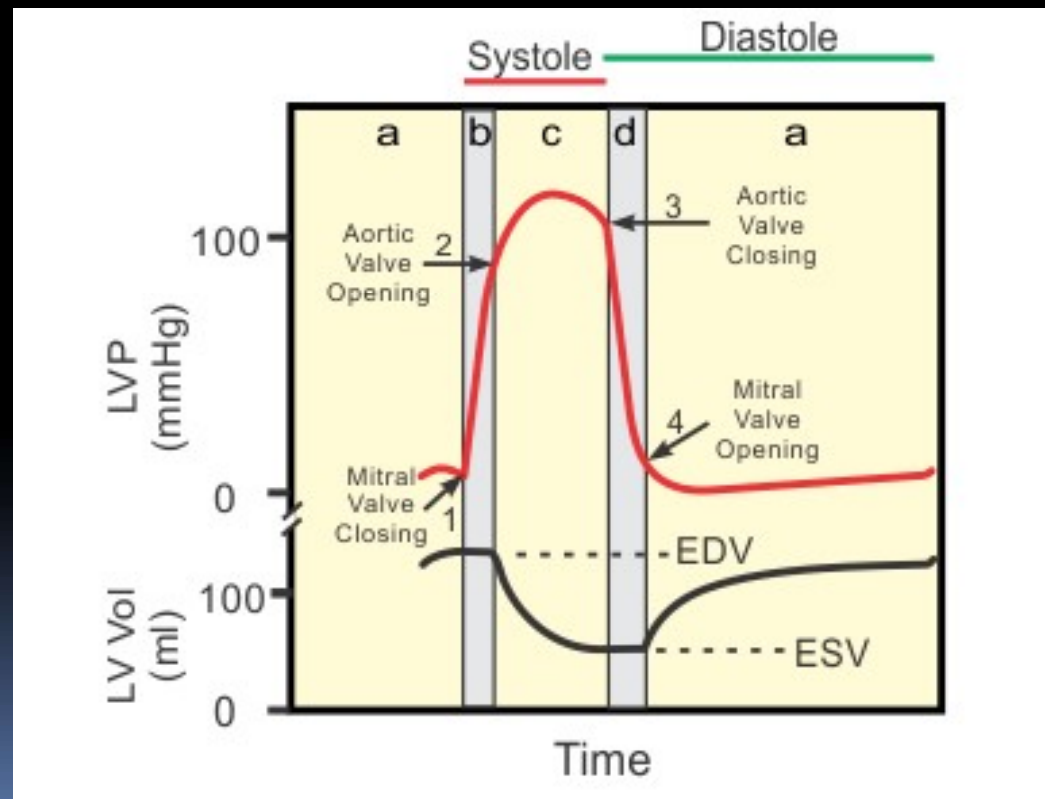
Η συστολή της αρ κοιλίας εξασφαλίζει ροή και πίεση στην συστηματική κυκλοφορία
Η συστολή της δεξιάς κοιλίας εξασφαλίζει ροή και πίεση στην πνευμονική κυκλοφορία





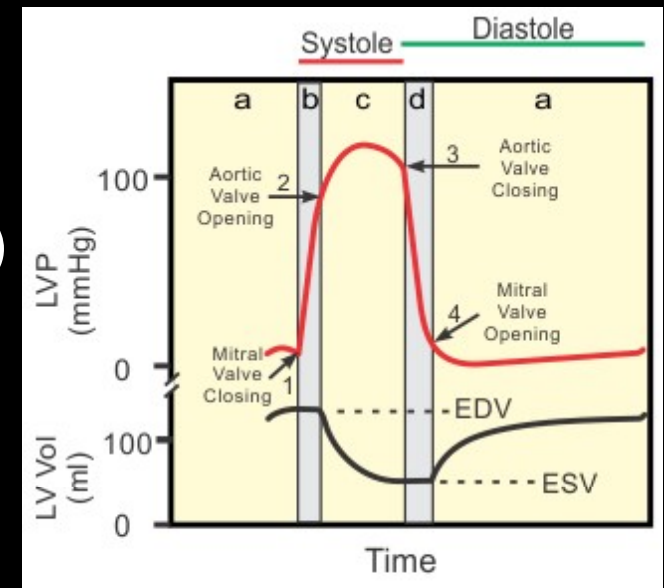
Systole

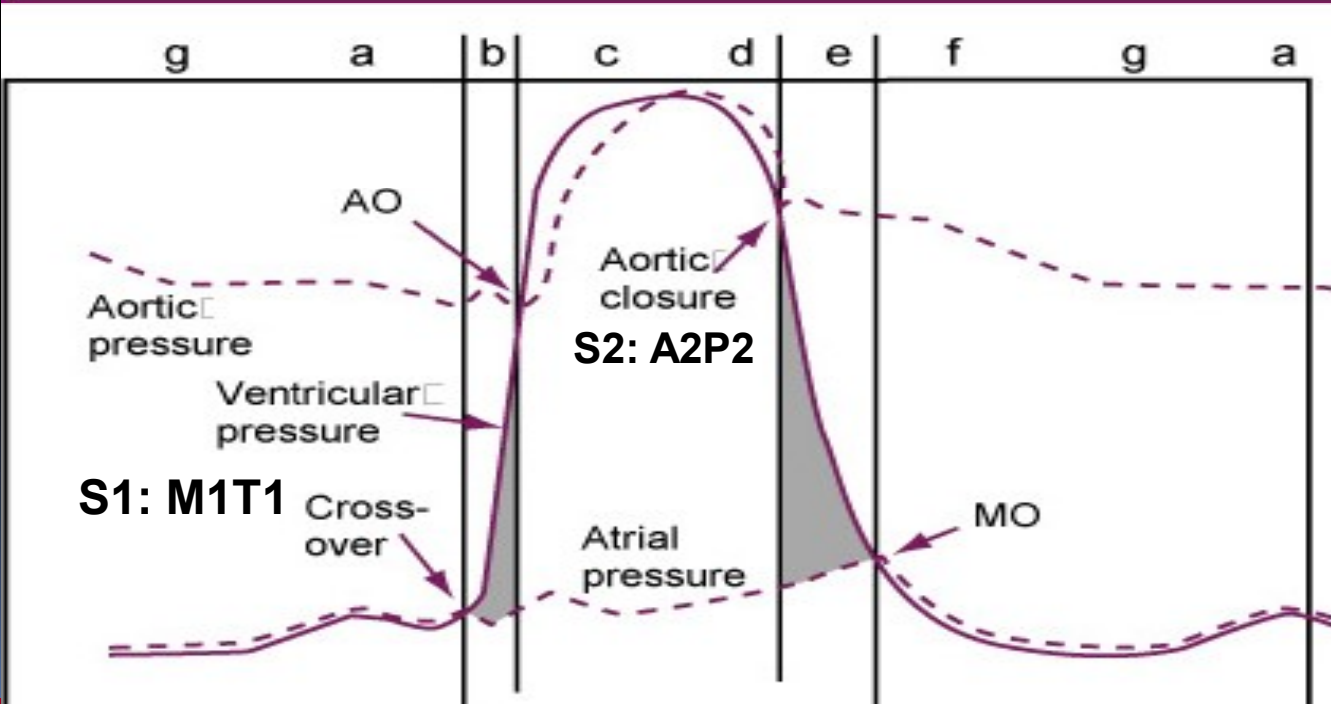
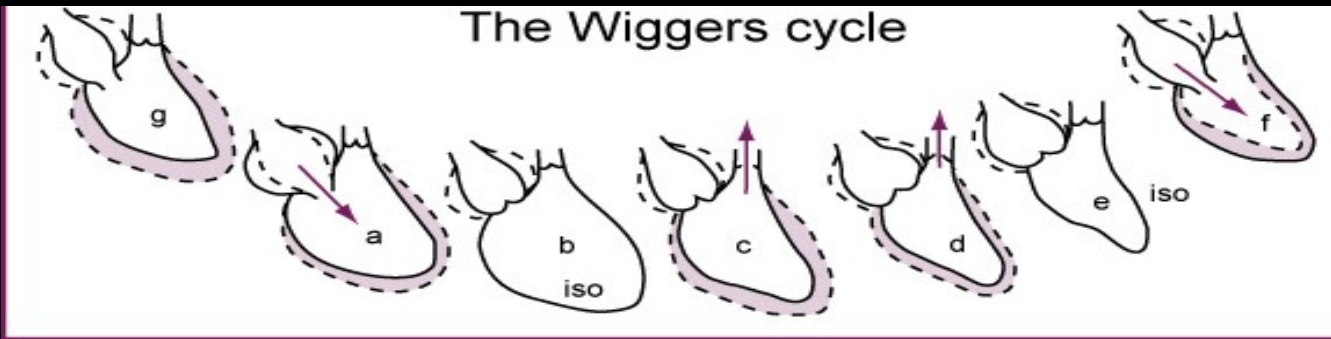
- Ισο-ογκωτική συστολή (b) → S1 (M1 + T1)
- Εξώθηση (c)

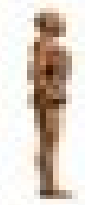


Diastole

- Ισο-ογκωτική χάλαση → S2 (A2 + P2)
- Ταχεία πλήρωση (Πρωτοδιαστολή)
- Διάσταση
- Κολπική συστολή (Τελοδιαστολή, ή Προσυστολή)







S1

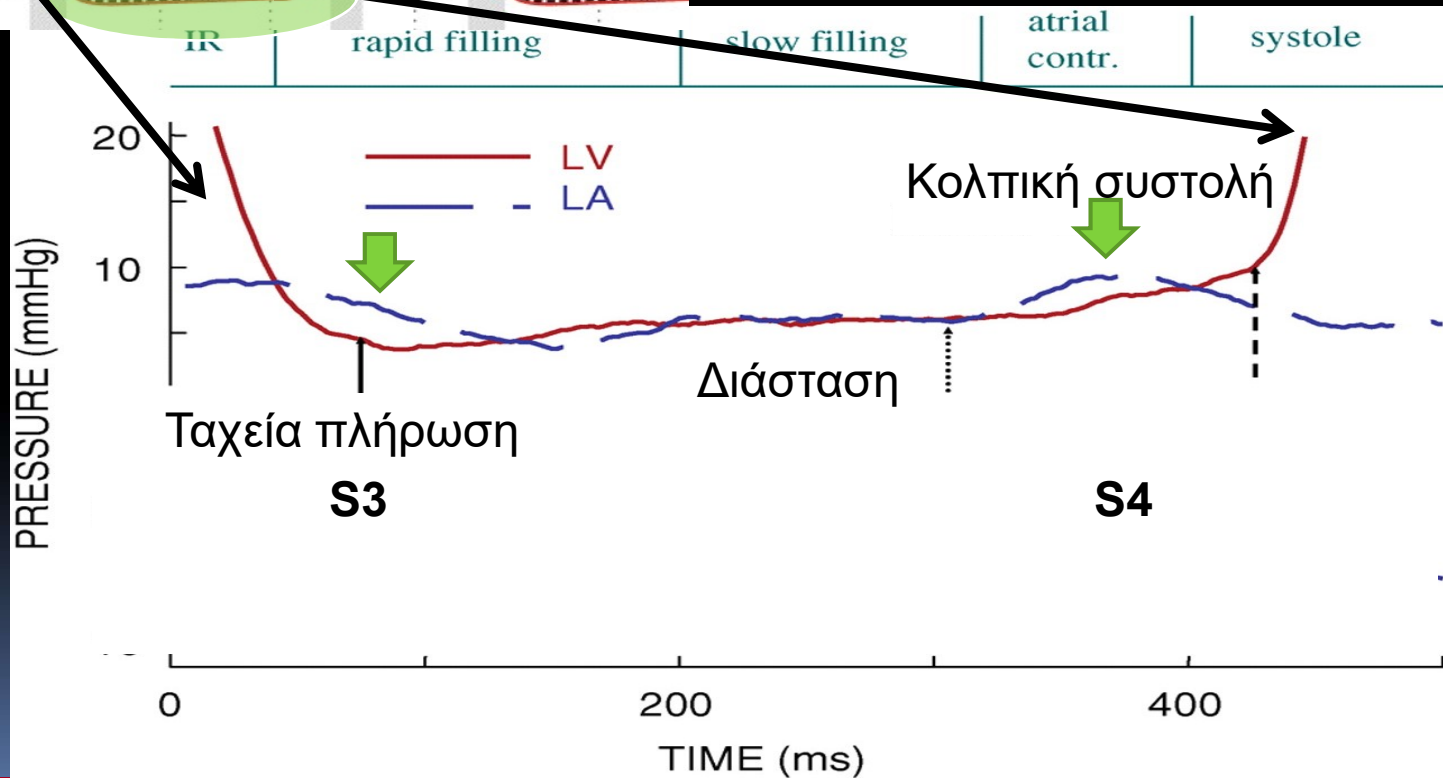
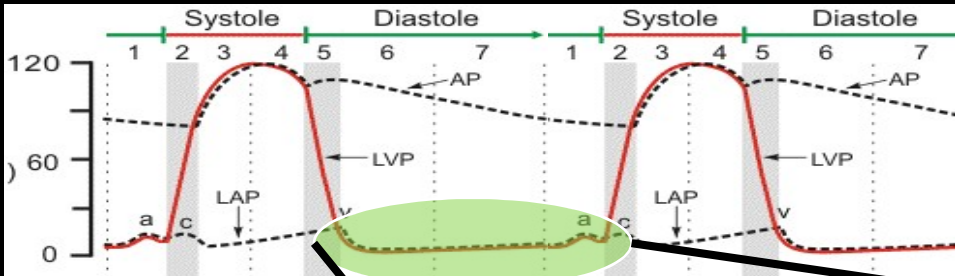


