

Επιστημονική Ημερίδα SOS ΙΑΤΡΟΙ
Ξενοδοχείο ΗΛΕΚΤΡΑ 29-11-2014

*Υπέρηχοι: Ένα δεύτερο «στηθοσκόπιο»
για τους παθολόγους και όχι μόνο;*

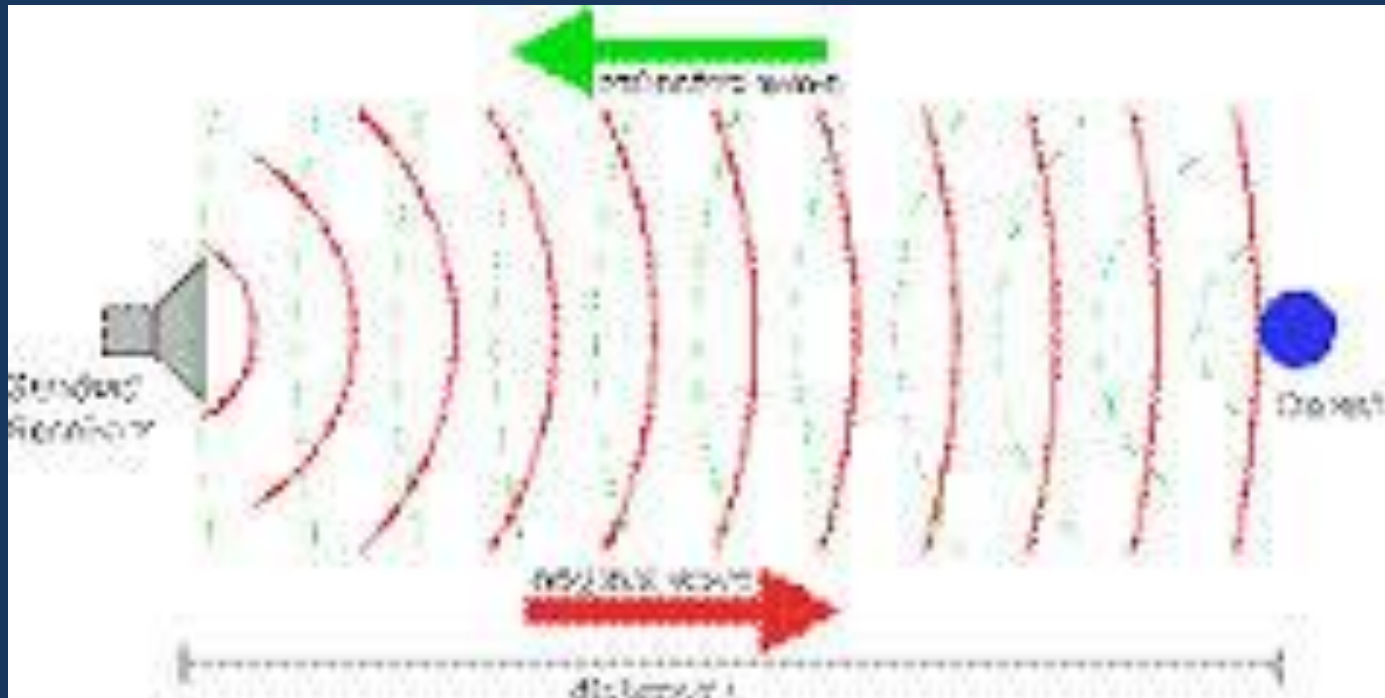
Δρ Ηλίας Κ Καραμπίνος
Καρδιολόγος



Is clinical examination really necessary or rather obsolete?

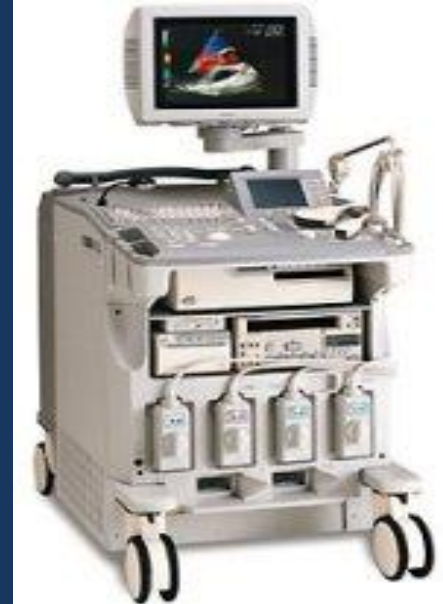


Echocardiogram is based on Physics of ultrasound



What is an Echo Machine?

- Simply it is an ultrasound of the heart using an echo machine equipped with a range of probes, each has a spectrum of frequencies



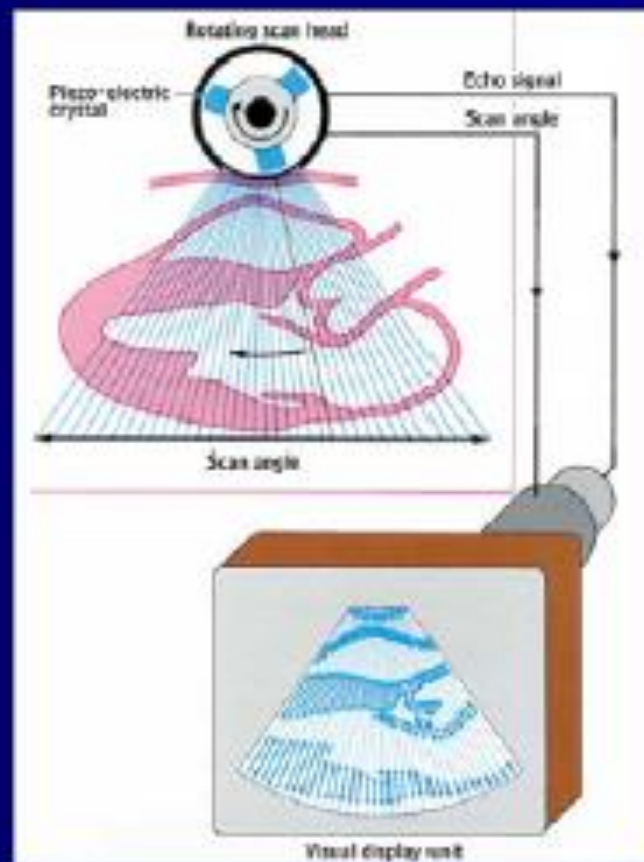
Echocardiogram

- An echocardiogram is a test in which ultrasound is used to examine the heart.
- Displaying a cross-sectional "slice" of the beating heart, including the chambers, valves and the major blood vessels that exit from the left and right ventricle
- **two- dimensional (2-D) Echo**
- **M-mode**
- **Doppler Examination**
- **3-D echo**

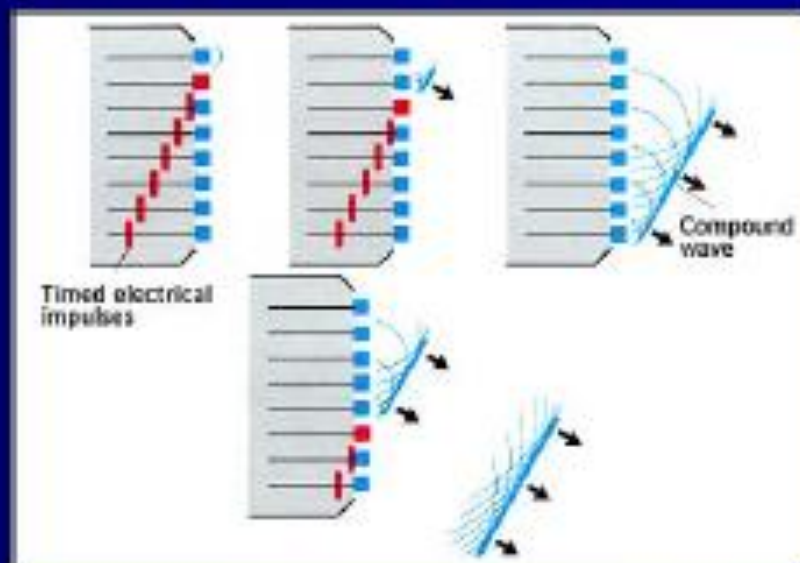
What information does Echocardiography and Doppler provide?

- Size of the chambers and thickness of the heart
- Pumping function of the heart
- Valve Function
- Volume status
- Hemodynamics
- Other Uses: fluid in the pericardium, *congenital heart diseases, blood clots or tumors within the heart*

Two-Dimensional Scanning Mechanical Sector Scanner

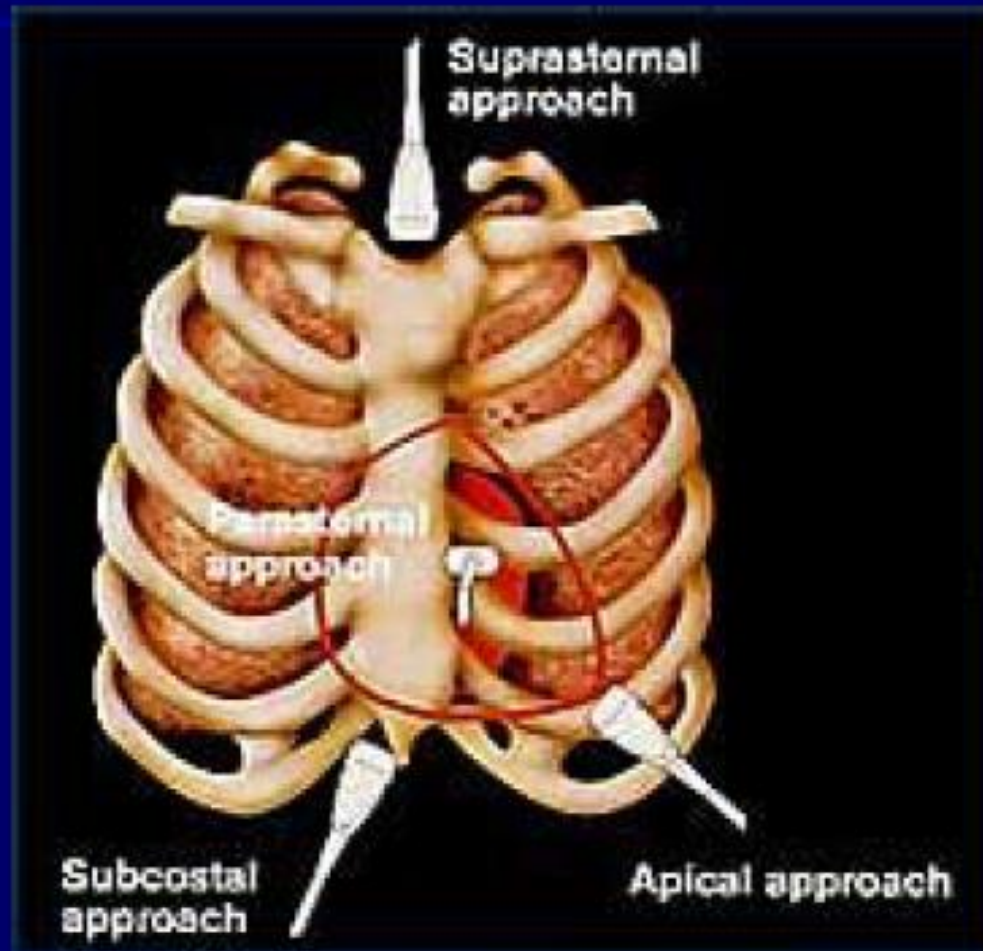


Two-Dimensional Scanning Phased Array Sector Scanners



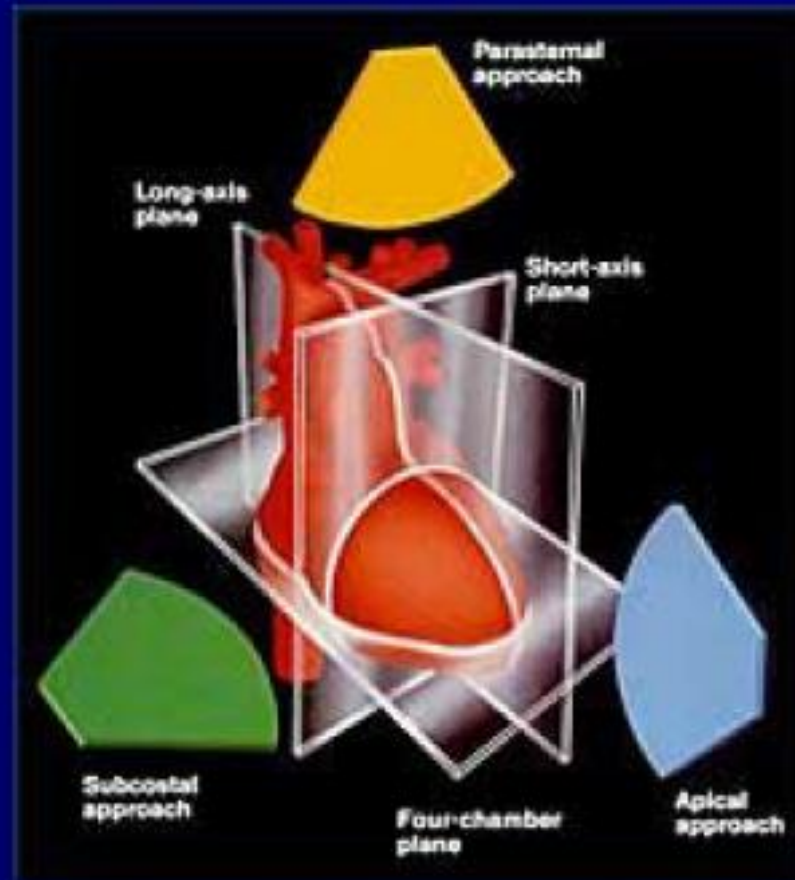
Transthoracic “viewing” of the heart: windows