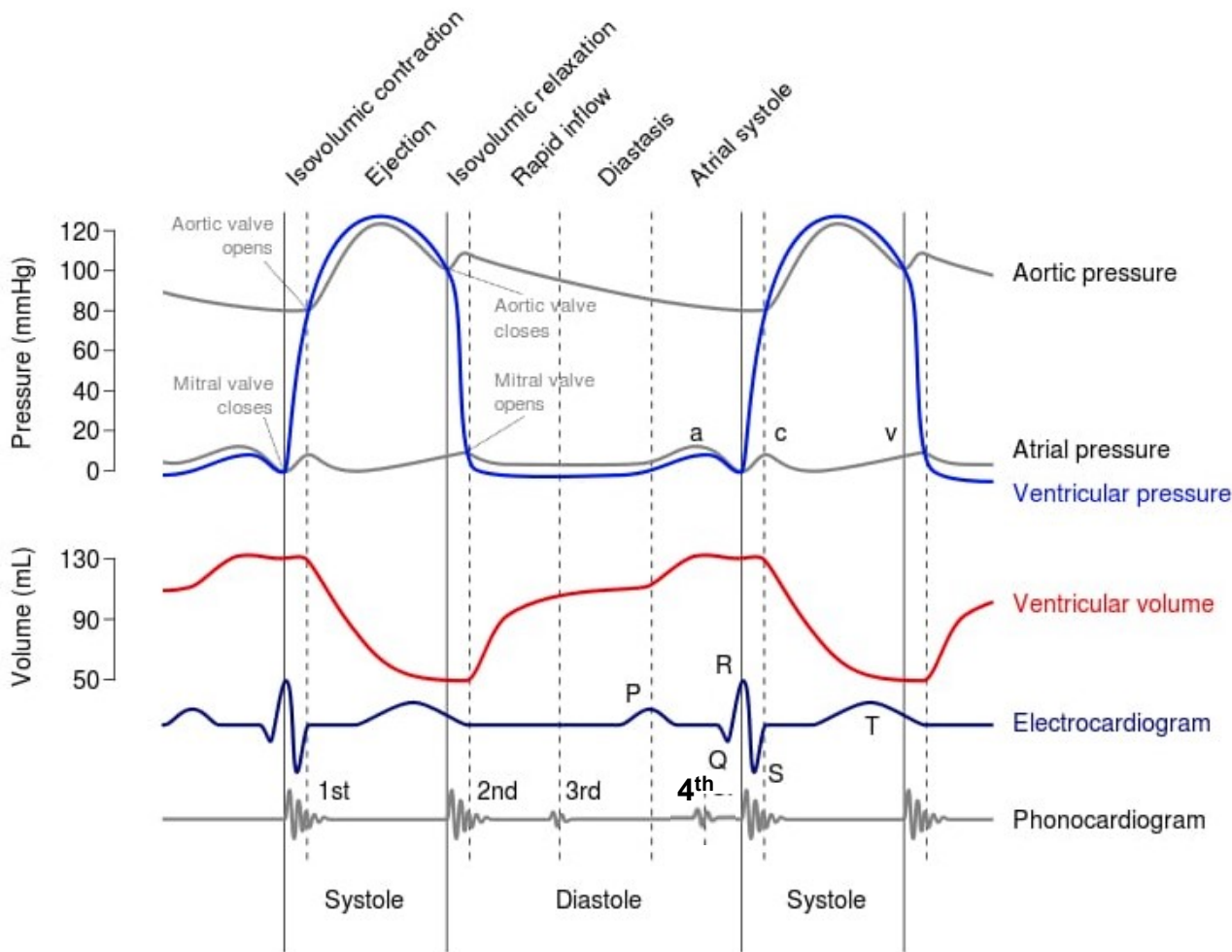
S2



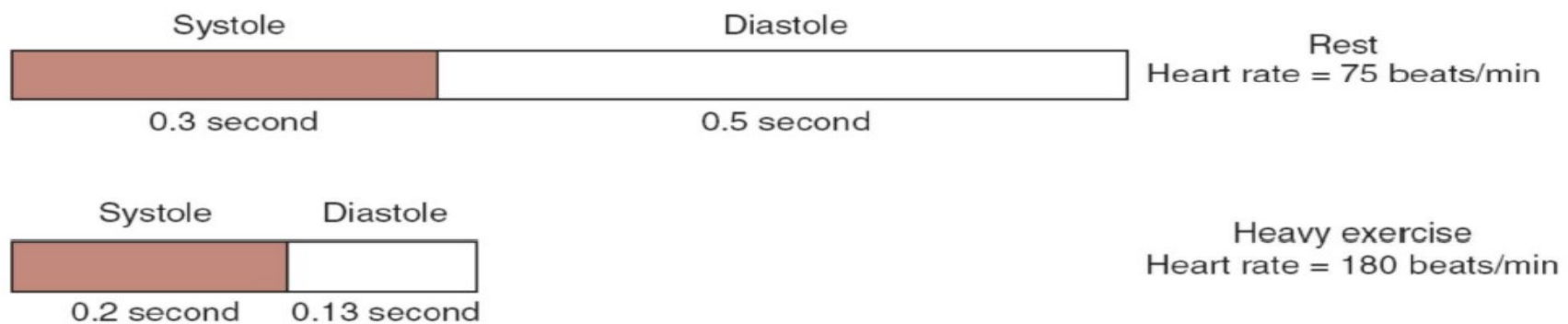
S1





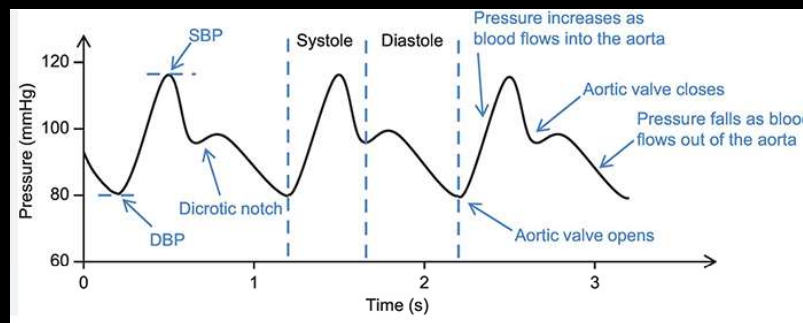


The Cardiac Cycle at Rest and During Exercise



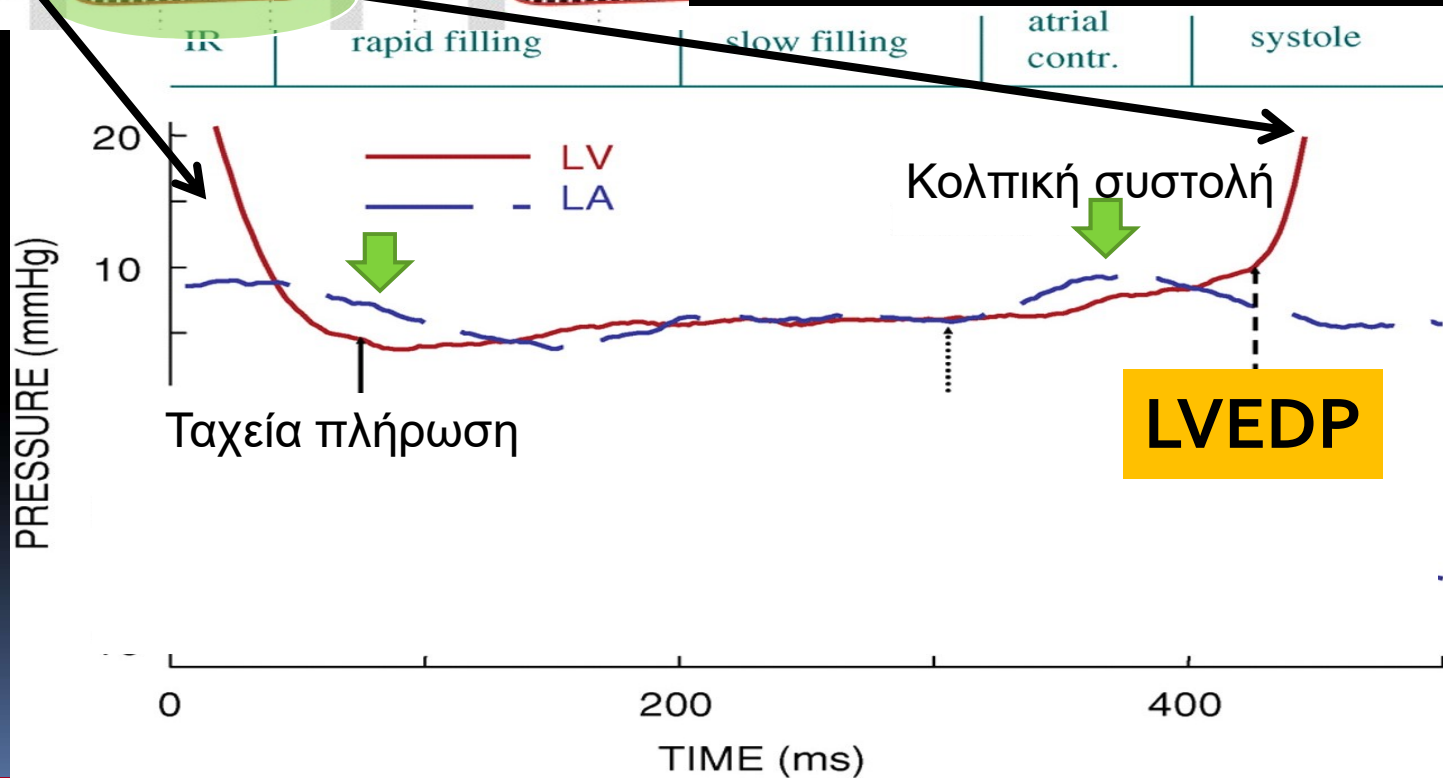
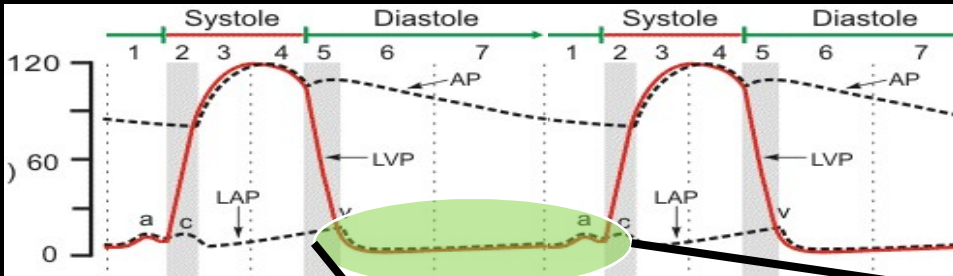
Pressures...

- Pressure anywhere in the CV system has **Systolic and Diastolic** component...



- E.g. LVP = 120/12 mmHg, Aorta = 120/80 mmHg, PA = 35/8 mmHg
- Mean Aortic Pressure (MAP)** = $(SBP + 2DBP)/3$
- Whenever we refer to pressure we should define if we mean systolic, diastolic, or mean...





LVEDP: LV END DIASTOLIC PRESSURE

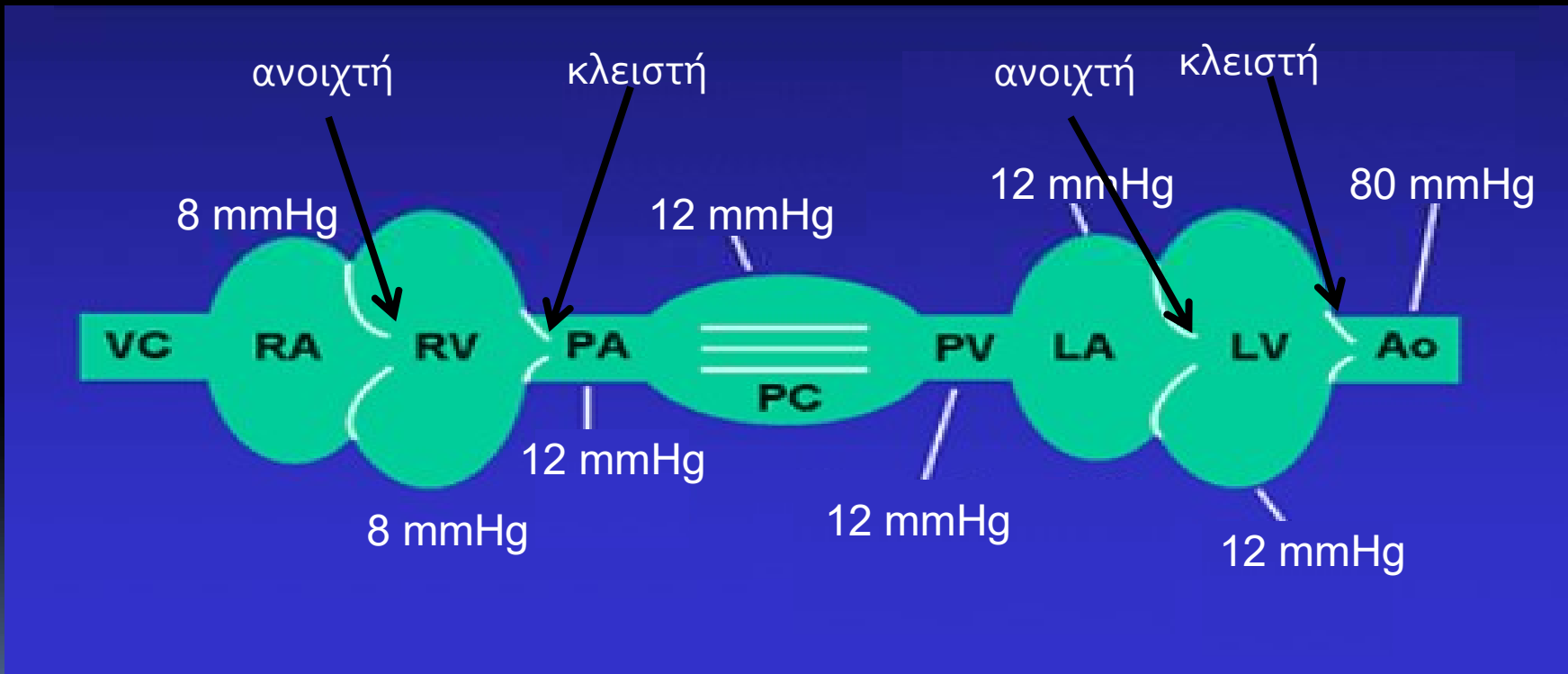
ΕΛΕΓΧΟΣ ΤΗΣ ΕΠΙΔΕΙΞΗΣ ΤΗΣ ΔΙΑΣΤΟΛΗΣ ΚΑΙ ΤΗΣ ΠΙΕΣΗΣ

- Η σημαντικότερη παράμετρος φυσιολογίας για τη λειτουργία της αριστερής κοιλίας
 - Η πίεση στο τέλος της διαστολής (LVEDP)
- Ανάλογη του τελοδιαστολικού όγκου και της «ενδοτικότητα» των τοιχωμάτων της κοιλίας
- Αντιπροσωπεύει την «προφόρτιση» για την επόμενη συστολή...
- Επειδή η μιτροειδής είναι ανοιχτή, «μεταβιβάζεται» προς τα πίσω (αρ. Κόλπος, πνευμονικές φλέβες, πνευμονικά τριχοειδή)



Η πίεση στη διαστολή...

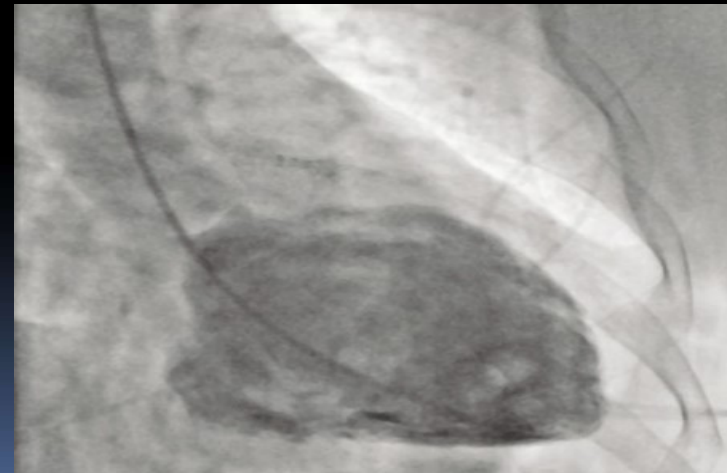
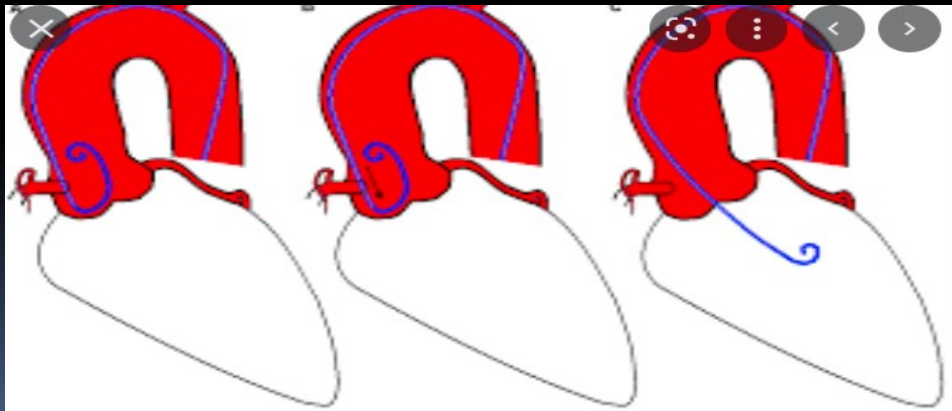
...και οι αιμοδυναμικές...

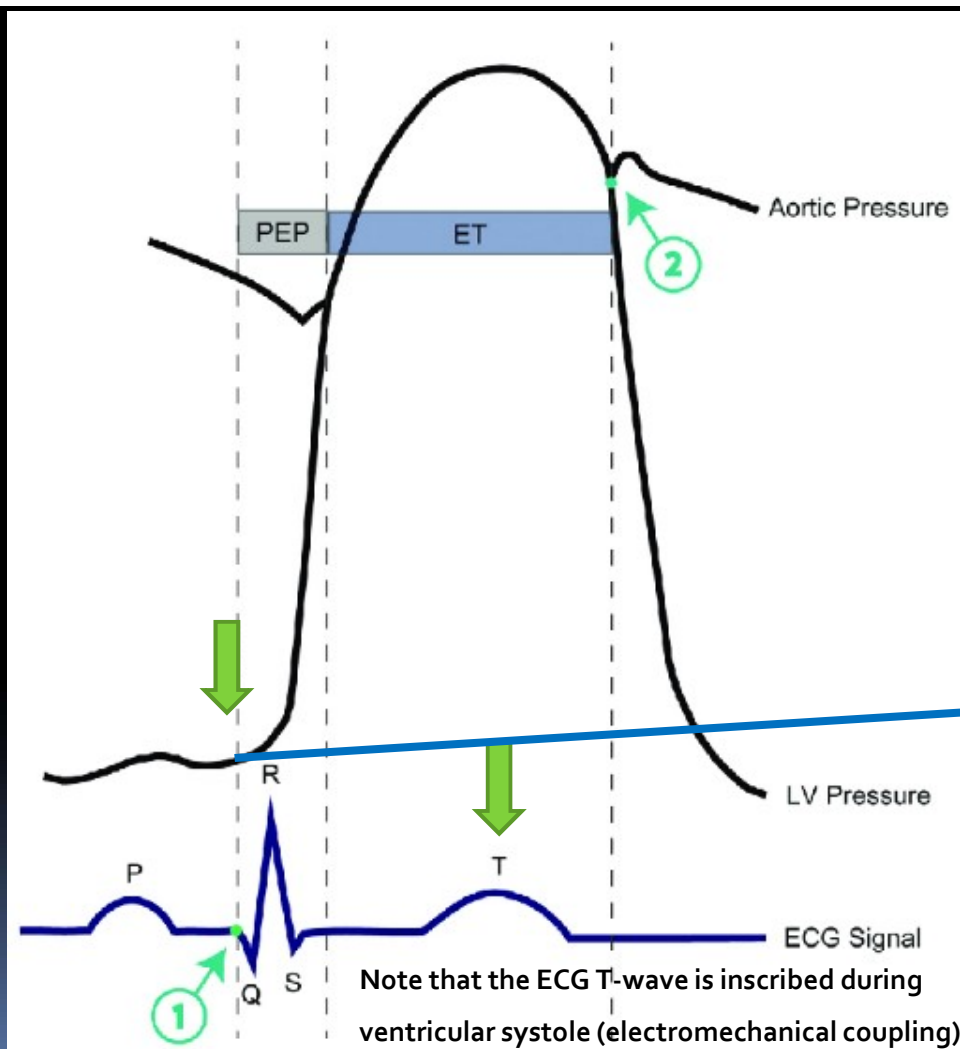


LVEDP: LV END DIASTOLIC PRESSURE

ΠΑΡΕΛΛΗΛΑ ΕΙΣΑΓΩΓΗ ΔΙΔΟΧΕΙΟΥ ΚΑΤΗΤΗΡΑ

- Πως τη μετρούμε
- 1. Καθετήρας εντός της LV (προϋποθέτει τοποθέτηση απο μια αρτηρία – μηριαία, κερκιδική- και προώθηση δια της αορτικής βαλβίδας)

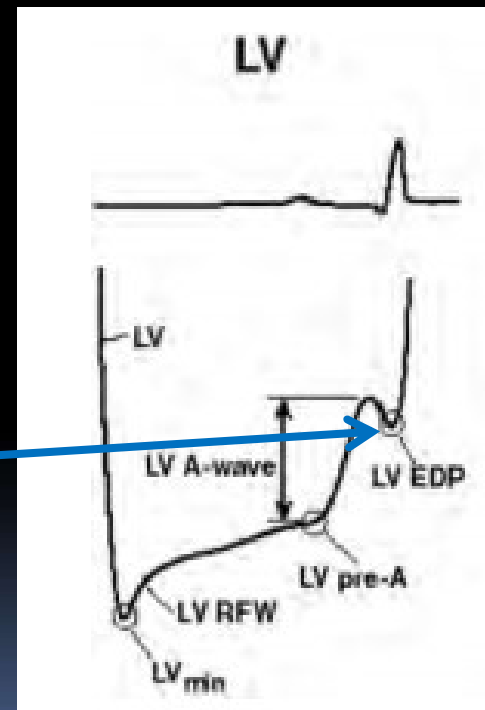




PEP = Pre Ejection Period (Isovolumetric)

ET = Ejection Time, RFW = Rapid Filling Wave

EDP is the pressure just before systole...



2 = Δικροτική Εντομή



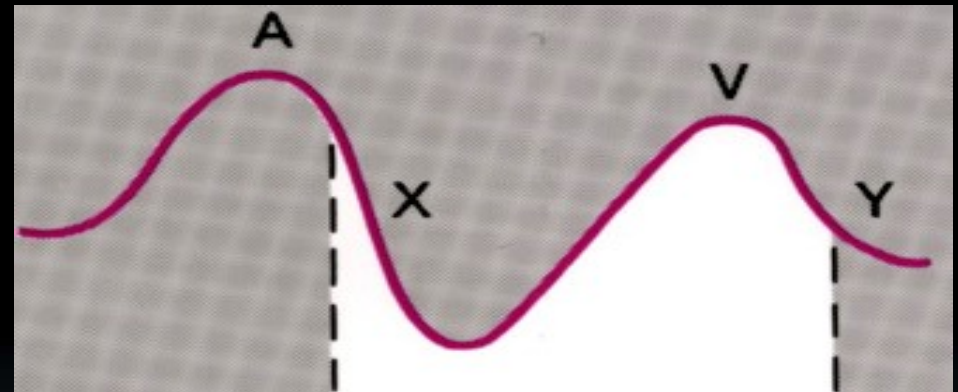
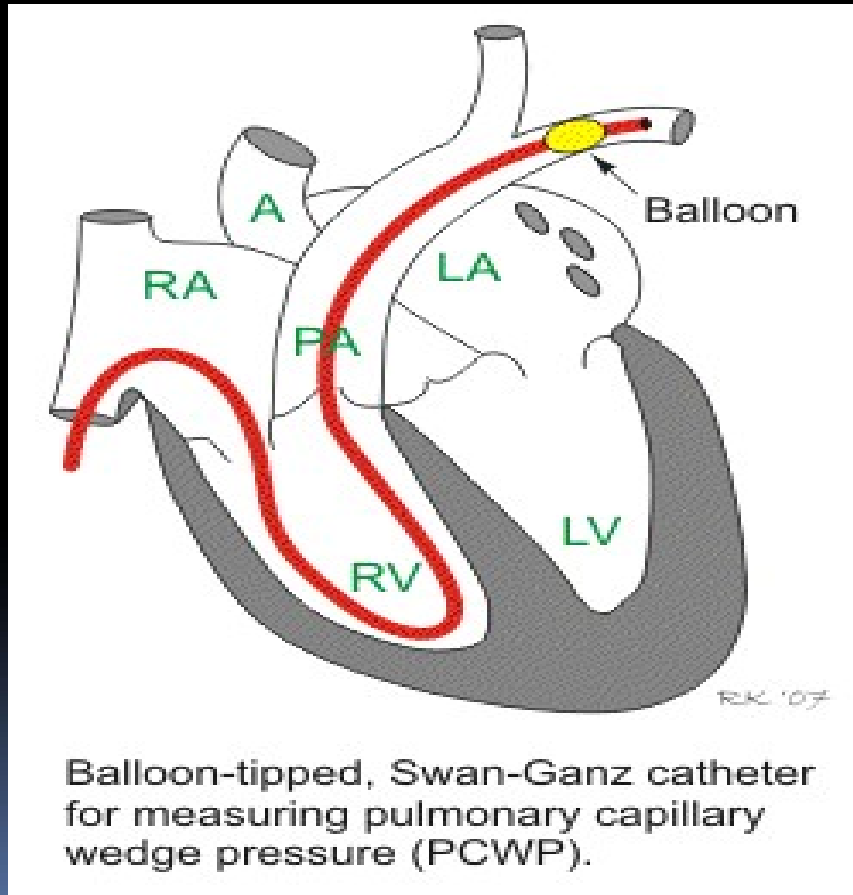
LVEDP: LV END DIASTOLIC PRESSURE

ΕΛΛΗΝΙΚΗ ΕΠΙΣΤΗΜΟΛΟΓΙΑ ΚΑΡΔΙΟΛΟΓΙΑΣ

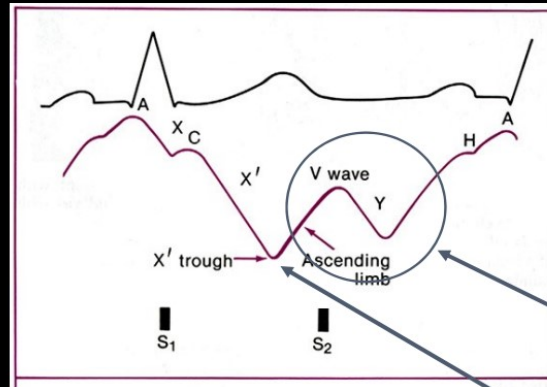
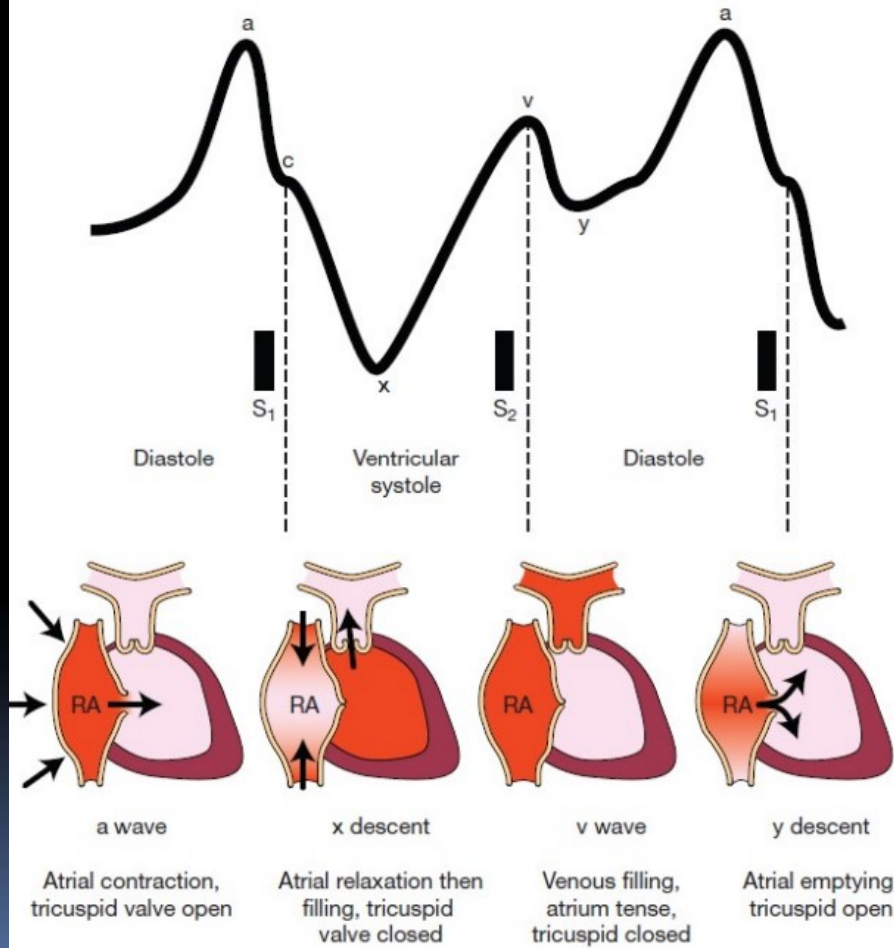
- Πως τη μετρούμε
- 2. «Εκμεταλευόμενοι» το γεγονός ότι ισούται (στη διαστολή) με την κοιλιακή πίεση, την πίεση των πνευμονικών φλεβών και την πίεση των πνευμονικών τριχοειδών → Πίεση ενσφήνωσης πνευμονικών τριχοειδών (Pulmonary Capillary Wedge Pressure-PCWP). Εισαγωγή καθετήρα Swan Ganz απο φλέβα (μηριαία, υποκλείδιο, έσω σφαγίτιδα)...



Right Heart Catheterization and PCWP...



Jugular Venous Pulsations



a wave: Κολπική συστολή

x, x' descent: Κολπική
χάλαση, Κοιλιακή συστολή

c wave: Καρωτιδικός σφυγμός
πιέζει τη σφαγίτιδα

V & Y μικρού εύρους
(RA distensibility)

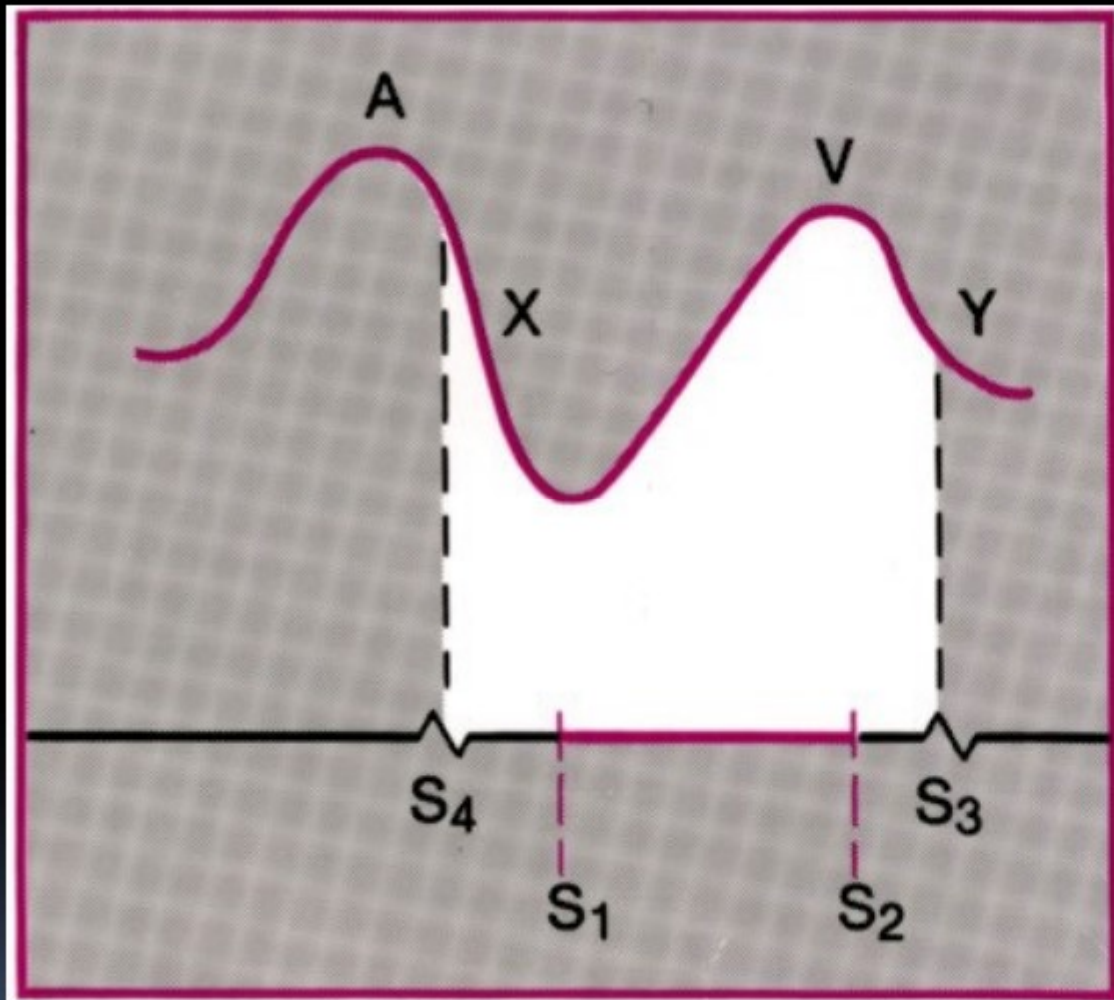
v wave: Κολπική πλήρωση – κοιλιακή συστολή

y descent: Ταχεία κοιλιακή πλήρωση

H wave: Διάσταση

X' deeper than Y (↑
φλεβική ροή στη
συστολή)





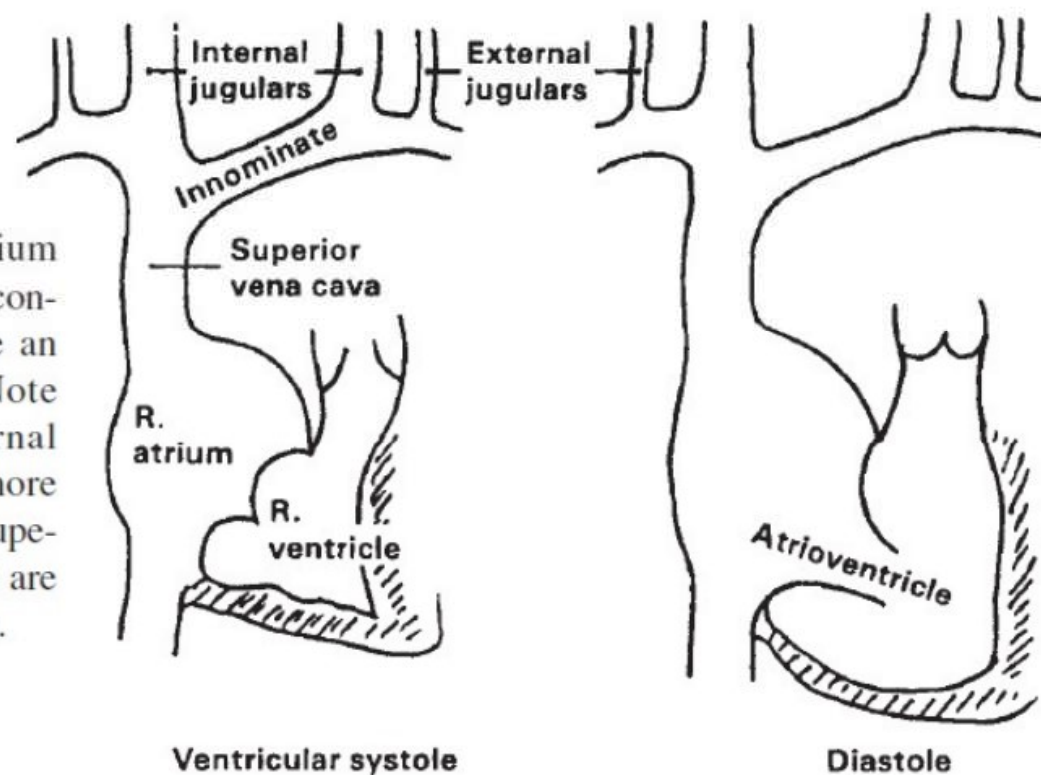
The fourth heart sound (S4) coincides with the phase of ventricular filling following atrial contraction.