Two-Dimensional Scanning

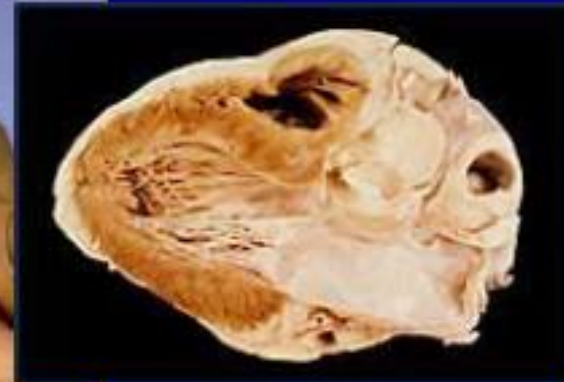


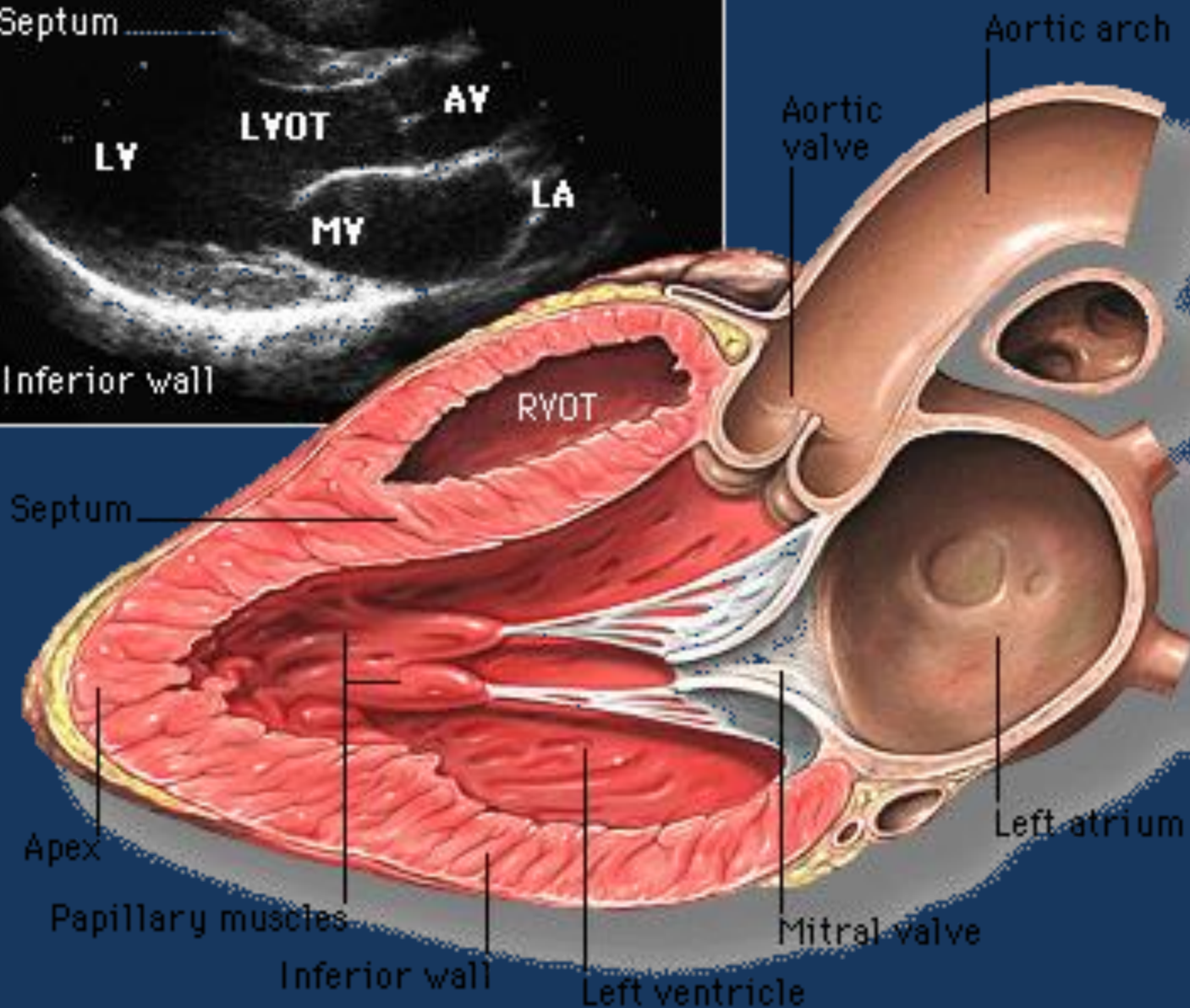
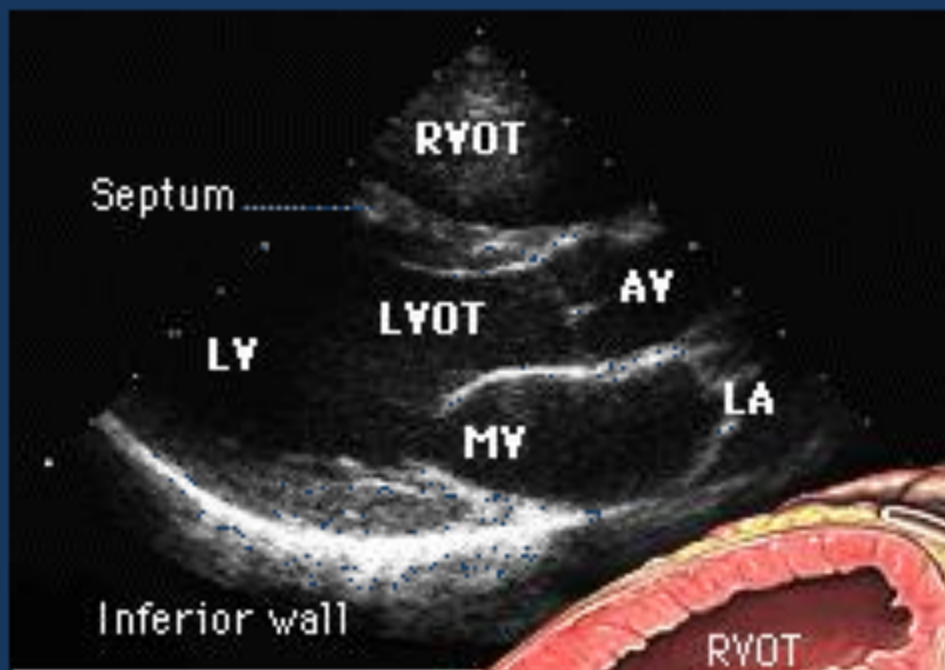
Two-Dimensional Scanning

Standard Planes for 2D Echocardiography



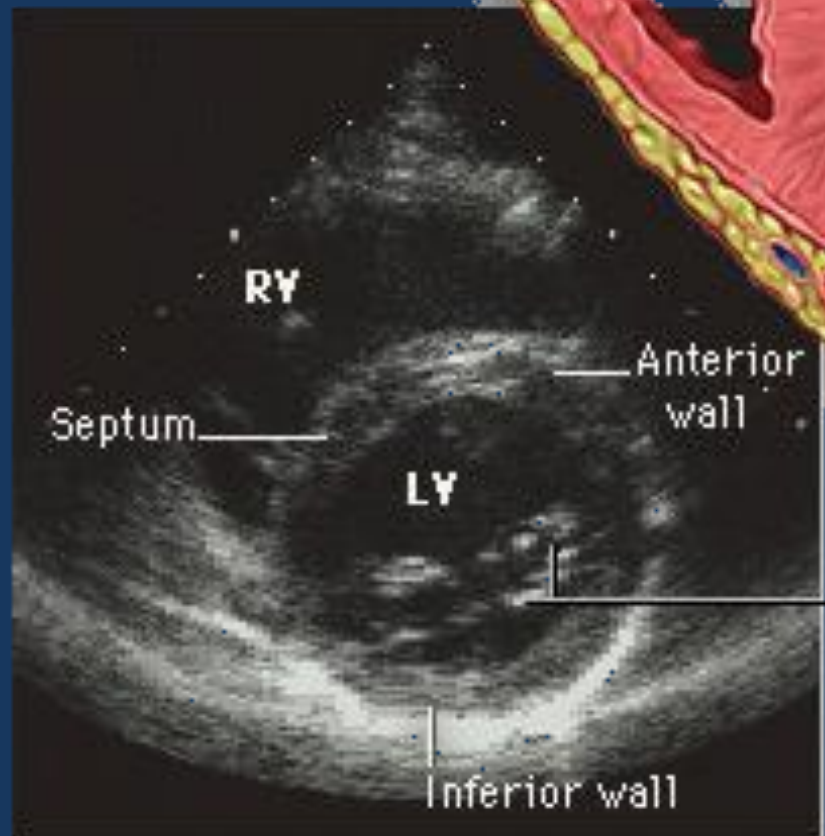
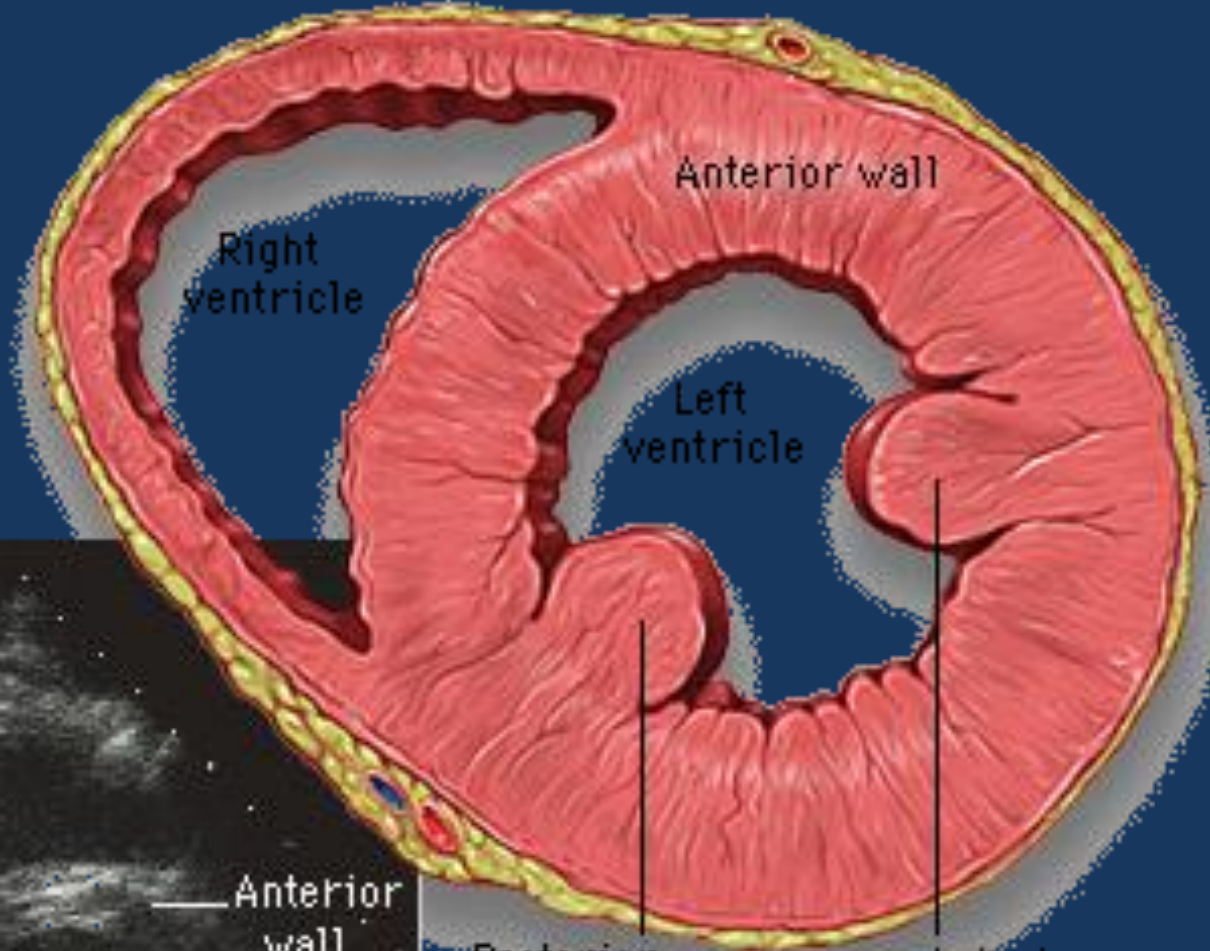
Two-Dimensional Scanning Parasternal Long axis view



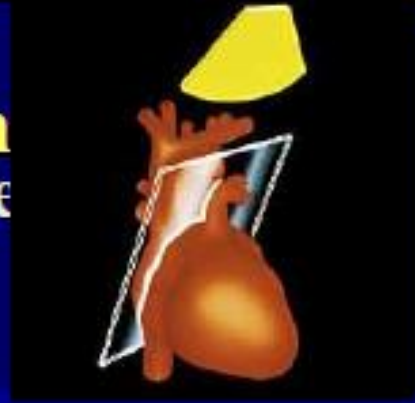


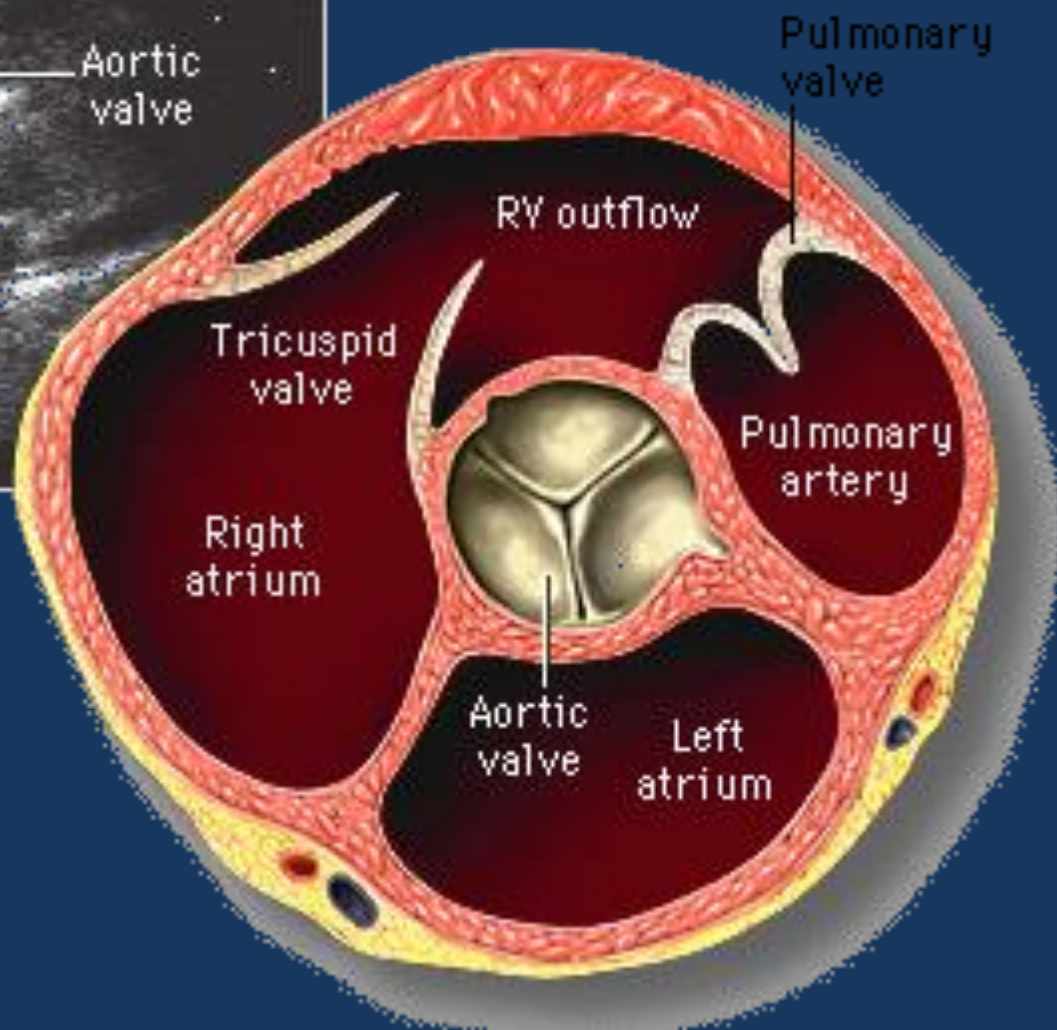
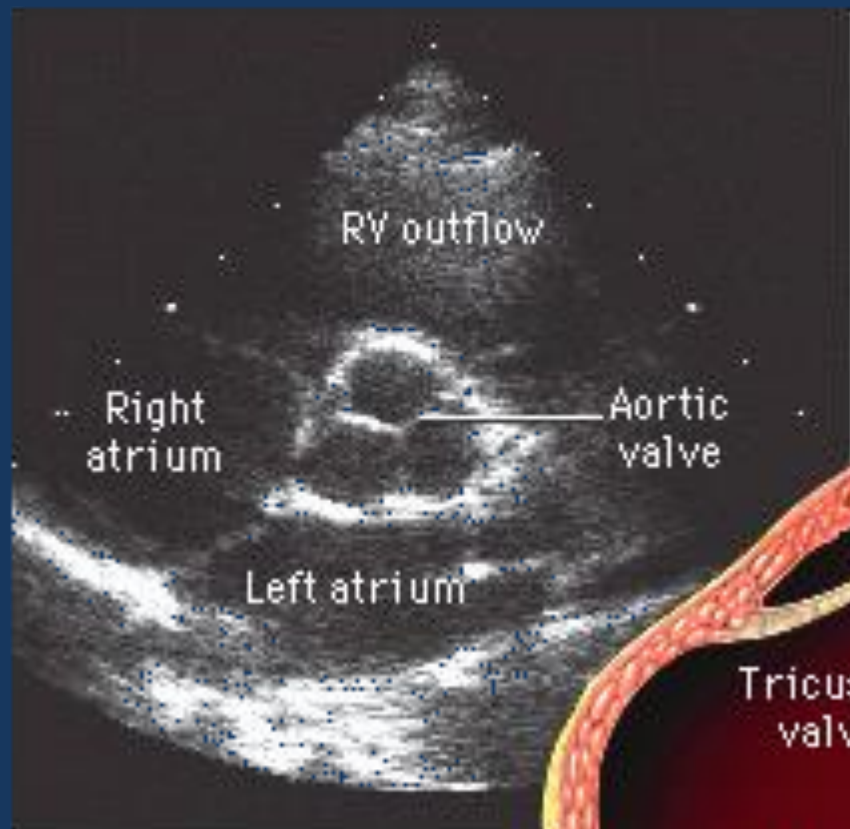
Two-Dimensional Scanning
Parasternal Short-Axis Plane
Mitral Valve Level



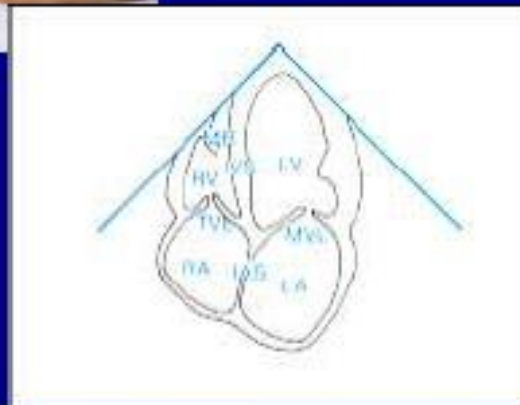


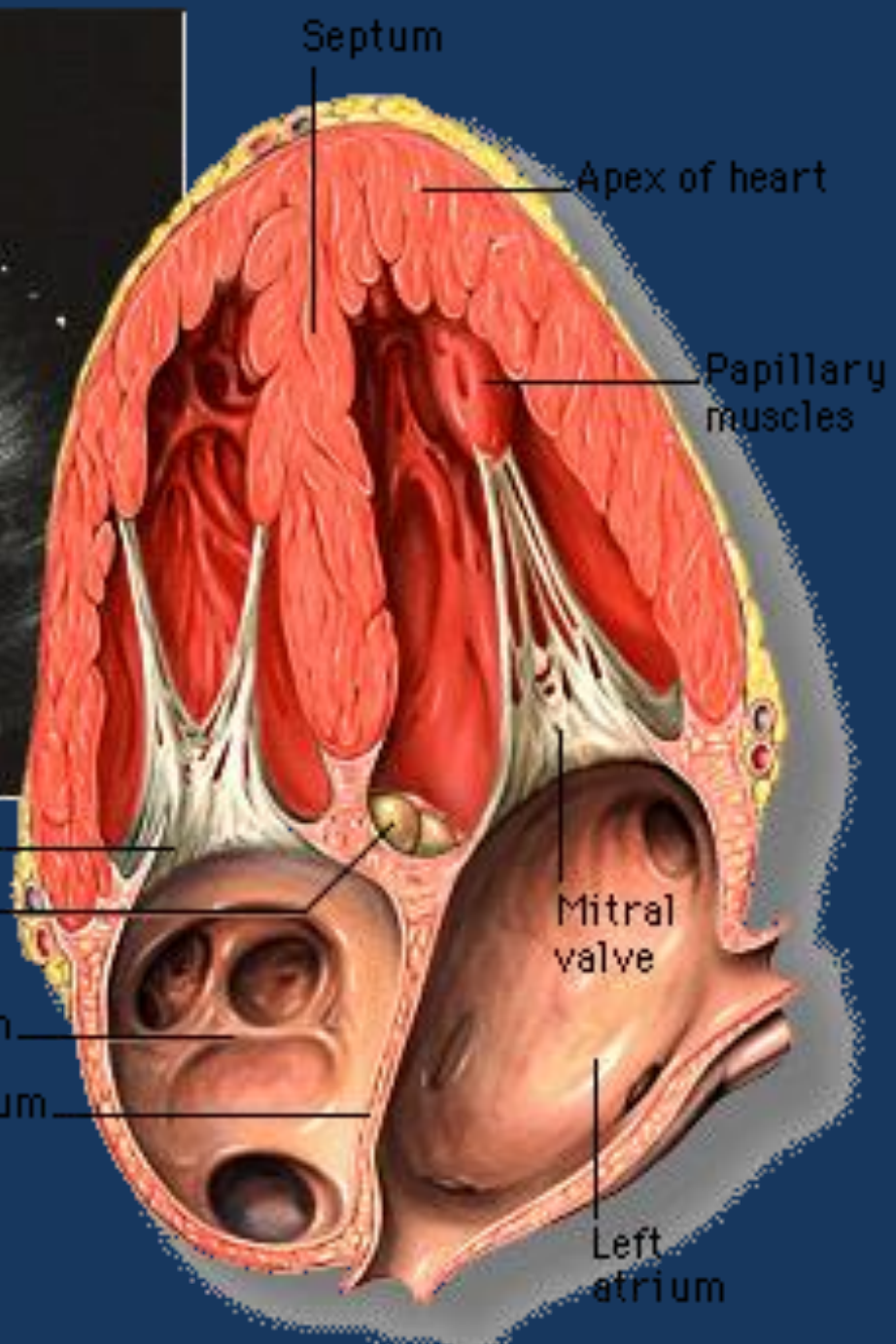
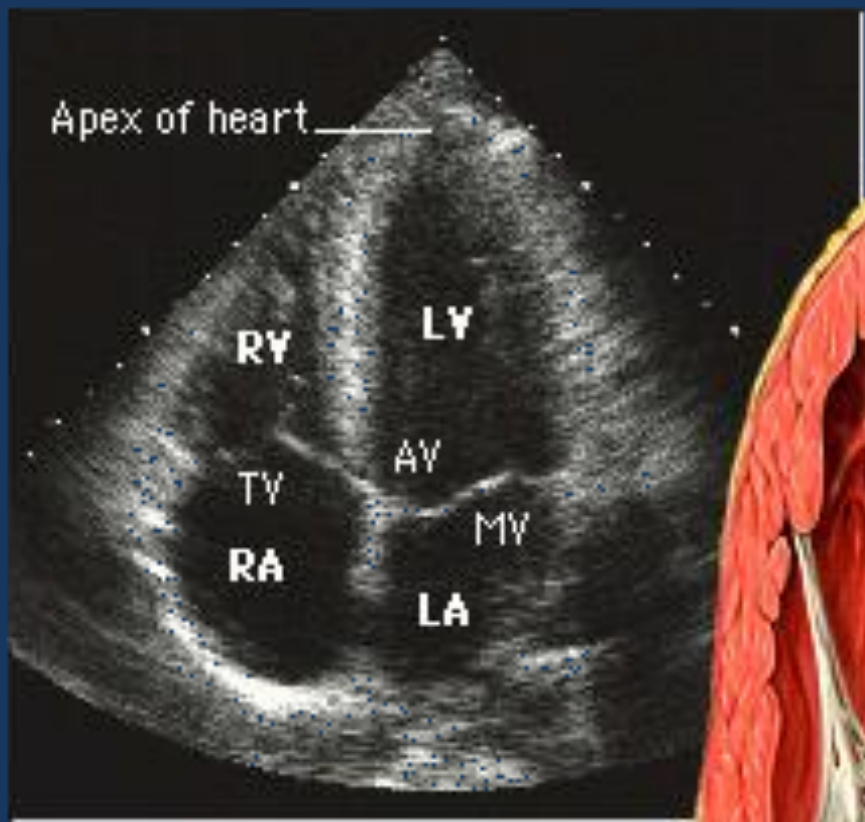
Two-Dimensional Scanning Parasternal Short-Axis Plane Aortic Valve Level