The third heart sound (S3) coincides with the y descent (the phase of rapid ventricular filling).

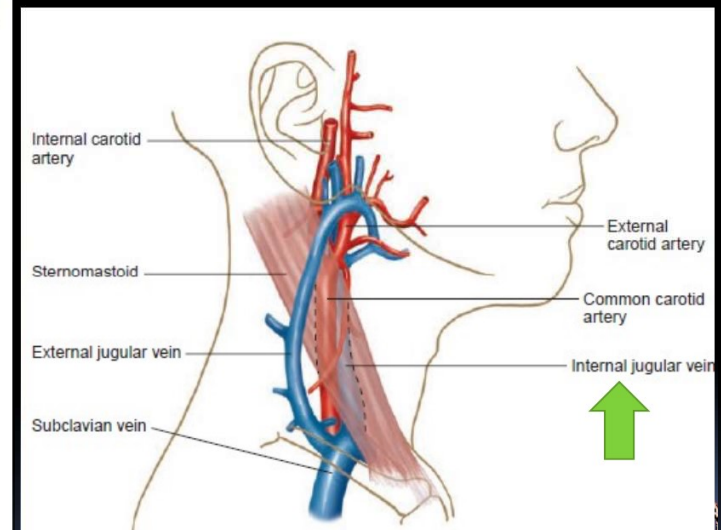
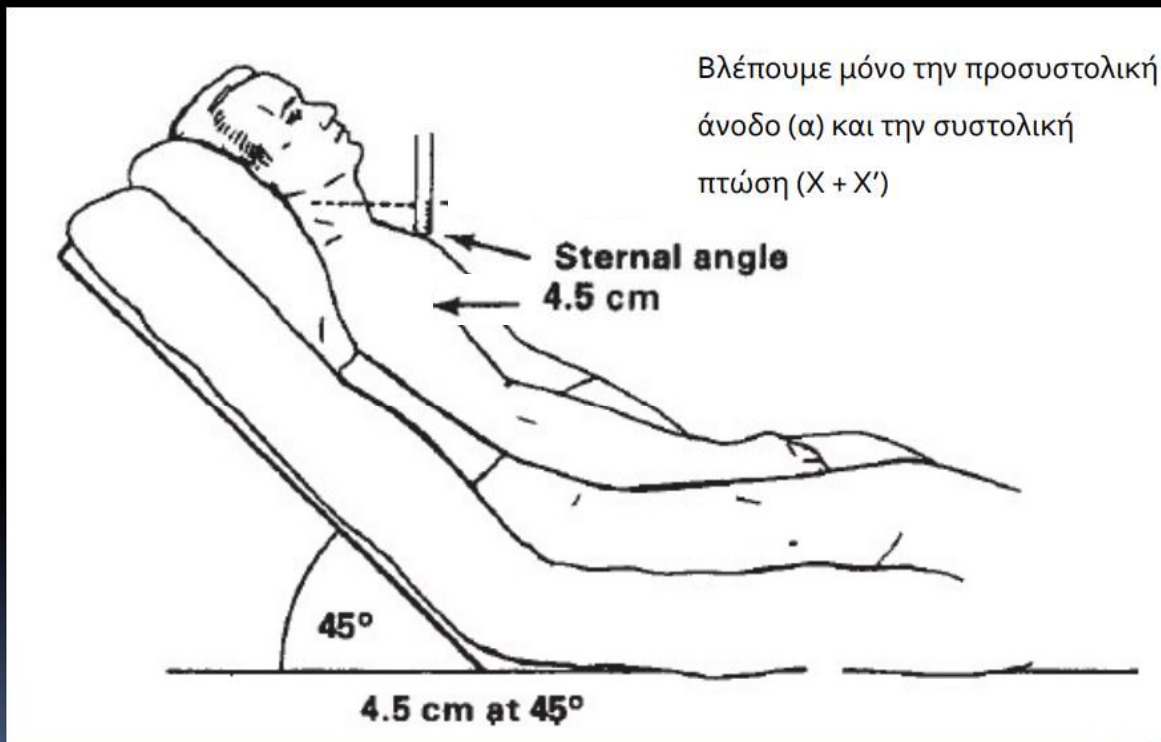
Προσδιορισμός JVP με Φυσική Εξέταση

υποστηρικτικό υλικό της φυσικής εξέτασης

In diastole, the atrium and ventricle are in continuity and become an “atrioventricle.” Note also that the internal jugulars are in a more direct line with the superior vena cava than are the external jugulars.



Προσδιορισμός JVP με Φυσική Εξέταση



Σφαγιτιδικός σφυγμός

- Ασθενής ύπτιος με τη ράχη στις 45°
- Εφαπτόμενη πηγή φωτός
- Αναζητήστε ταχεία, διπλή (ενίοτε τριπλή) κυματομορφή με κάθε καρδιακό κύκλο
 - Ελαφρά πίεση πάνω από την κλείδα: Αν οι κυματομορφές δεν εξαφανίζονται, πρόκειται για τις καρωτίδες...



Central Venous Pressure

- Venous pressure is a term that represents the average blood pressure within the venous compartment.
- The term "**central venous pressure**" (CVP) describes the pressure in the thoracic vena cava near the right atrium
 - therefore CVP and right atrial pressure are essentially the same

- CVP is a major determinant of the filling pressure and therefore the preload of the right ventricle, which regulates stroke volume



Central Venous Pressure

\approx
Right Atrial Pressure

(is a reflection of)

RAP *relates with*

Right Ventricular End
Diastolic Pressure

RVEDP *relates with*

Right Ventricular End
Diastolic Volume

CVP

does **NOT** measure
directly any variable

RVEDV *relates with*

preload



- Factors increasing CVP

Raised intrathoracic pressure

- Eg, IPPV, coughing, expiration in spont ventilation

Circulatory overload; Venoconstriction

Impaired cardiac function

- Eg, outlet obstruction, cardiac failure, cardiac tamponade

Superior vena cava obstruction



Central Venous Pressure

- Factors decreasing CVP

Reduced intrathoracic pressure

- Eg, inspiration in spont ventilation

Hypovolemia

Venodilatation

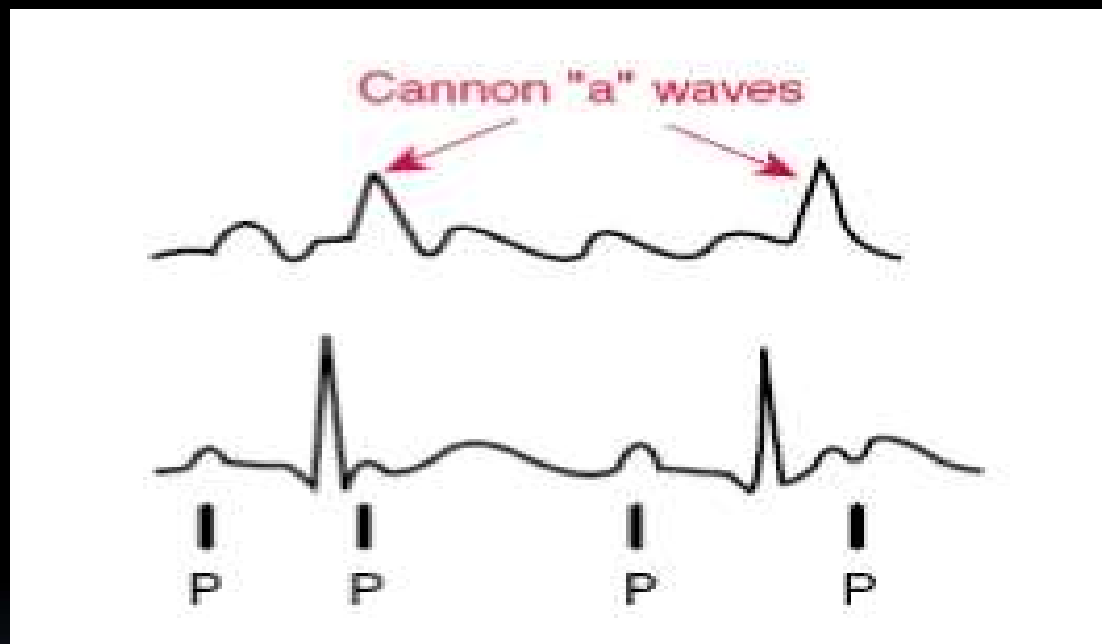
- Eg, septic shock



Abnormalities of the a-wave

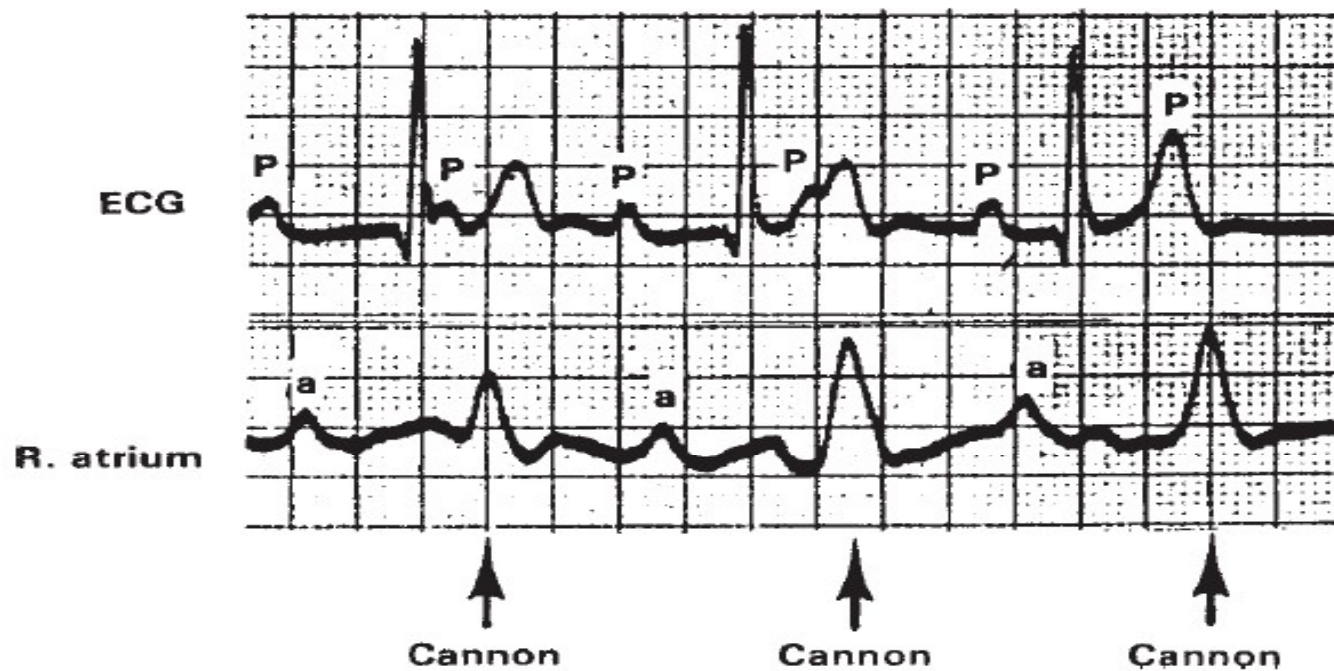
- **Prominent a waves occur in increased resistance to right atrial contraction, as in:**
 - *Tricuspid stenosis*
 - *Pulmonic stenosis*
 - *Pulmonary hypertension*
 - AV-dissociation...
 - **3rd-degree atrioventricular block (cannon waves)**
 - Supraventricular tachycardia
 - Junctional rhythms
- **Absent a waves occur in atrial fibrillation...**





- Cannon a wave: AV dissociation

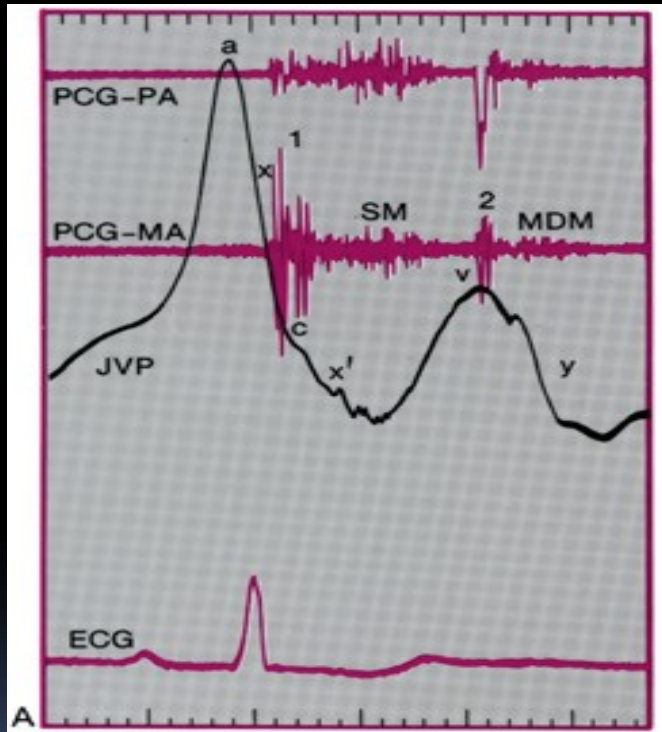




Note that in this patient with complete atrioventricular block, every other P wave happens to fall on a T wave, i.e., it occurs during ventricular systole when the tricuspid valve is closed. Thus, there is a cannon A wave with every other P wave.