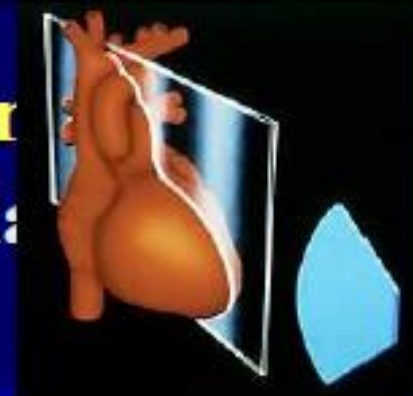
Two-Dimensional Scanning Apical Four-chamber Plane





Two-Dimensional Scar

Apical Long-Axis Pla

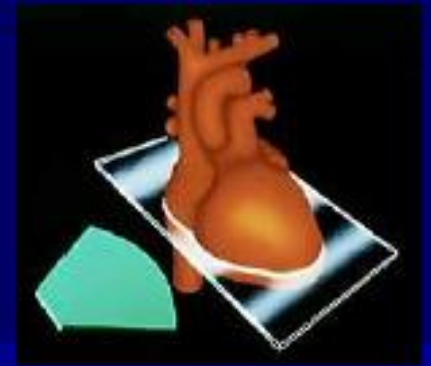


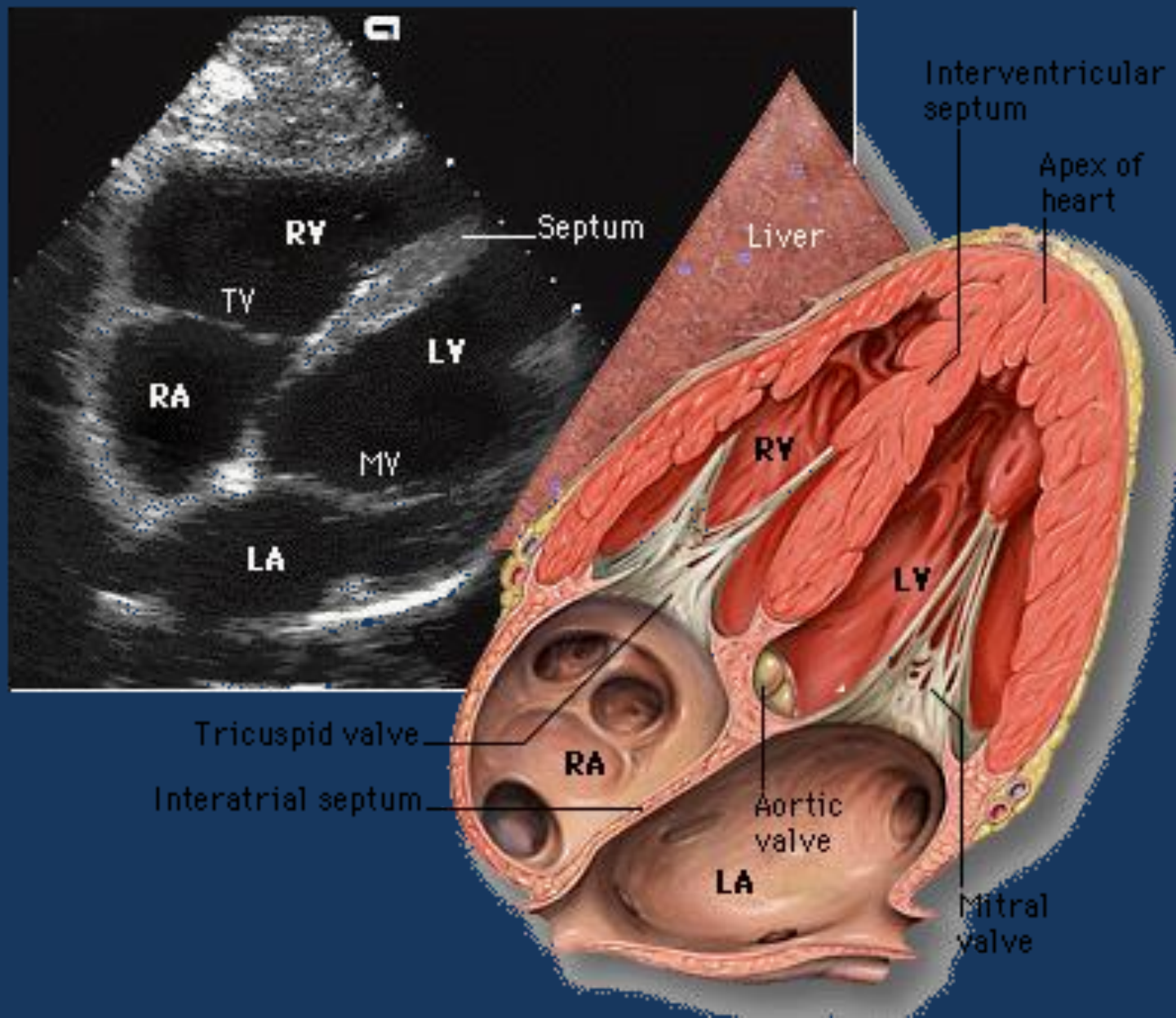
Two-Dimensional Scanning

Apical 5-chamber view



Two-Dimensional Scanning Sub-costal views





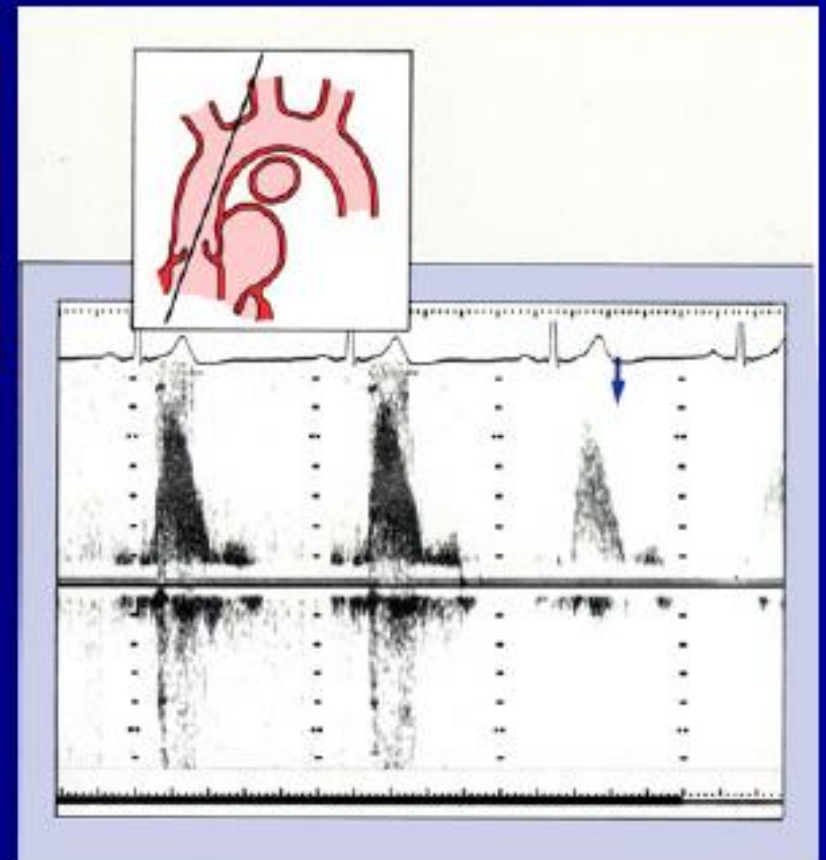
Two-Dimensional Scanning

Sub-costal views



Two-Dimensional Scanning

Suprasternal Views



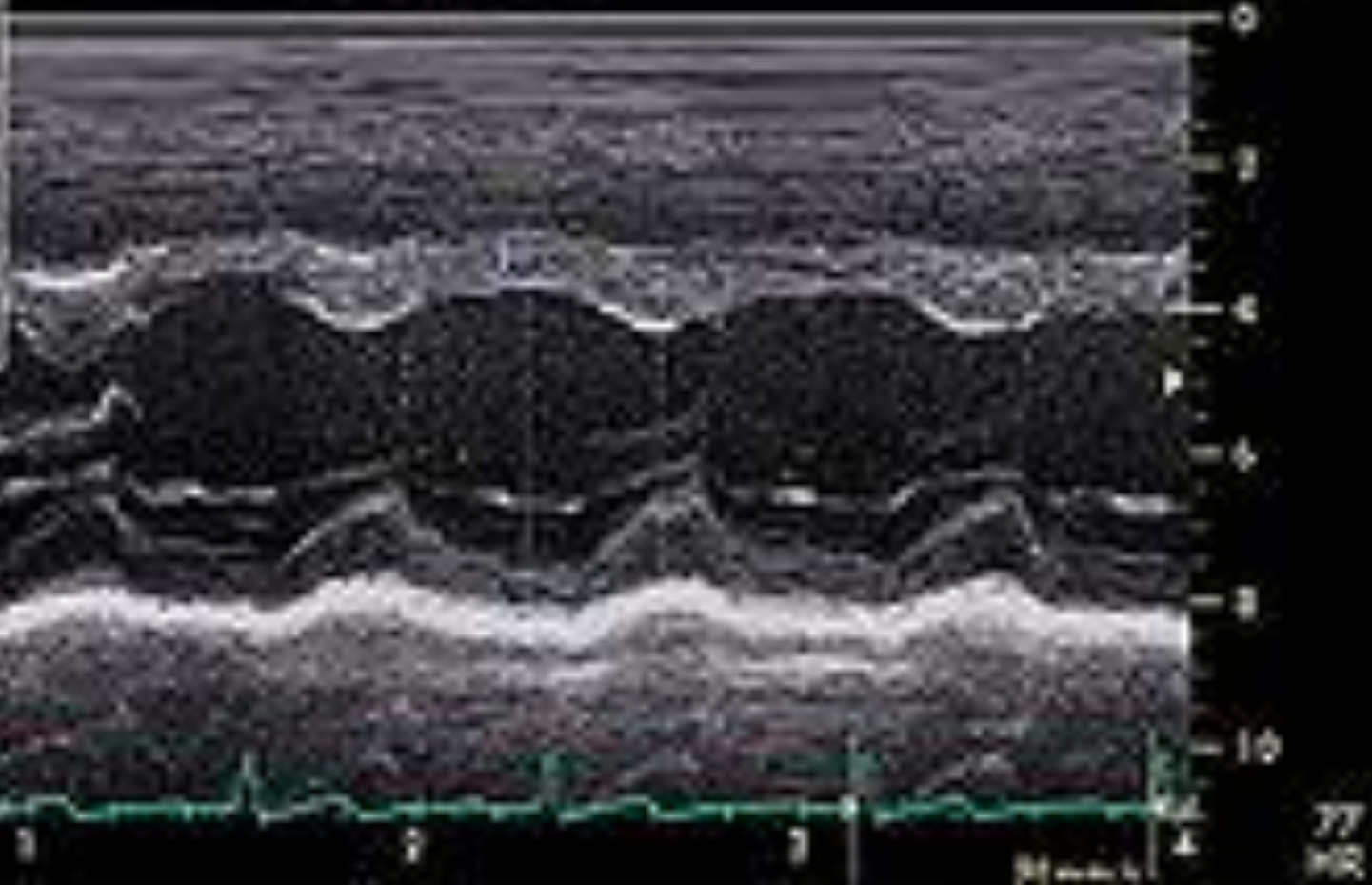
Transthoracic Echocardiography Windows

- **Left parasternal**
 - Long axis view
 - Short axis view
- **Apical window**
 - 4 chamber view
 - 5 chamber view
 - 2chamber view
- **Subcostal window**
 - Interatrial septum
 - Ivc
- **Suprasternal window**
 - Aorta in coarctation
- **Right parasternal window**
 - A S & Ascending aorta

What is M-Mode?



1 IVSd	0.70 cm
IVSs	1.09 cm
LVID-d	3.94 cm
LVIDs	2.46 cm
LVPWd	0.51 cm
LVPWs	1.01 cm
EDV(Teich)	67.5 ml
ESV(Teich)	21.4 ml
EF(Teich)	68.5 %
St(Teich)	46.1 ml
%FS	37.6 %



What is Doppler?

Doppler echocardiography is a method for detecting the direction and velocity of moving blood within the heart.

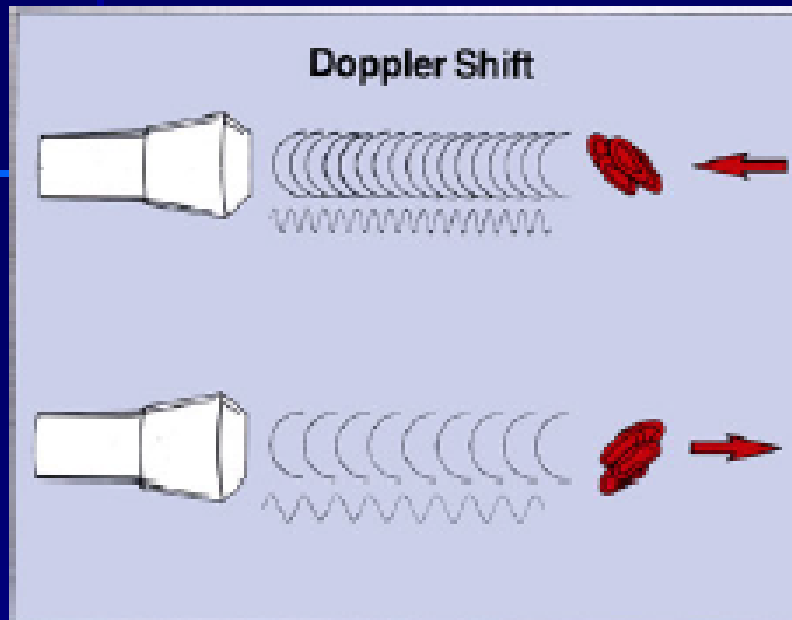
BASIC PHYSICS

MODES OF DOPPLER ECHO

THE DOPPLER EXAMINATION

THE DOPPLER CALCULATIONS

What is Doppler?



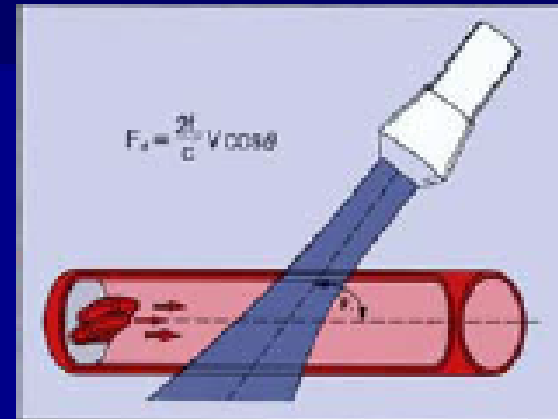
Positive Doppler shift.

Negative Doppler shift

Doppler systems are totally dependent on the changes in the frequency of the transmitted ultrasound that result from the encounter of the wavefront with moving red blood cells. ■

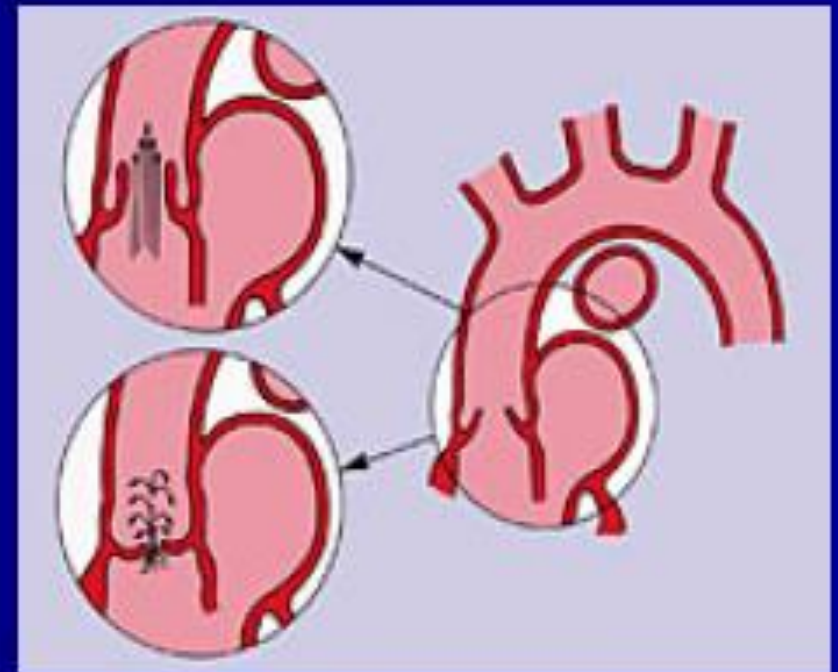
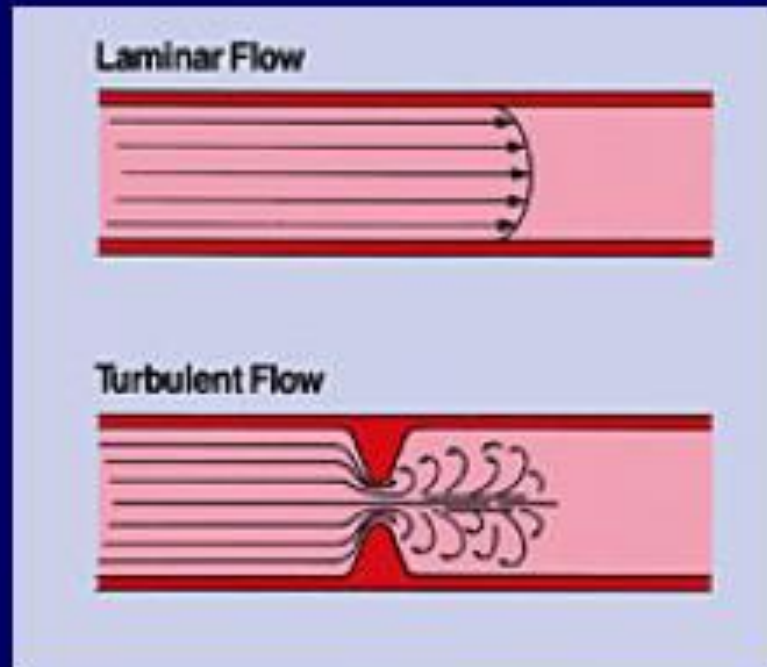
the returned frequency will be higher after encountering red blood cells moving toward the transducer and lower after encountering red cells moving away from the transducer ■

The Doppler Equation



the Doppler shift (F_d) of ultrasound will depend on both the transmitted frequency (f_0) and the velocity (V) of the moving blood. This returned frequency is also called the "frequency shift" or "Doppler shift" and is highly of ultrasound transmitted from the transducer and the moving red blood cells. The velocity of sound in blood is constant (c)

The Doppler device can be regarded as a complex speedometer designed to detect red cell motion



Modes Of Doppler Echocardiography

Blood Flow

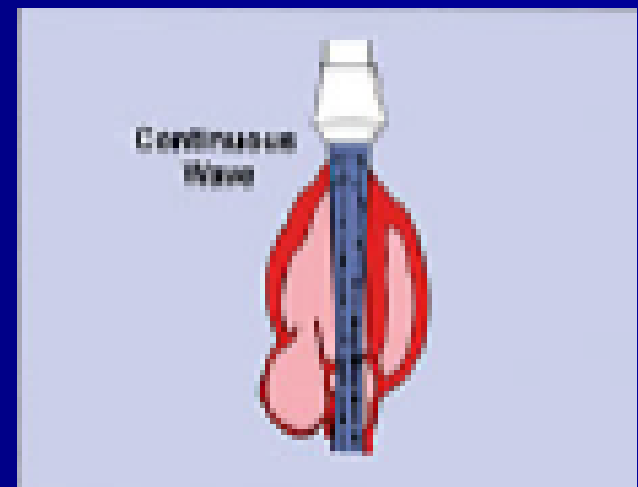
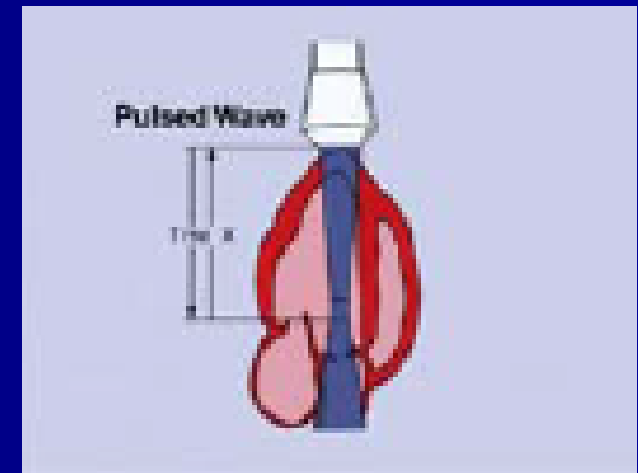
Pulsed Wave

HRF Pulsed Wave

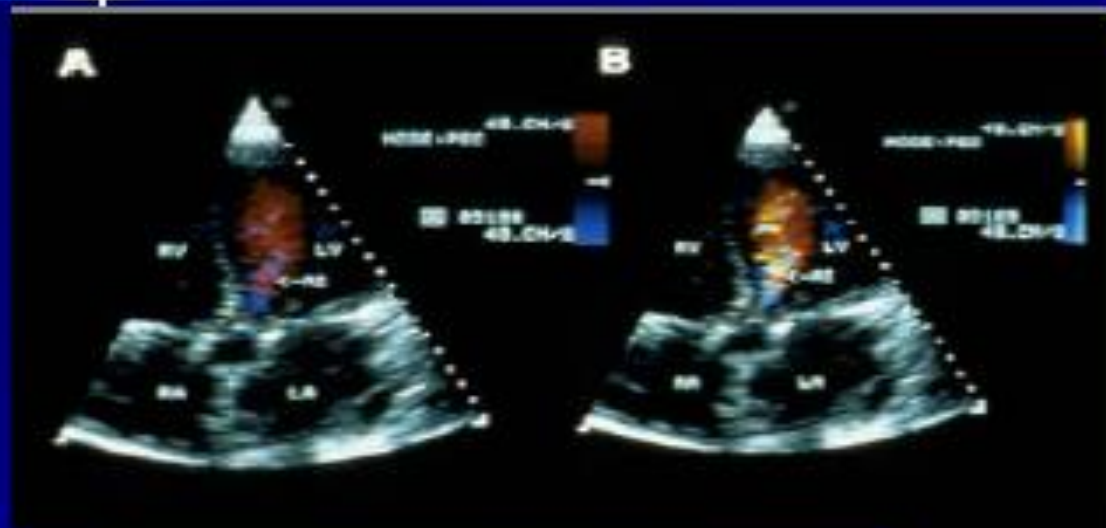
Continuous Wave

Tissue Motion

Tissue Doppler



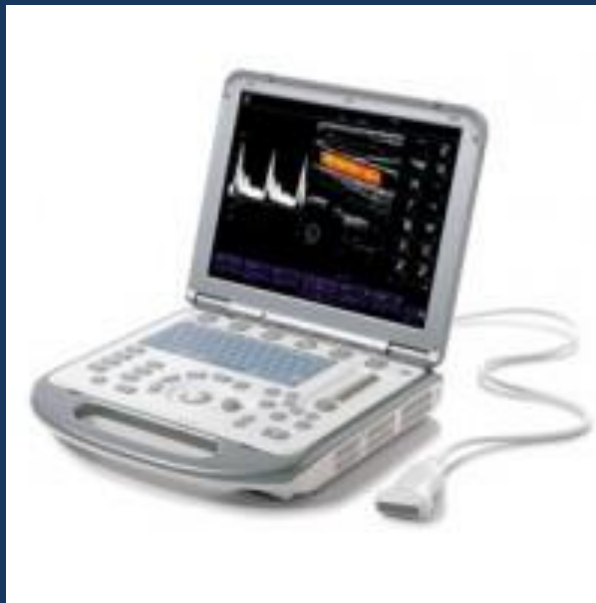
Doppler Color flow imaging



Φυσιολογική μελέτη



Is there any rationale for a non cardiologist to use an echo machine?