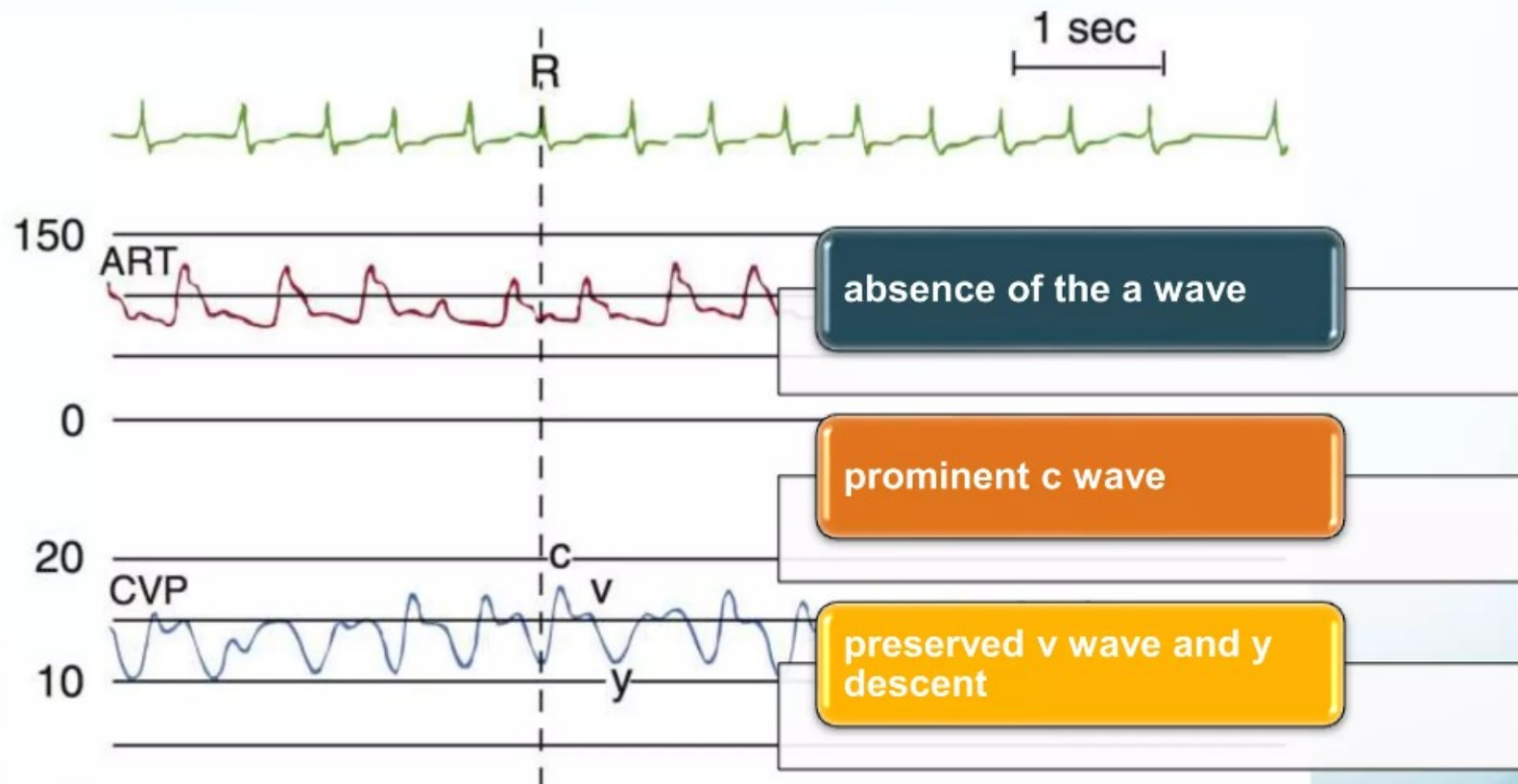


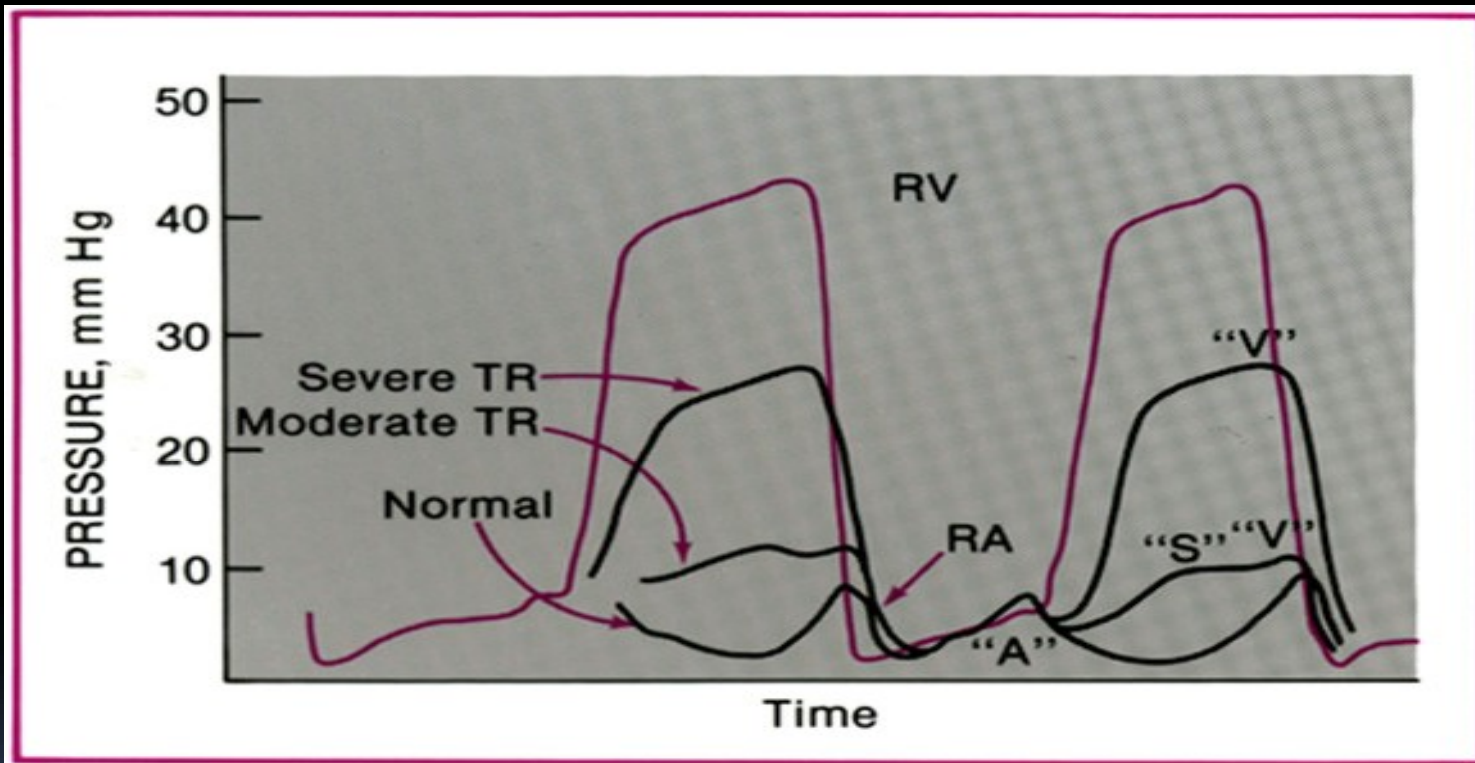
- **a wave:** Ενισχυμένο όταν υπάρχει αντίσταση στην κοιλιακή συστολή (RVH, PHT, TS)
- **RV failure & SR:** Ενίσχυση α & υ

MS + PHT: ↑↑ α λόγω ↓ ενδοτικότητας RV



CVP – Atrial fibrillation





JVP in TR



Σφαγιτιδικός σφυγμός

εφελιασικός οφθαλμός

- **Ενισχυμένο v ή $c-v$:** TR, συστολική κίνηση του λοβού του αυτιού και ενίοτε δεξιά προς τα αριστερά κίνηση της κεφαλής με κάθε συστολή.



Video 1

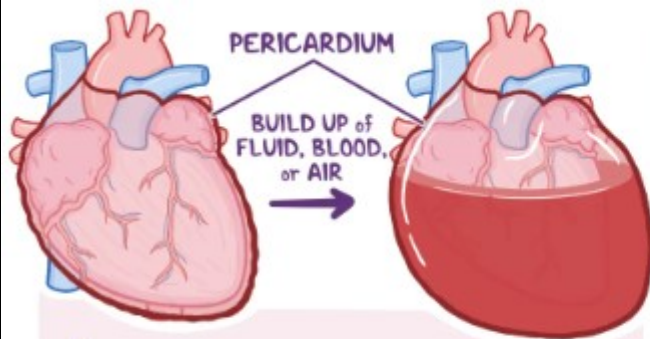


Σφαγιτιδικός σφυγμός

παθολογικός σφολιγός

- **x descent:** ενίσχυση σε ασθενείς με \uparrow α ή φόρτιση όγκου RV (ASD => Ενισχυμένα επίσης ν & γ), μείωση σε ασθενείς με RV failure ή Af
- **y descent:** βραδεία όταν υπάρχει αντίσταση (TS), ταχεία όταν υπάρχει απρόσκοπτη ροή (TR)....

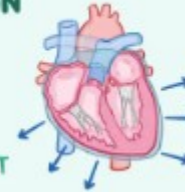




⚠️ **CONSIDERED a MEDICAL EMERGENCY**
 CAN PROGRESS to CIRCULATORY SHOCK and CARDIAC ARREST

PERICARDIAL EFFUSION

- PERICARDIAL FLUID BUILDS up SLOWLY OVER TIME
- ↳ ALLOWS PERICARDIUM to STRETCH OUT to ACCOMMODATE BIGGER VOLUMES of FLUID w/o COMPRESSING HEART



SYMPTOMS



CHEST PAIN



SHORTNESS of BREATH



COMPRESSION of NEAR STRUCTURES

LOW BLOOD PRESSURE



BECK'S TRIAD



DISTENSION of JUGULAR VEINS



MUFFLED HEART SOUNDS

ACUTE PERICARDIAL TAMPONADE

- SUDDEN FLUID ACCUMULATION
- PERICARDIUM CANNOT ADJUST
- ↳ DRAMATIC INCREASE in PRESSURE INSIDE PERICARDIAL SAC

CAUSES



CHEST TRAUMA



RUPTURED AORTA

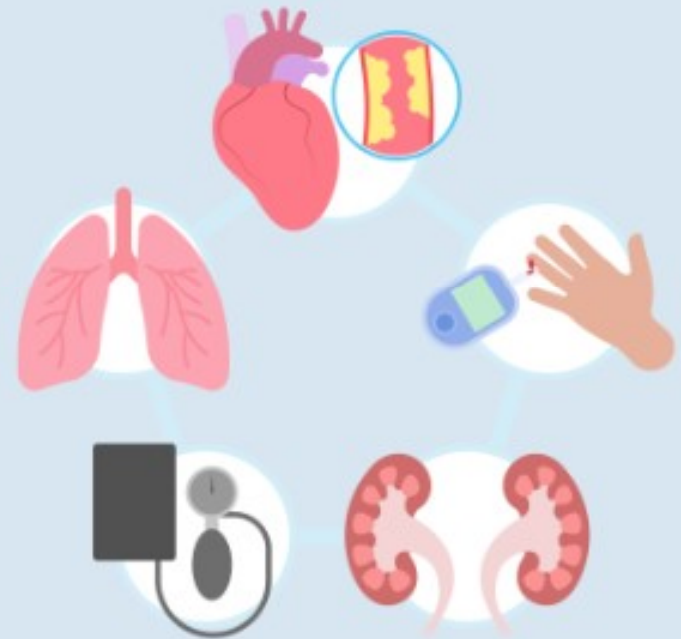


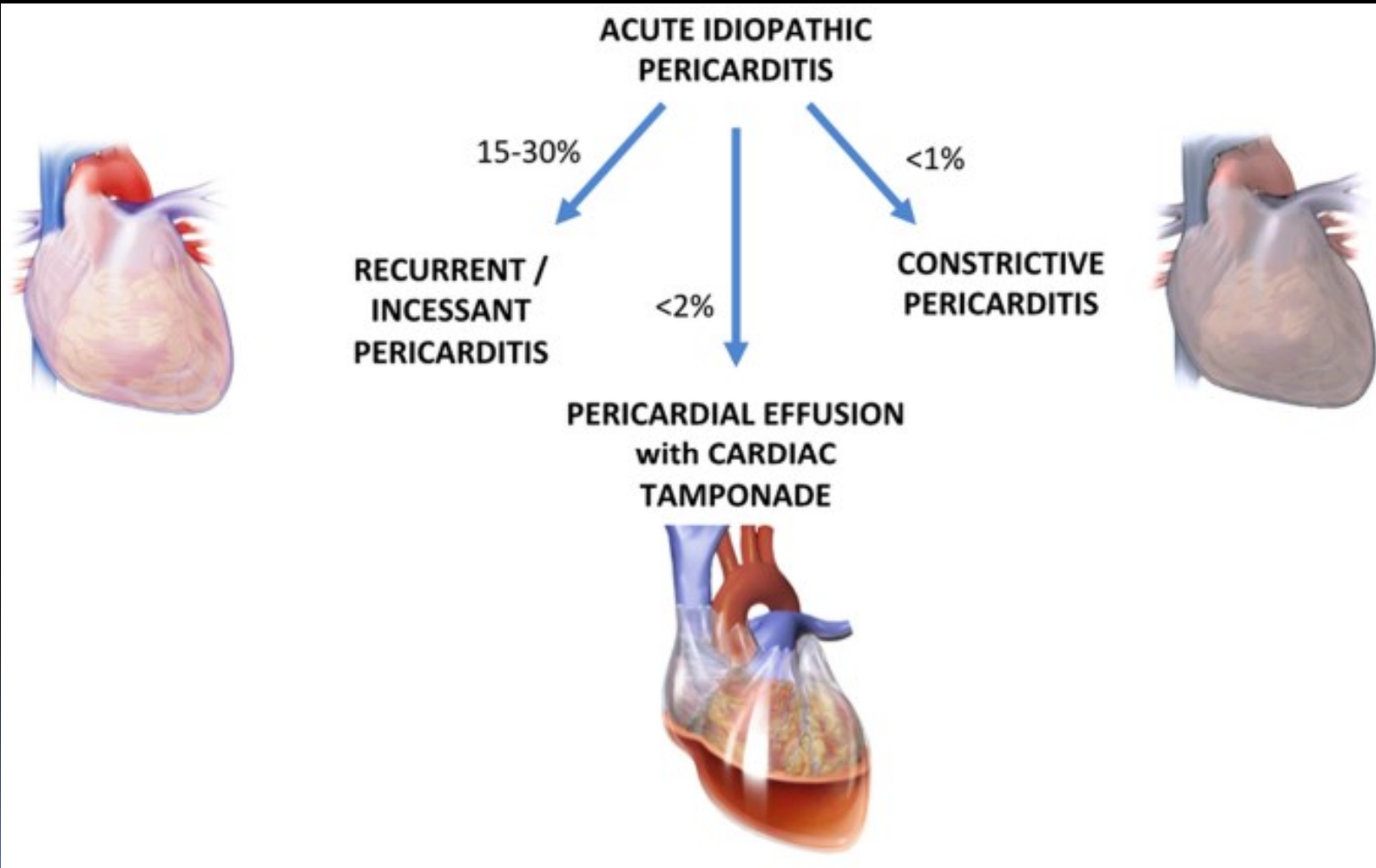
RUPTURED of VENTRICLE AFTER a HEART ATTACK



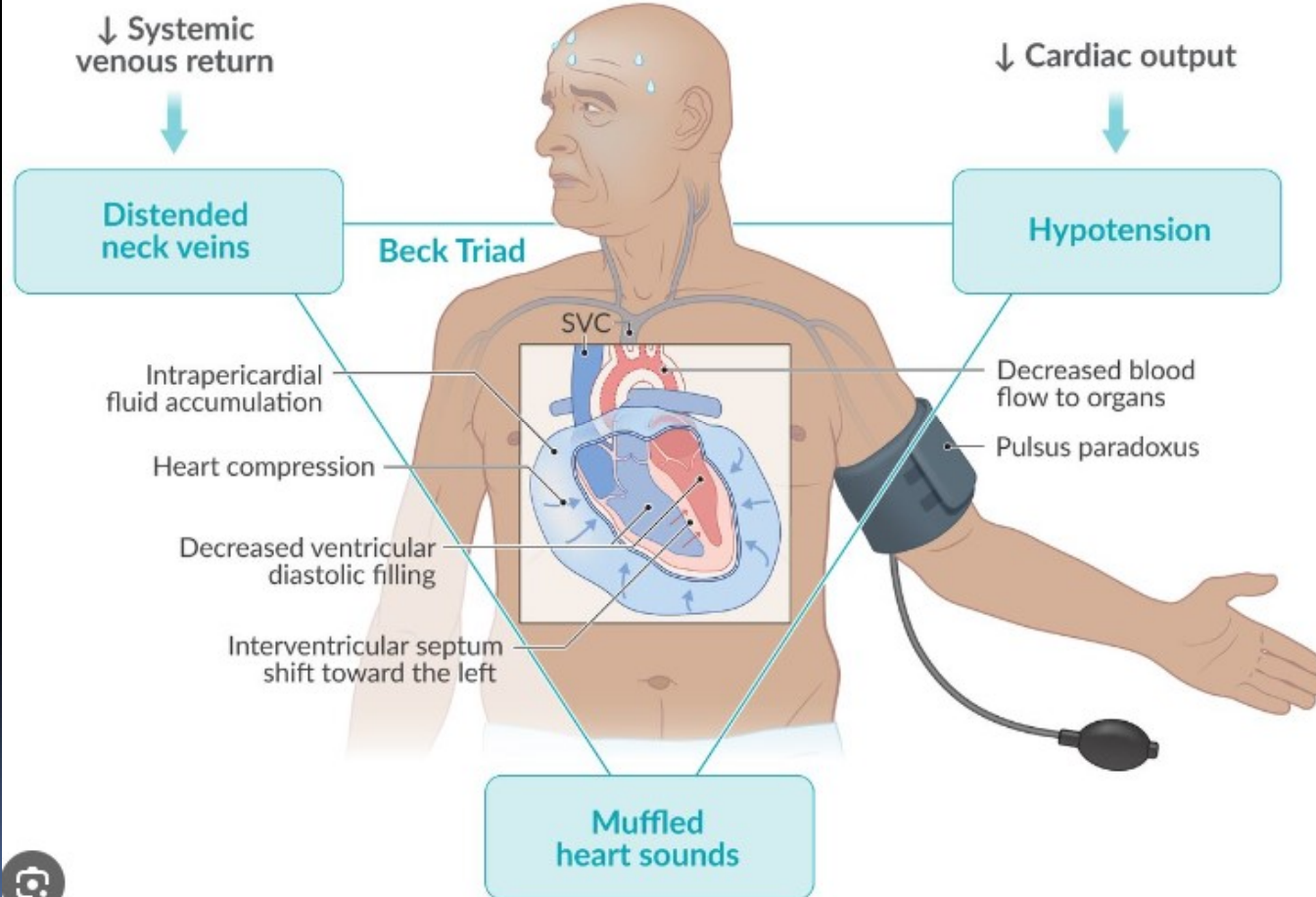
Who is at Risk for Cardiac Tamponade?