...then a complementary tool to aid in DD
In every day clinical practice!!!!

Emergency ECHO

- **1st employed in ED in 1980s in USA**
- **Allows rapid recognition of life-threatening conditions and direct appropriate intervention and treatments.**
- **Mainly a focused exam and try to answer clinical questions**
- **Most situations require only a 2D scan.**
- **Doppler may help**

Clinical Indications

Primary indications

- Detection of Pericardial Effusion +/- Cardiac Tamponade
- Evaluation of cardiac activity in cardiac arrest patients
- LV systolic fx evaluation

Extended indications

- Estimation of intravascular volume status
- RV evaluation
- Evaluation of proximal aorta for dissection/aneurysm

Emergency Conditions where ECHO can help!

- Trauma
- Cardiac Arrest
- Unexplained hypotension
- Shortness of Breath
- Chest Pain
- Symptoms indicative of a stroke

Pericardial Effusion

- **Detection of echo-free rim around the heart within the hyperechoic parietal pericardium**
- **Maybe complex echogenic if fluid accumulation is due to inflammation and malignancy**
- **False +ve: pleural effusion and epicardial fat pad**

Pericardial Effusion

- Subcostal views

Subcostal Short
axis view



- Parasternal views



Pericardial Effusion

Pericardial effusion	Size	Location
Small	<10mm in diastole	Posterior only and not circumferential
Moderate	<=10mm in diastole	circumferential
Large	10-20mm	circumferential
Very large	>20mm	Circumferential+/- features of tamponade

Cardiac Tamponade

- Pericardial effusion causing haemodynamic collapsed because of impaired ventricular filling and, in turn, cardiac output.
- Acute accumulation of even small amount of fluid in pericardial sac can have significant haemodynamic effect. [rigid fibrous sac]
- Beck's Traid: Elevated JVP, Muffled heart sounds, hypotension

Cardiac Tamponade

- ECHO features:
 - RA and RV diastolic collapse
 - RV free wall moves towards the RV cavity early in diastole [normally it moves away]
 - RA moves inwards at the end of diastole and the beginning of systole.

Cardiac Arrest

- Mainly detect organized cardiac activity
- To find the treatable causes of Pulseless Electrical Activity:
 - Cardiac Tamponade
 - Hypovolaemia
 - +/-Massive PE

Unexplained Hypotension

- Obtain subcostal or parasternal long-axis views
- Assess for pericardial effusion and tamponade
- **Assess for wall-motion abnormalities:**
 - large hypocontractile LV segment
 - primary LV failure
 - inotropic support
 - RV hypokinesis & normal LV function
 - RV infarction or massive PE
 - try fluid resuscitation

Unexplained Hypotension

- Hypovolaemia
 - small heart with near complete systolic emptying
 - flat IVC with exaggerated normal respiratory variation
- **Assess abdomen for AAA and haemoperitoneum**

LV systolic Fx Evaluation

- Useful in managing hypotensive patients
- To differentiate cardiogenic or noncardiogenic shock

Κλάσμα Εξώθησης της Α.Κ.

είναι:

- φυσιολογικό = 60-70%
- ελαφρότητα μειωμένο = 55-60%
- μέτρια μειωμένο = 45-55%
- μέτρια προς σοβαρά μειωμένο = 30-40%
- σοβαρά μειωμένο = <30%

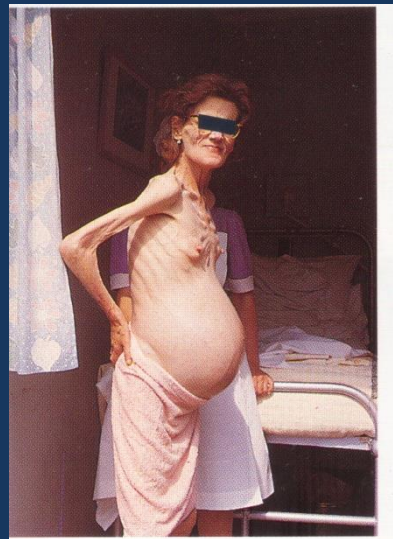
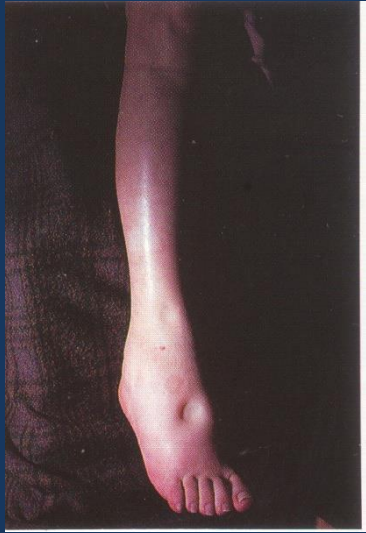
Κλινική εικόνα

Η βαρύτητα της συστολικής δυσλειτουργίας δεν βαίνει αναλόγως με την βαρύτητα της συμπτωματολογίας

Γιατί;

1. Κοιλιακή διατασιμότητα
2. Βαλβιδικές ανεπάρκειες
3. Περικάρδιο
4. Λειτουργικότητα δεξιάς κοιλίας
5. Φυσιολογία μυών
6. Ενδοθηλιακή δυσλειτουργία
7. Νευροορμονικοί μηχανισμοί
8. Συμπαραμαρτούντες παθήσεις
9. Κοιλιακός Δυσυγχρονισμός

Διαγνωστική ακρίβεια συμπτωμάτων καρδιακής ανεπάρκειας

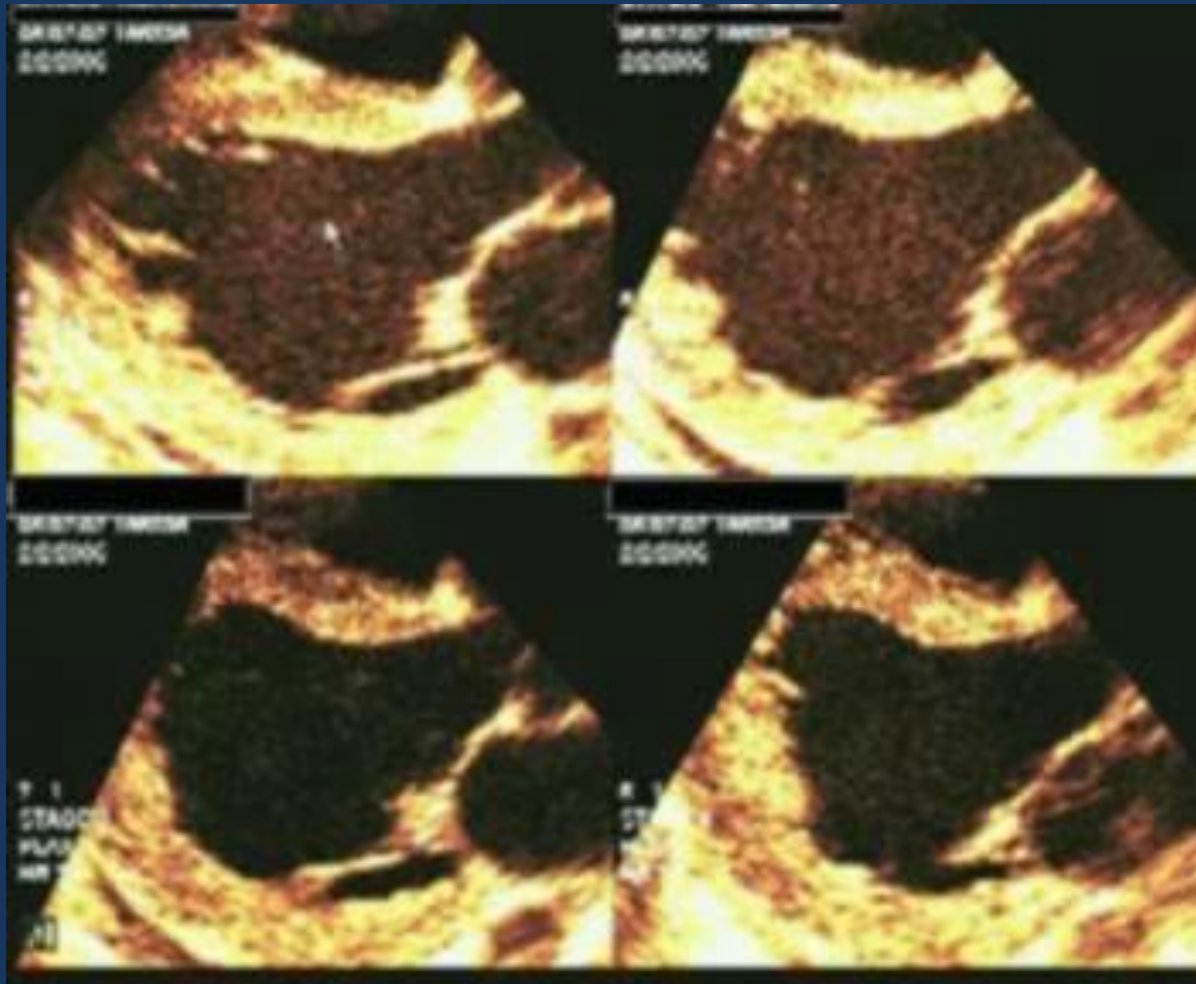


		Harlan <i>et al.</i> ¹	Chakko <i>et al.</i> ²	Stevenson and Perloff ³	Echeverria <i>et al.</i> ⁴
<i>Dyspnoea on exertion</i>					
	Sensitivity	66			97
	Specificity	52			15
	PPV	23			63
	NPV				75
<i>Orthopnoea</i>					
	Sensitivity	21	66	91	73
	Specificity	81	47	100	40
	PPV	2	61	100	65
	NPV		37	64	50
<i>Paroxysmal nocturnal dyspnoea</i>					
	Sensitivity	33			50
	Specificity	76			45
	PPV	26			58
	NPV				38
<i>Ankle oedema</i>					
	Sensitivity	23	46	23	23
	Specificity	80	73	100	70
	PPV	22	79	100	54
	NPV		37	18	38

Διαγνωστική ακρίβεια σημείων καρδιακής ανεπάρκειας

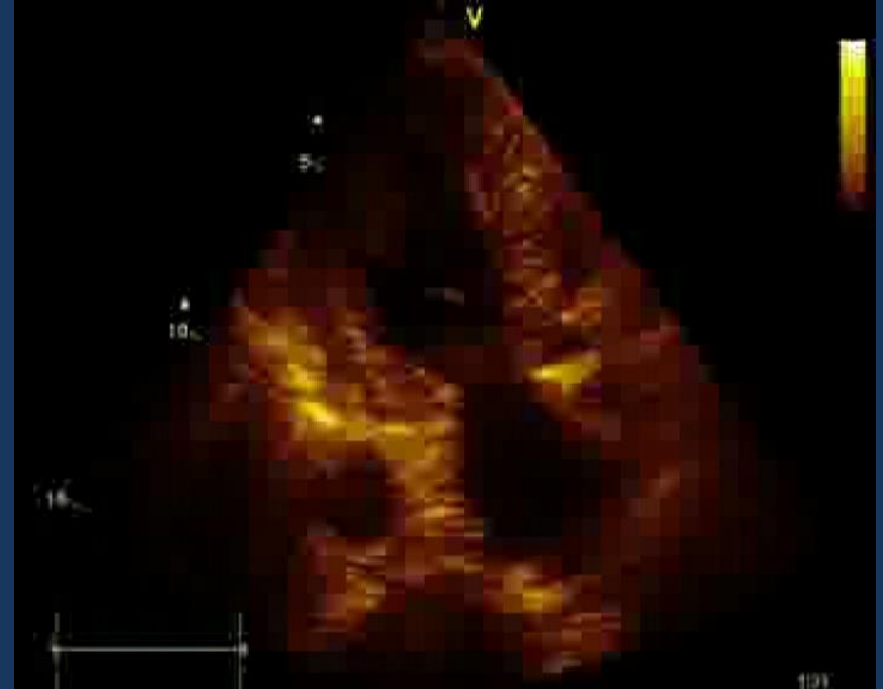
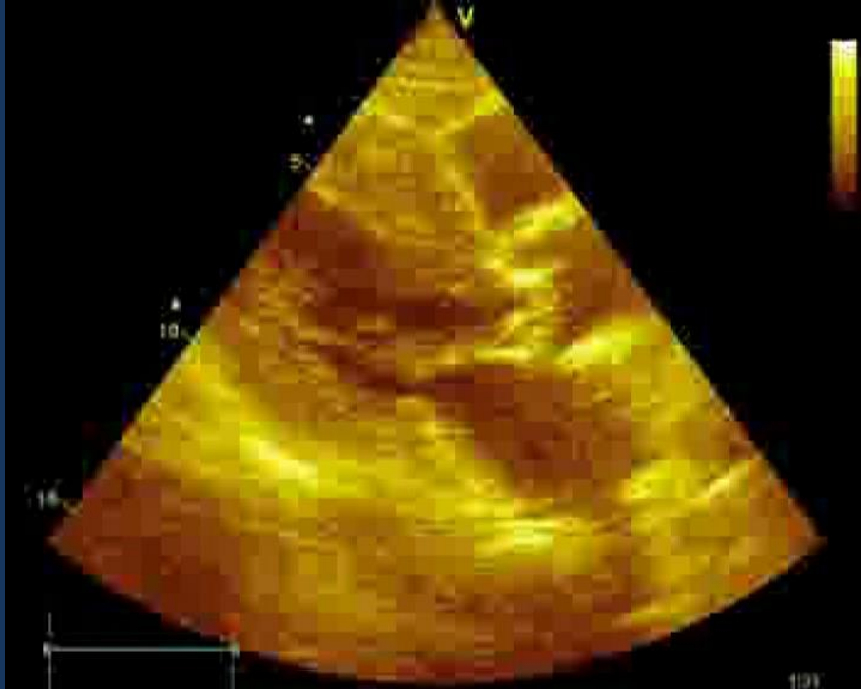
	Harlan <i>et al.</i> ¹	Heckerling <i>et al.</i> ⁵	O'Neill <i>et al.</i> ⁶	Chakko <i>et al.</i> ²	Butman <i>et al.</i>	Stevenson and Perloff ³	Echeverria <i>et al.</i> ⁴
<i>Resting tachycardia</i>							
Sensitivity	7						
Specificity	99						
PPV	6						
NPV							
<i>Pulmonary crackles</i>							
Sensitivity	13			66	24	19	70
Specificity	91			84	100	100	35
PPV	27			87	100	100	62
NPV				61	35	17	44
<i>Ankle oedema</i>							
Sensitivity	10			46		23	40
Specificity	93			73		100	70
PPV	3			79		100	67
NPV				46		18	44
<i>Third heart sound</i>							
Sensitivity	31			73	68	98	63
Specificity	95			42	73	14	55
PPV	61			66	86	88	68
NPV				85	48	50	50
<i>Jugular venous distension</i>							
Sensitivity	10			70	57	58	47
Specificity	97			79	93	100	65
PPV	2			85	95	100	67
NPV				62	47	28	45
<i>Increased percussion distance</i>							
Sensitivity		94					
Specificity		67					
PPV							
NPV							
<i>Displaced apex beat</i>							
Sensitivity			59				60
Specificity			76				50
PPV			59				64
NPV			77				45
<i>Proportional pulse pressure</i>							
Sensitivity						91	
Specificity						8	
PPV						91	
NPV						87	