- Cancer
- HIV
- A history of heart procedures
- Kidney disease that's in its end stage
- Tuberculosis
- Congestive heart failure
- Autoimmune diseases

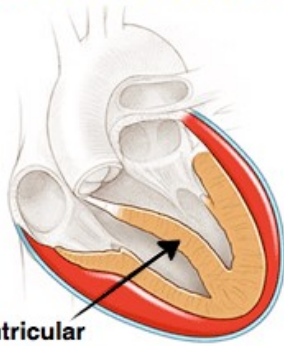




Cardiac tamponade



Cardiac Tamponade



Beck's Triad

- 1 Hypotension
- 2 Jugular venous distension
- 3 Muffled heart sounds

Don't mix up with:

Tension pneumothorax

1. Hypotension
2. Jugular venous distension
3. Absent breath sounds

Cardiac Tamponade - Beck's Triad



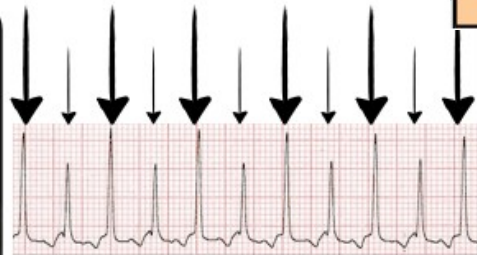
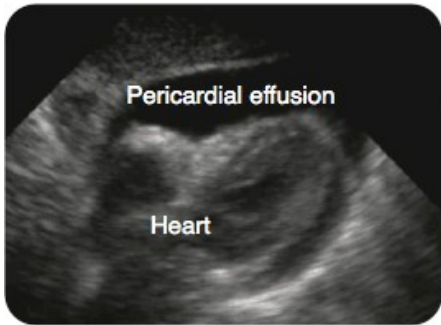
Jugular Venous Distension (JVD)



Muffled or Distant Heart Sounds

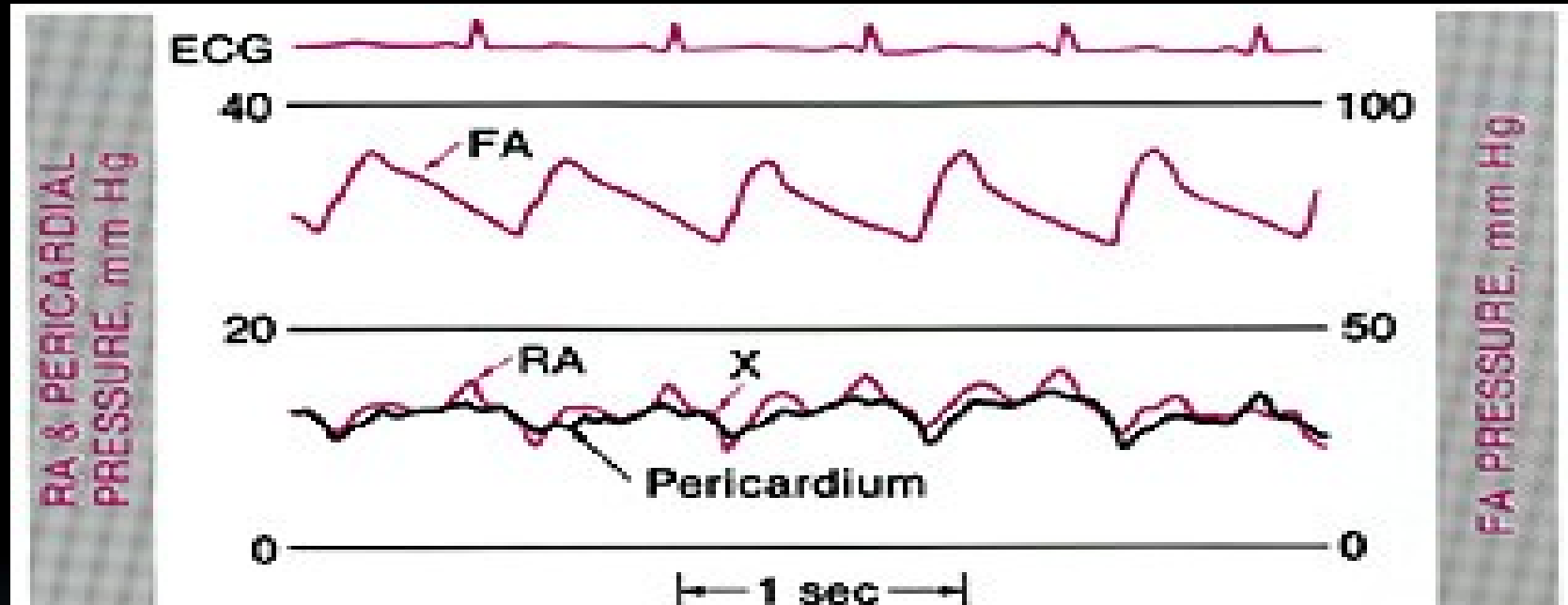


Low Blood Pressure



Electrical Alternans

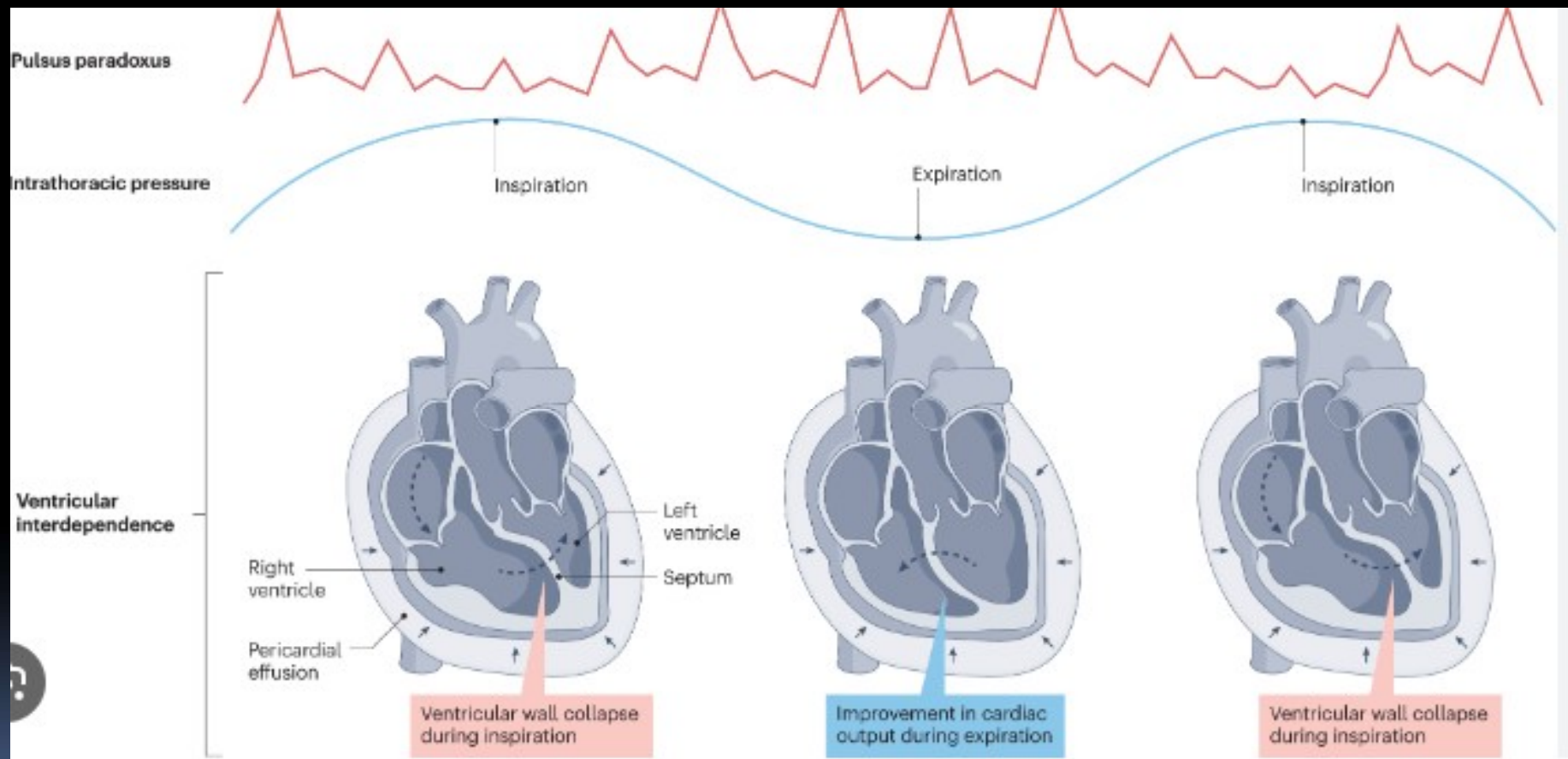




✓ **Tamponade:** Εξίσωση διαστολικών πιέσεων

✓ Εξαφάνιση του Y λόγω περιορισμού στην πλήρωση από την αρχή της διαστολής...





Περιοριστική φυσιολογία...

Περιοριστική φυσιολογία...

- Περιοριστική ΜΚΠ, συμπύεση, έμφραγμα RV, σοβαρή RV ή LV failure
- *Ταχύτατη κάθοδος του γ:* η κοιλία πληρώνεται μόνο στην πρωτοδιαστολή ...
- **Steeply rising H wave:** Μετά την πρωτοδιαστολή η ροή ↓ και η πίεση ↑ ...

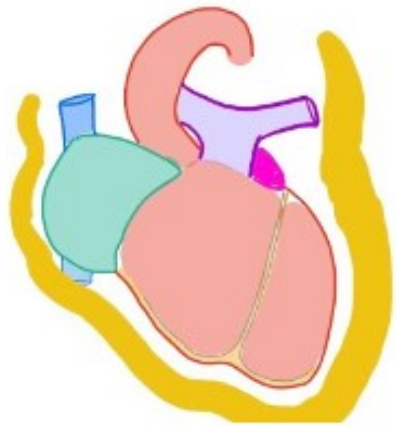


Constrictive Pericarditis

VS

Cardiac Tamponade

Medicosis

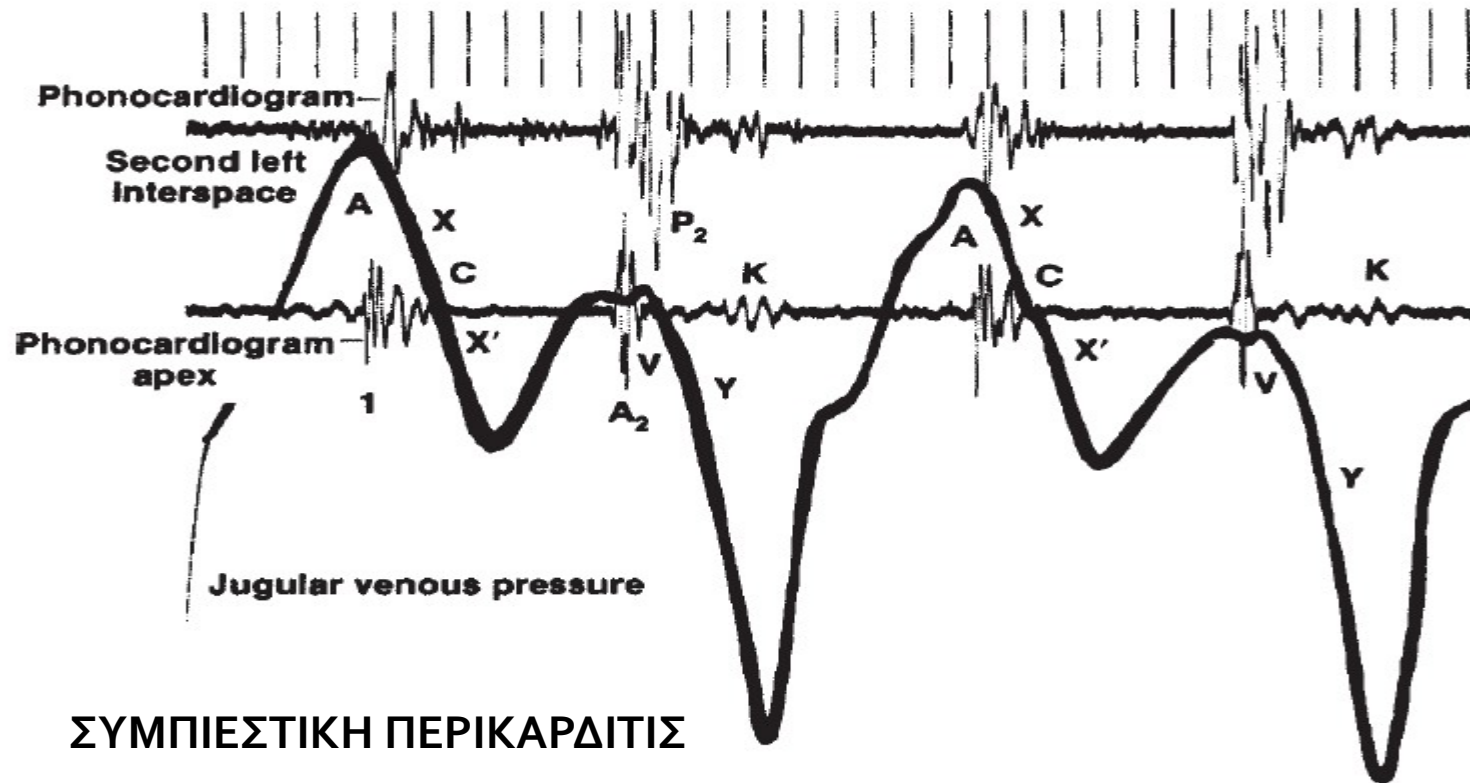


Σφαγιτιδικός σφυγμός

παθολογικός σφολητός

- **Συμπύεση:** Ενισχυμένη ταχεία πλήρωση (y) και ταχεία αύξηση πίεσης σε ένα διαστολικό plateau (H wave) χωρίς ενίσχυση του a . Ενίοτε το x ενισχύεται επίσης π.χ. Effusive-constrictive (κύμα “W”). Στον επιπωματισμό το x είναι πιο έντονο.
- Σημείο Kussmaul...

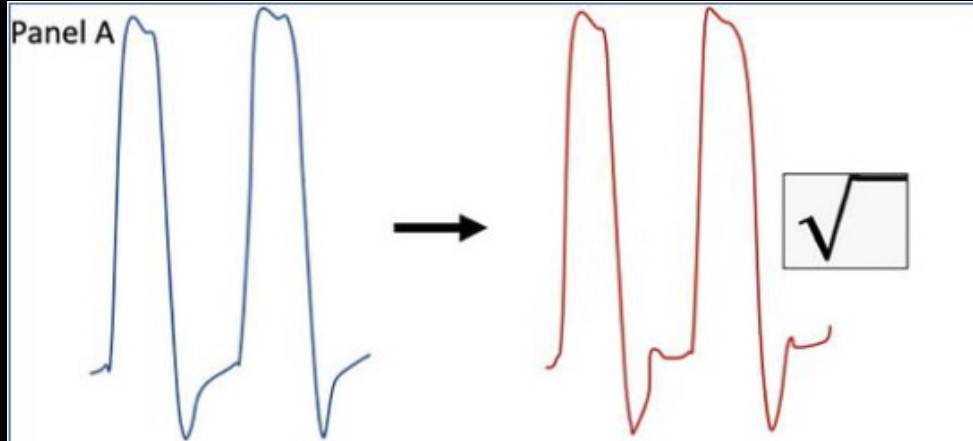




ΣΥΜΠΙΕΣΤΙΚΗ ΠΕΡΙΚΑΡΔΙΤΙΣ

Severe constrictive pericarditis. Shown is a jugular pulse tracing from a patient with severe constrictive pericarditis. Note the double descent with a dominant Y descent and relatively small X' descent. K indicates a pericardial knock sound. (From E. Craige, Heart Sounds. In E. Braunwald [ed.], *Heart Disease* [2nd ed.]. Philadelphia: Saunders, 1984).





Normal LV pressure pattern

Constrictive LV pressure pattern

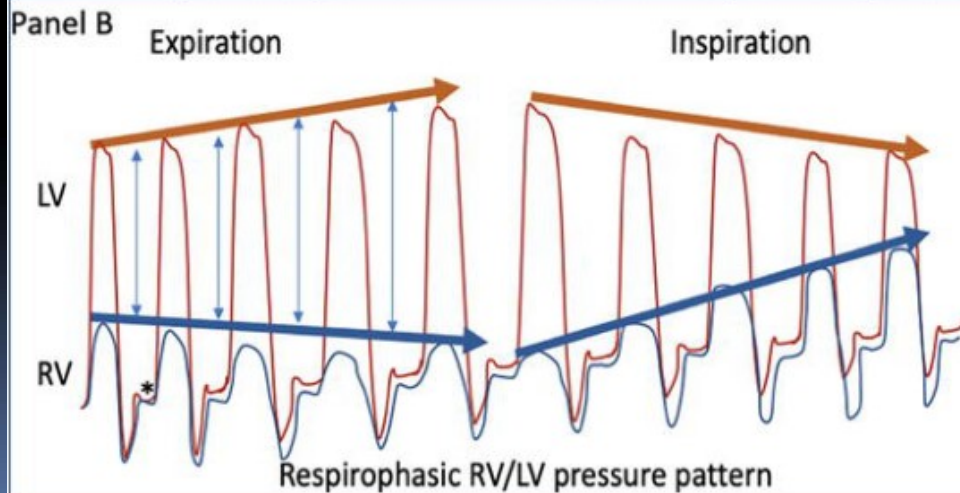
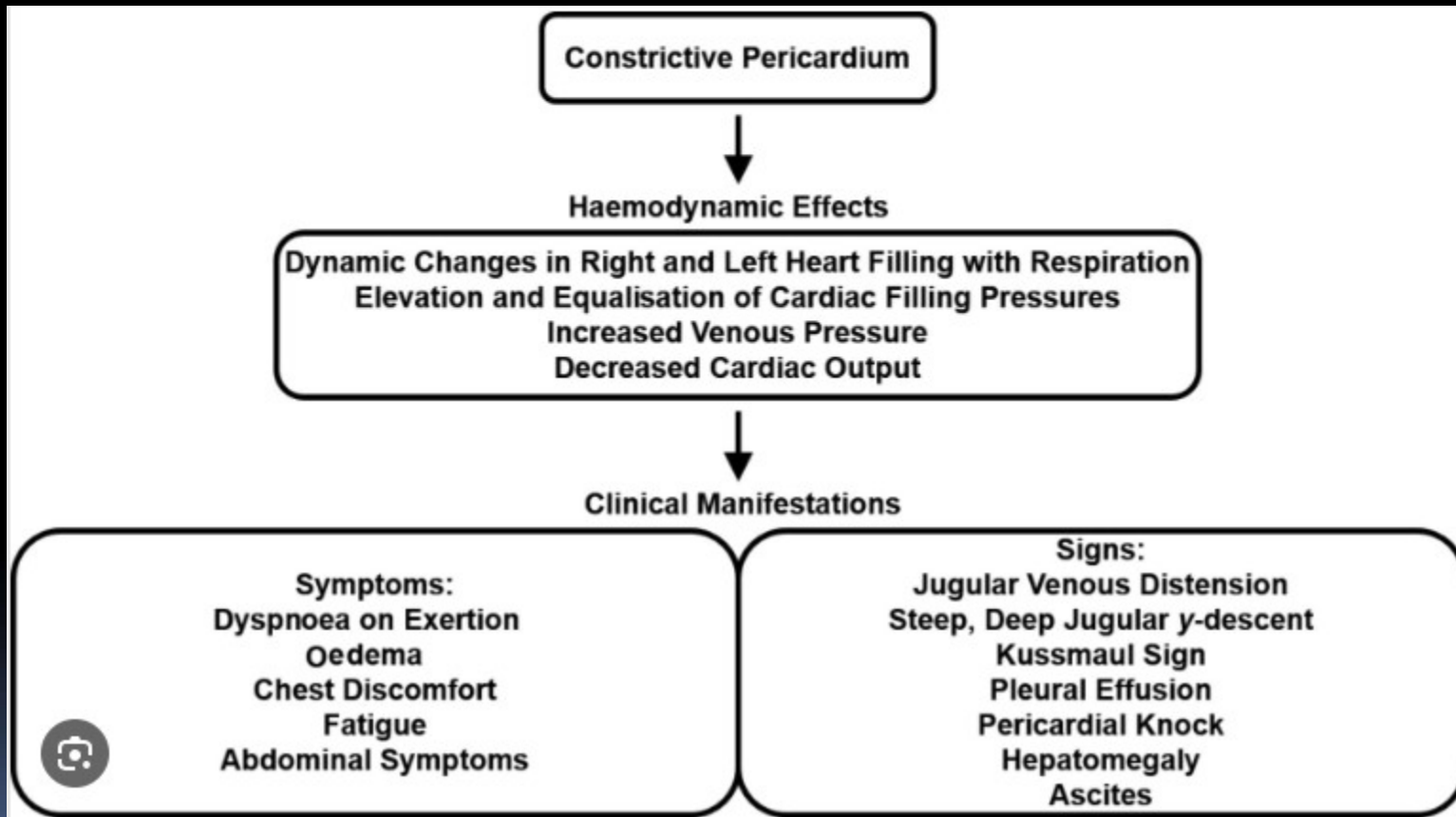


Table of Comparison Between
Constrictive Pericarditis
 &
Tamponade

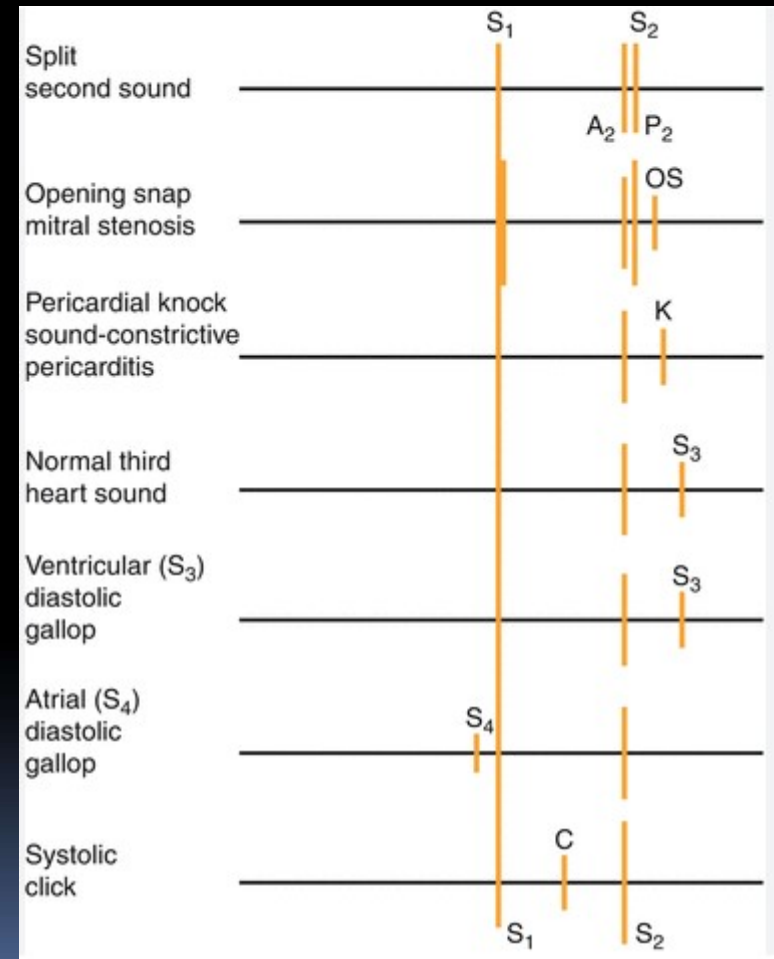
Difference between constrictive pericarditis and tamponade

Aspect	Constrictive Pericarditis	Tamponade
State of the pericardium	Thickened or rigid pericardium	Accumulated fluid in the pericardial sac
Primary sign	Kussmaul's sign	Beck's triad
Time of onset	Mostly chronic	Mostly acute
Treatment	<ul style="list-style-type: none"> • Medications (early onset) • Surgery (severe stage) 	<ul style="list-style-type: none"> • Drainage • Surgery (severe cases)



- Diastolic Heart Sounds...

- S2 split
- OS mitral stenosis
- PK constrictive pericarditis
- S3
- S4

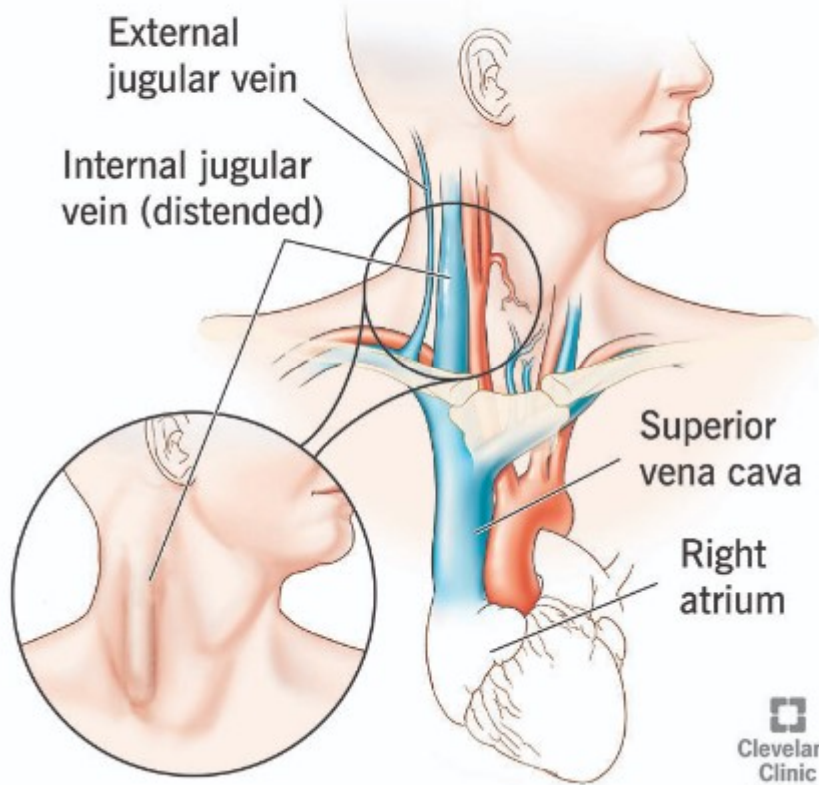


Διατεταμένες Σφαγίτιδες

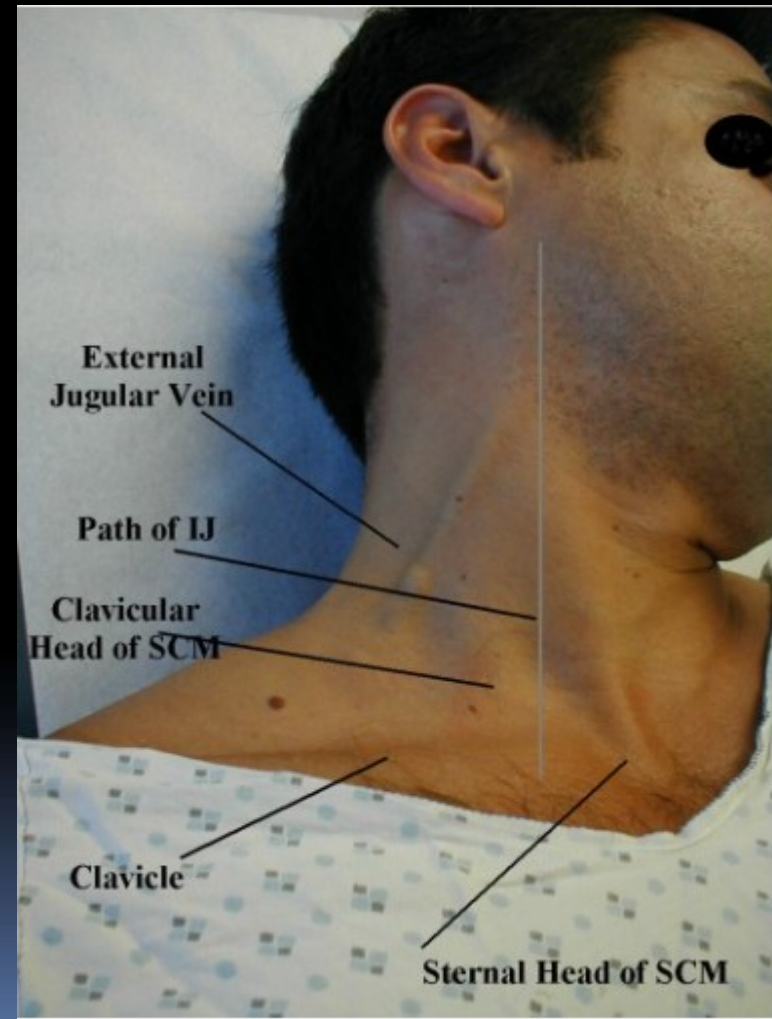
- Αυξημένη πίεση δεξιού κόλπου (RA)
 - Στένωση τριγλώχινας (TS)
 - Αυξημένη διαστολική πίεση δεξιάς κοιλίας (RVEDP), δηλαδή δεξιά καρδιακή ανεπάρκεια
 - Επειδή συχνή αιτία της RHF είναι η LHF, συχνά διατεταμένες σφαγίτιδες θεωρούνται σημείο LHF...



Jugular vein distention



Cleveland
Clinic
©2021





Hepato-Jugular reflux and Kussmaul's sign



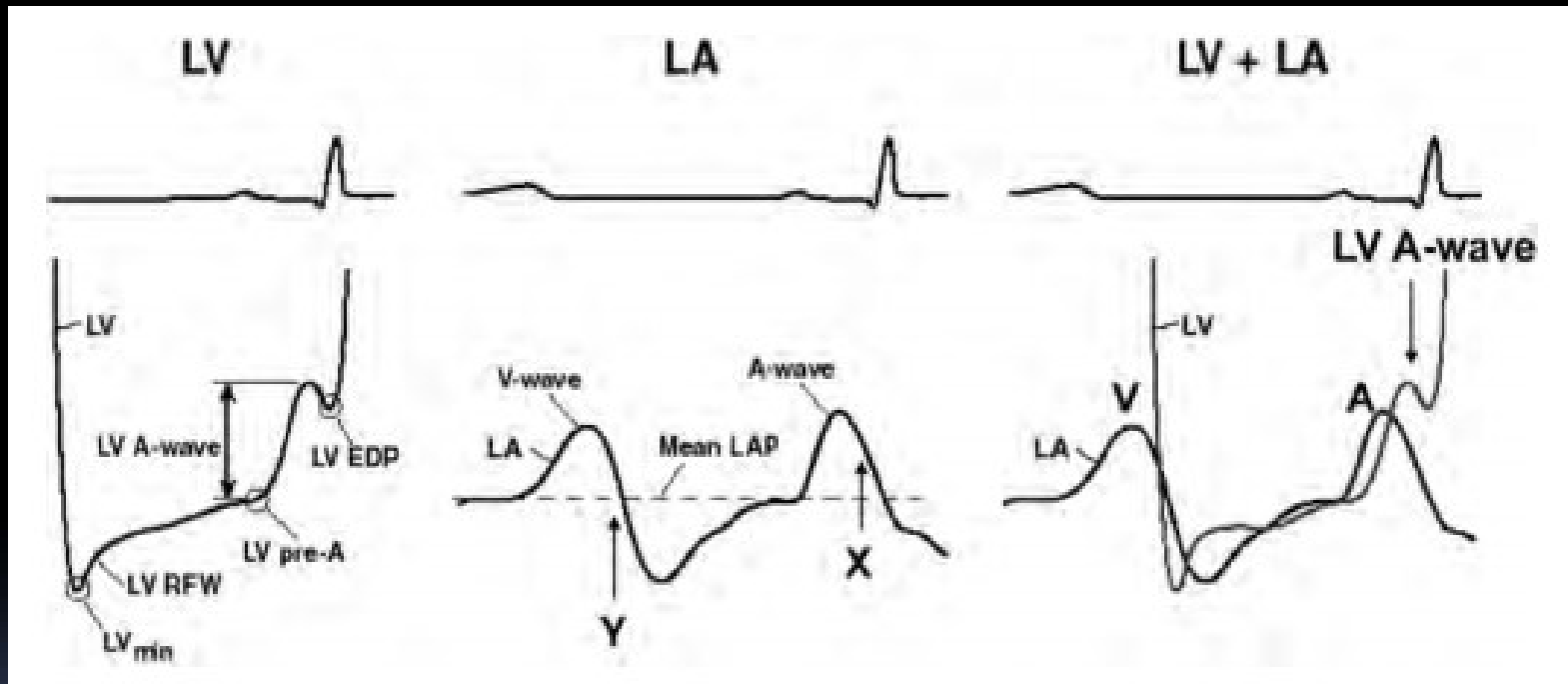
- Hepato-jugular reflux (various definitions)
 - sustained rise 1 cm for 30 sec.
 - ↑ venous tone & SVR
 - ↓ RV compliance
- Positive HJR correlates with $LVEDP > 15$
- JVP normally falls with inspiration
- Kussmaul's sign
 - inspiratory ↑ in JVP
 - constriction
 - rarely tamponade
 - RV infarction