Δ.Δ. Δύσπνοια



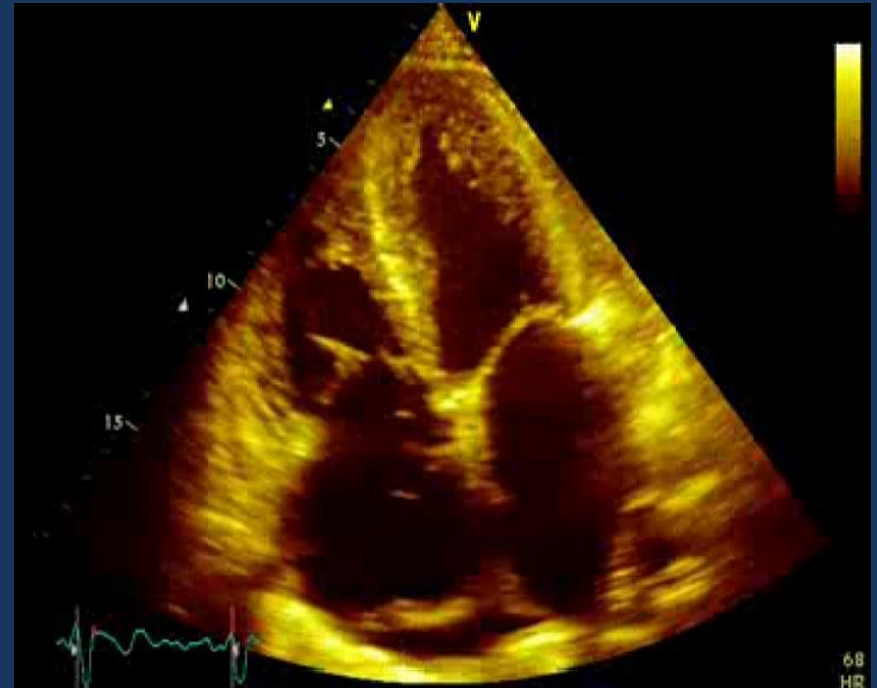
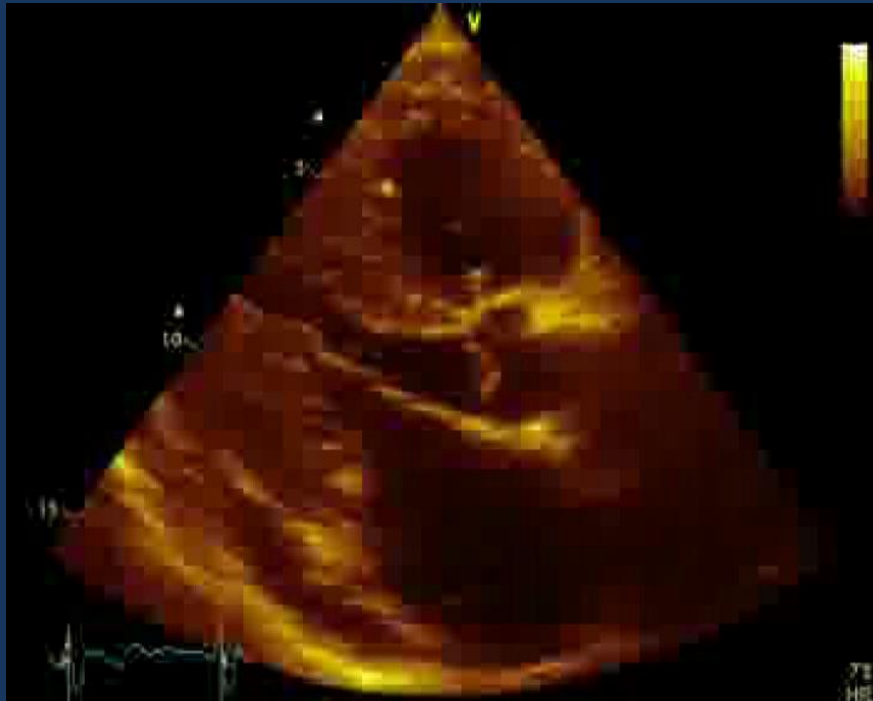
**Διατακτική μυοκαρδιοπάθεια λόγω ανεπάρκειας αορτής:
Ελαττωμένη συσταλτικότητα, Διάταση, Ικανό πάχος τοιχωμάτων**

Δ.Δ. Δύσπνοιας



Υπερτροφία/Υπερτροφική Μυοκαρδιοπάθεια :
ΗΚΓ με μεγάλα επάρματα, αρνητικά T

Δ.Δ. Δύσπνοιας



**Αμυλοείδωση-Περιοριστική μυοκαρδιοπάθεια:
Υπερτροφία και ΗΚΓ με χαμηλά επάρματα**

Δ.Δ. Δύσπνοιας



έλεγχος για πλευριτική συλλογή

Εκτίμηση του προφορτίου της αριστερής κοιλίας

- Το προφόρτιο είναι η τάση που ασκείται στα τοιχώματα της Α.Κ. στο τέλος της διαστολής.
- Frank - Starling :όσο μεγαλύτερο είναι το προφόρτιο τόσο μεγαλύτερη είναι η δύναμη της συστολής.
- Μεθοδος εκτίμησης του προφορτίου της Α.Κ. είναι οι διαστάσεις και υπολογισμός του τελοδιαστολικού όγκου

Διαστάσεις αριστερής κοιλίας

	ΓΥΝΑΙΚΕΣ				ΑΝΔΡΕΣ			
	ΦΤ	Ηπico Διέτωση	Μέτριο Διέτωση	Σοφορή διέτωση	ΦΤ	Ηπico Διέτωση	Μέτριο Διέτωση	Σοφορή διέτωση
ΤΑΔ Διόμετρος, cm	3,9- 5,3	5,4-5,7	5,8-6,1	>6,2	4,2- 5,9	6- 6,3	6,4-6,8	>6,9
Διόμετρος/ ΔΜΣ, cm/m ²	2,4- 3,2	3,3-3,4	3,5-3,7	>3,8	2,2- 3,1	3,2-3,4	3,5-3,6	>3,7
ΤΑΔ Όγκος, mL	56- 104	105-117	118-130	>131	67- 155	156-178	179-201	>201
ΤΑΔ Όγκος/ ΔΜΣ, mL/ m ²	35- 75	76-86	87-96	>97	35- 75	76-86	87-96	>97
ΤΕΣ Όγκος, mL	19- 49	50-59	60-69	>70	22- 58	59-70	71-82	>83
ΤΕΣ Όγκος/ ΔΜΣ, mL/ m ²	12- 30	31-36	37-42	>43	12- 30	31-36	37-42	>43

Preload assessment

- Normally IVC collapsed with inspiration
- Hypovolaemia: collapsed IVC
- RVF/ RV MI, Massive PE, TR, Cardiac Tamponade: distended IVC and Loss of inspiratory Collapse
- Semi-quantitative estimation of RAP possible

Preload assessment



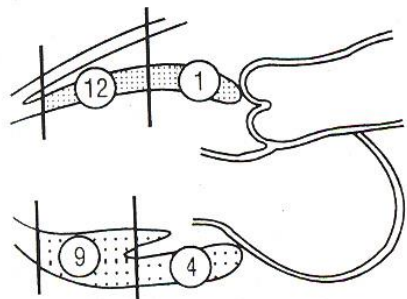
Preload assessment

	IVC size	Change with inspiration	Estimated RAP
Hypovolaemic	<1.5cm	Collapsed	0-5mmHg
Normal	1.5-2.5cm	Decrease >50%	5-10mmHg
Normal	1.5-2.5cm	Decrease <50%	10-15mmHg
Dilated	>2.5cm	Decrease <50%	15-20mmHg
Dilated	>2.5cm + Distended Hepatic Vein	No Change	>20mmHg

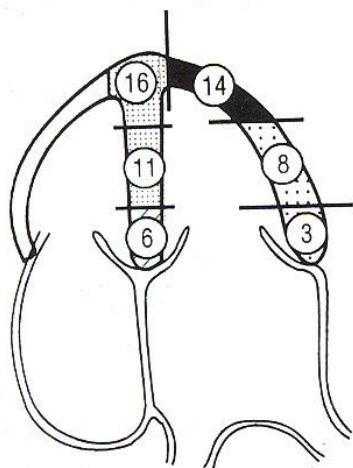
Chest Pain

- **Possibly detectable Causes by ECHO:**
 - **AMI, ACS—regional wall motion abnormality**
 - **Aortic Dissection—dilated Ao, visible intimal flap**
 - **Pulmonary Embolism—dilated RV and IVC, visible thrombus in RV/PA**
 - **Pericarditis with effusion—pericardial effusion**

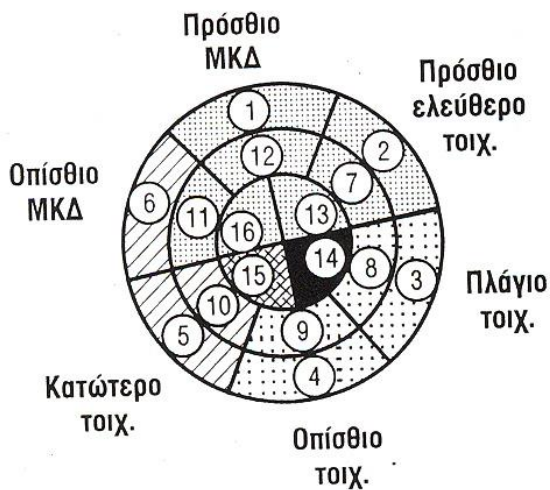
Μοντέλο 16 τμημάτων








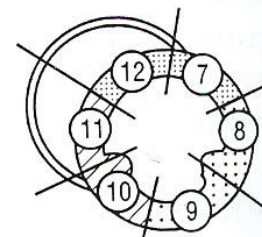
Παραστερνική
επιμήκης προβολή



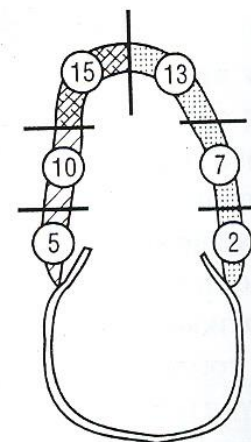
Κορυφαία προβολή
4-κοιλοτήτων



-  Πρόσθιος κατιών
-  Περισπωμένη αρτηρία
-  Δεξιά στεφανιαία αρτηρία
-  Πρόσθιος κατιών ή περισπωμένη αρτηρία
-  Πρόσθιος κατιών ή δεξιά στεφανιαία αρτηρία