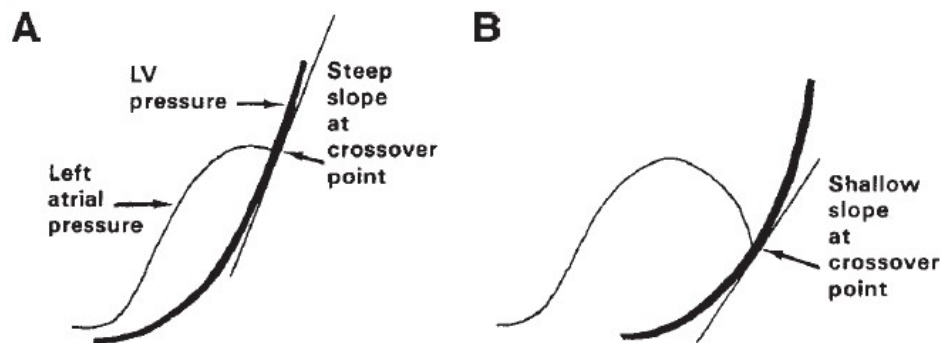


<https://img.grepmed.com/uploads/5162/clinical-kussmauls-physicalexam-sign-jvd-original.gif>





Βραχύ P-R, αύξηση έντασης S1

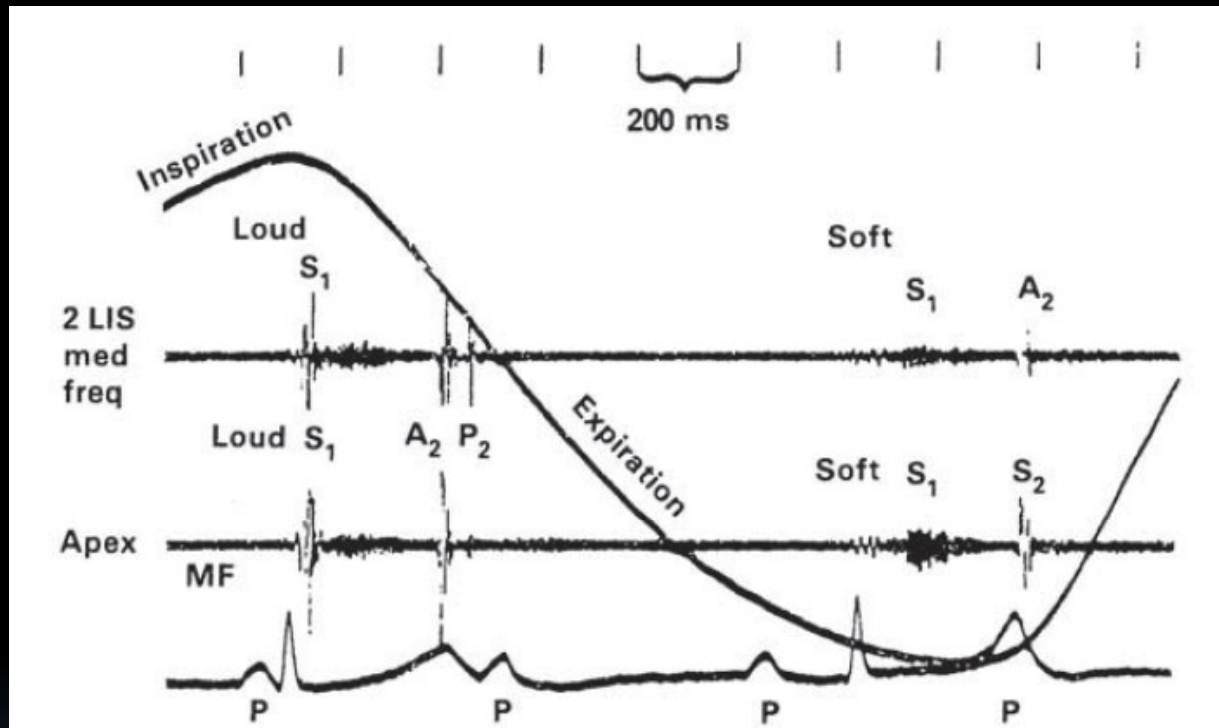


A. If the P-R interval is short, the LV contracts before the left atrium has had a chance to relax and drop its pressure. Therefore, the LV pressure will not exceed left atrial pressure until it has contracted for a long enough time to accelerate to a stage of rapid pressure rise by the time the mitral leaflets are closed. This produces an abrupt deceleration of forward flow and a loud sound.

B. If the P-R interval is long, the LV contracts later than at A, so that the left atrium has had time to drop to a low pressure when the LV pressure exceeds it. The pressure crossover point is on the slow part of the LV acceleration curve, and the valves are closed at a relatively slow rate, producing a soft sound.

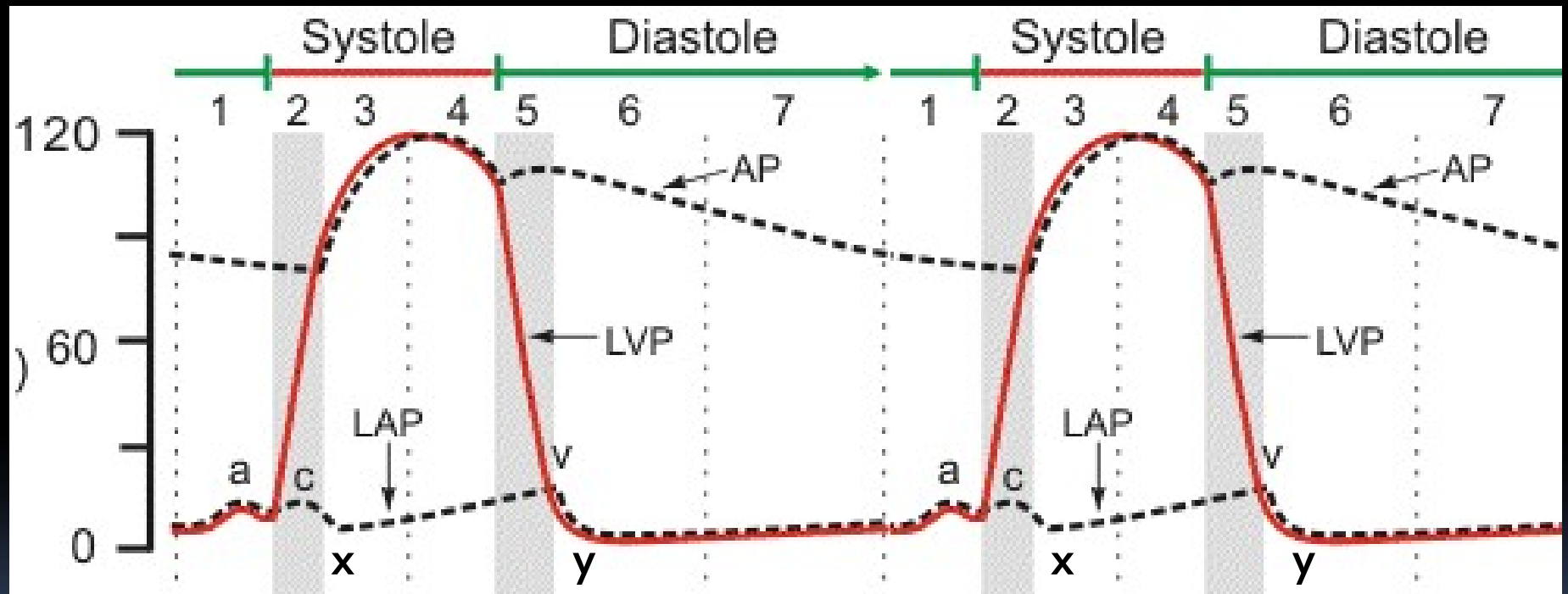
- Η ένταση του S_1 εξαρτάται από την θέση των μιτροειδικών γλωχίνων στην έναρξη της συστολής.
- ↑S1: Βραχύ P-R, ταχυκαρδία, βραχείς κύκλοι σε atrial fibrillation, MS (mitral stenosis)

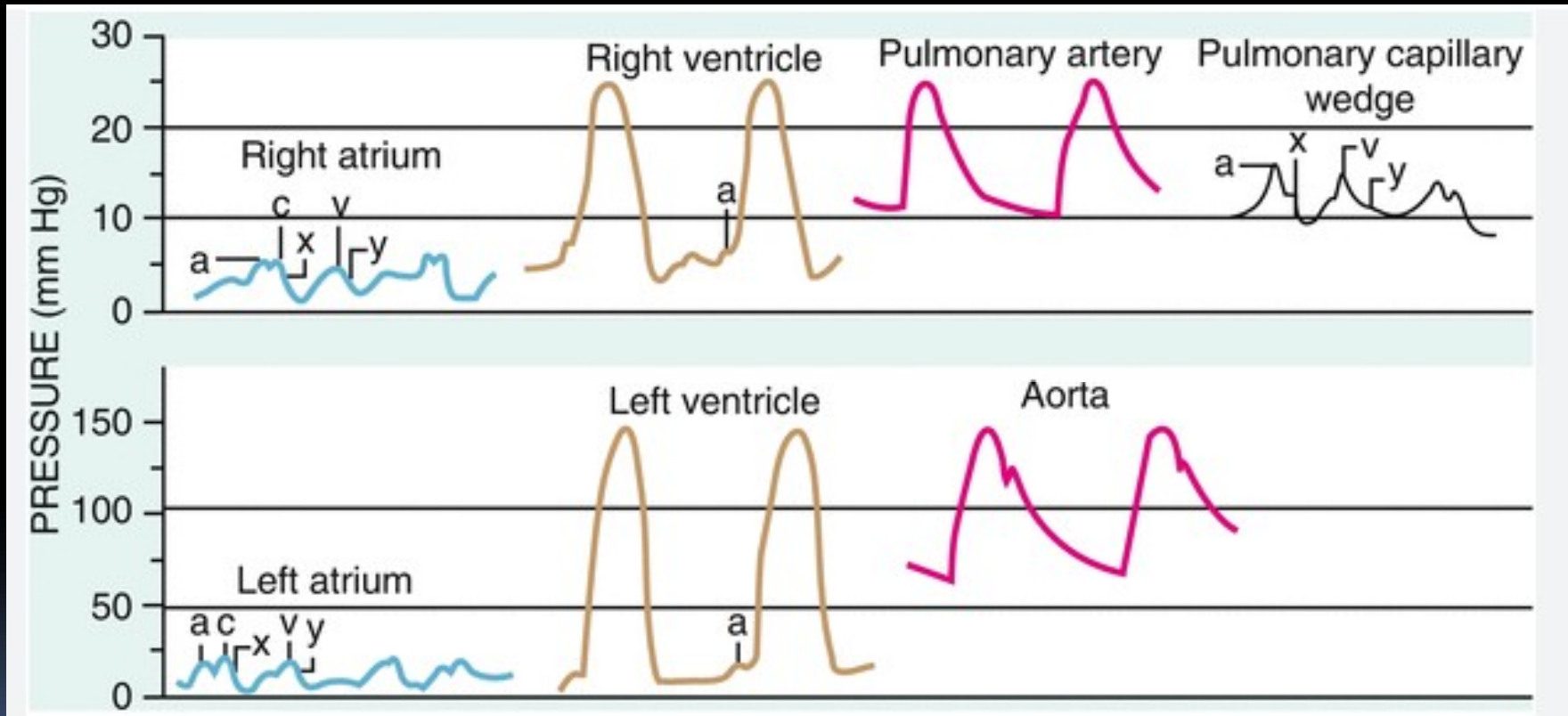


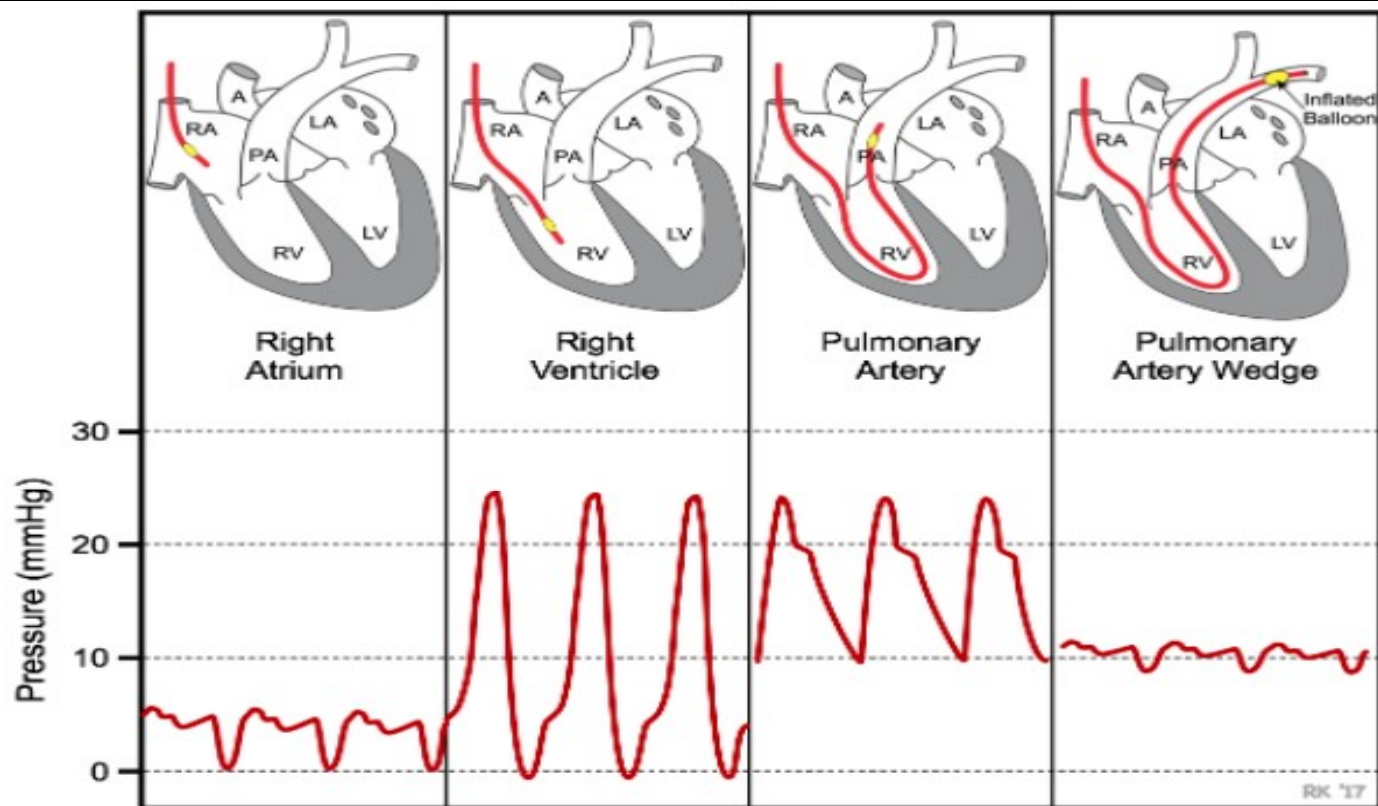


This medium-frequency (MF) phonocardiogram is from a patient with complete AV block, i.e., the P waves and QRS complexes are independent, thus causing the P-R intervals to vary. Note the loud S_1 after the short P-R (first one) and the soft one after the long P-R both at the apex and second left interspace (2 LIS).









The pressure recorded during balloon inflation is similar to left atrial pressure because the occluded vessel and its distal branches that eventually form the pulmonary veins act as a long catheter that measures the blood pressures within the pulmonary veins and left atrium.