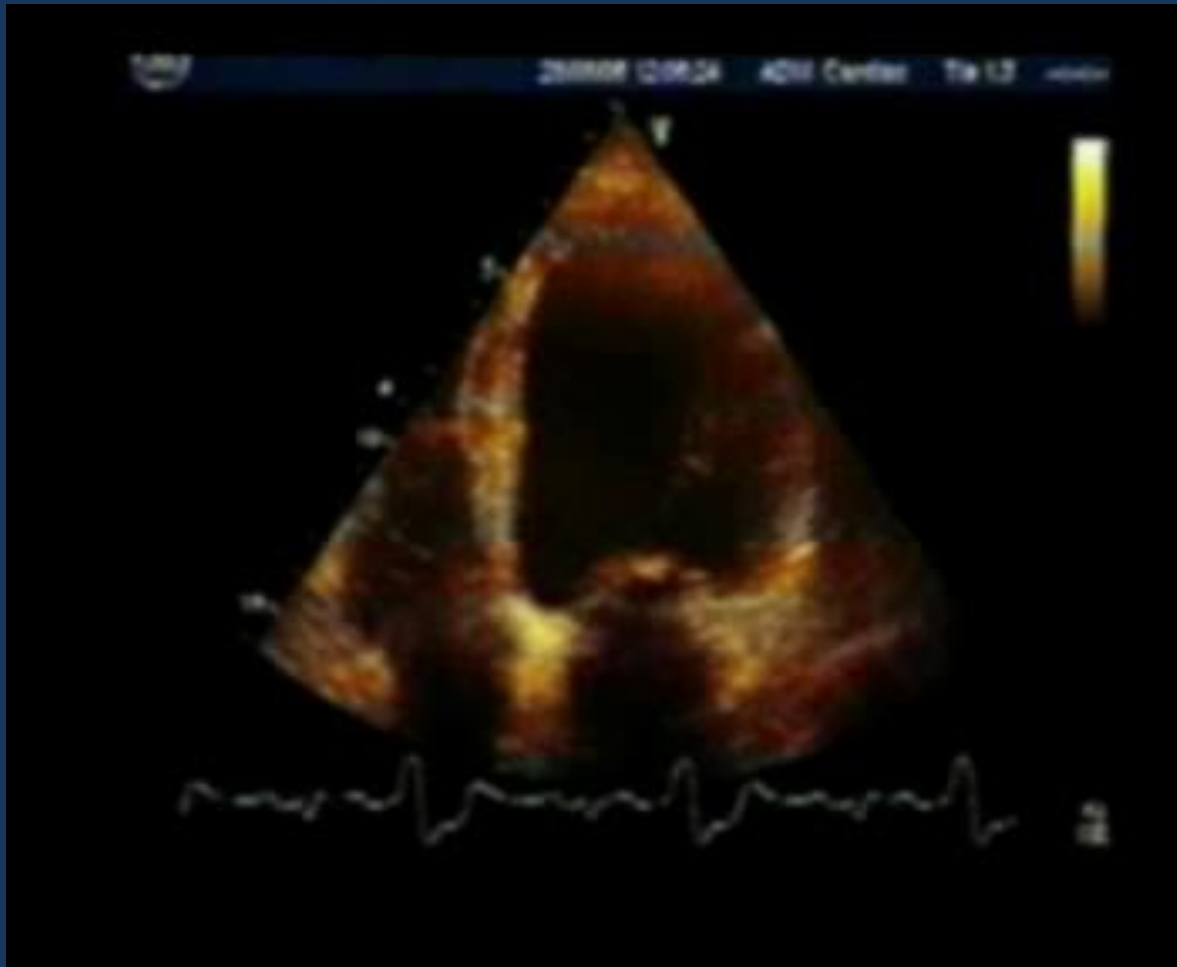


Παραστερνική
εγκάρσια προβολή



Κορυφαία προβολή
2-κοιλοτήτων

Δ.Δ. Θωρακικός Πόνος

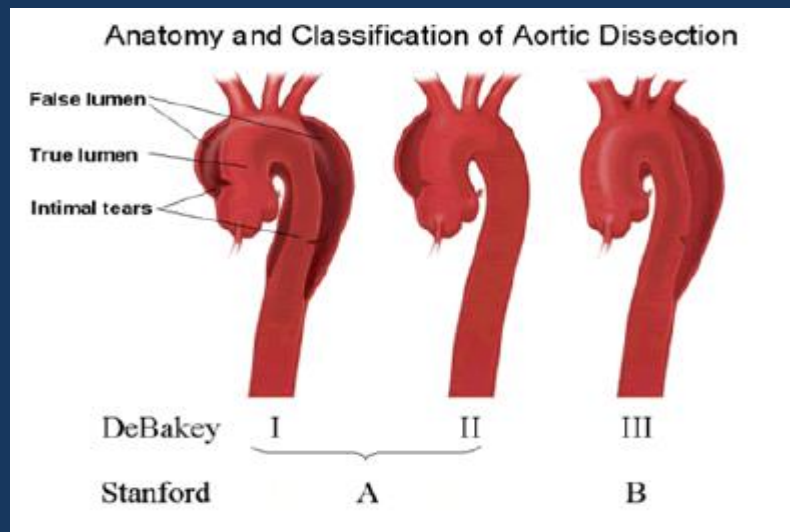


Μυοκαρδίτιδα:

Πυρετός, ελατωμένη συσταλτικότητα χωρίς διάταση

Aortic Dissection

- High mortality if untreated: 1-2%/hour over 1st 24-48 hours
- Only 43% of confirmed patients with AD were suspected and up to 28% was diagnosed postmortem
- CXR: normal in 12-18% and only 10-18% have widened mediastinum



Symptoms in aortic dissection

PAIN: 90% of cases

Congestive heart failure

Syncope or neurological manifestations (6-19%)

Cerebrovascular accident (3-6%)

Ischemic peripheral neuropathy

Paraplegia

Anuria-severe hypertension (5-8%)

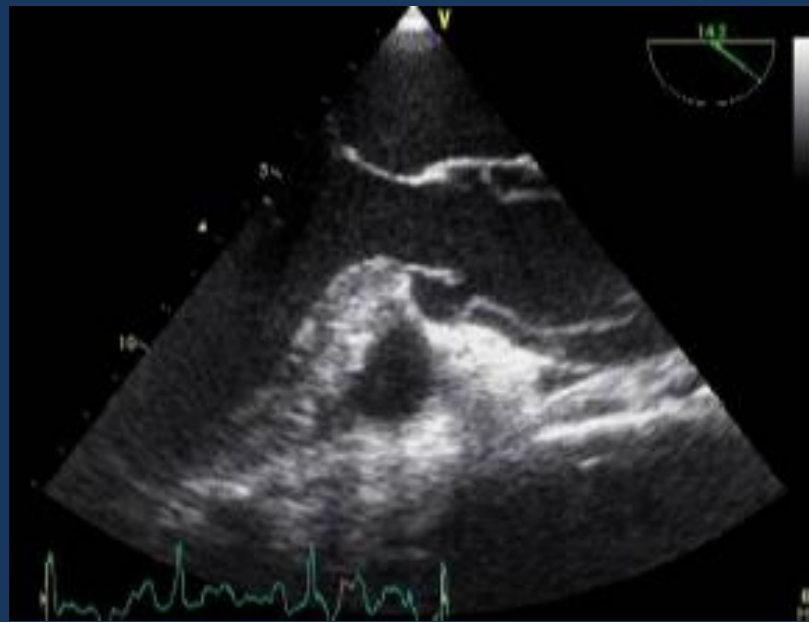
Mesenteric ischemia symptoms (3-5%)

Spittell et al, Mayo Clin. Proc 1993

Task Force Report Erbel et al, EHJ 2001

Aortic Dissection

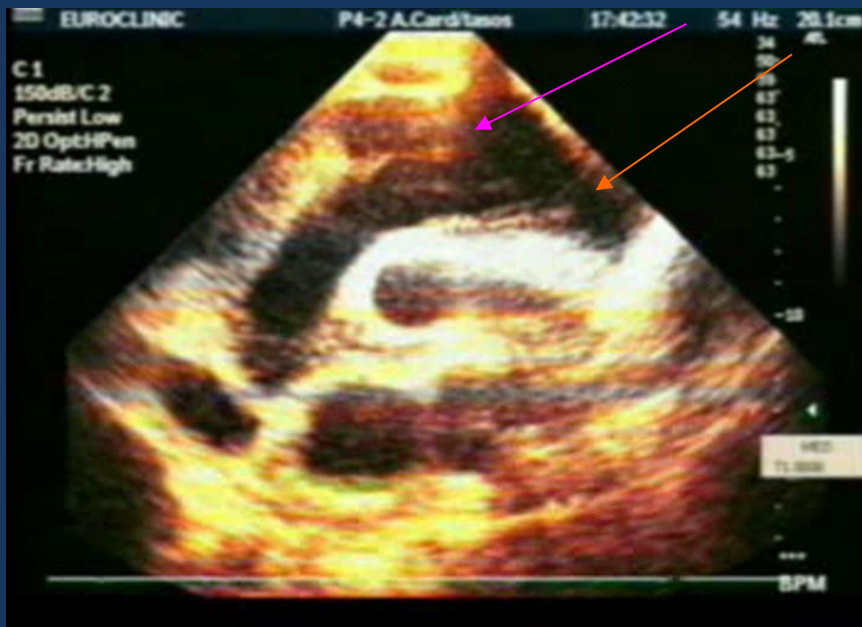
- Sensitivity for aortic dissection
 - Transthoracic Echo: 70%, mainly for proximal disease
 - Transesophageal Echo: near 100%



Δ.Δ. Θωρακικός Πόνος



Διαχωρισμός της αορτής



Thrombosed dissection at its biggest part (partially)

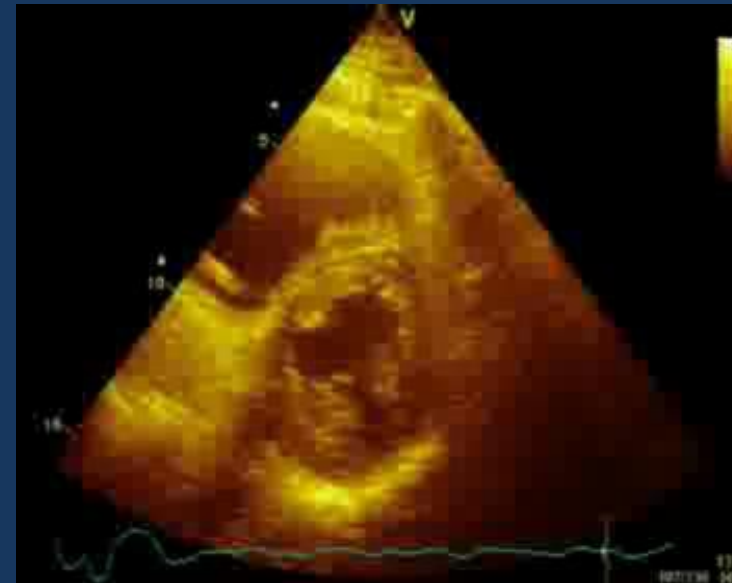
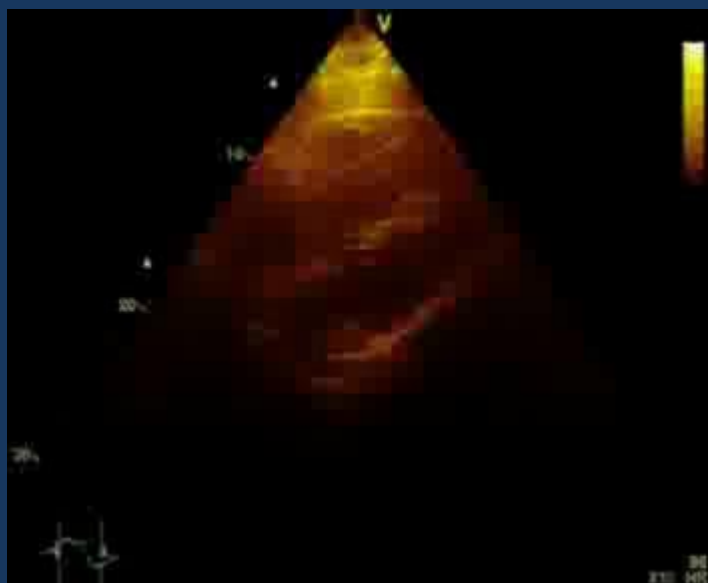


Only entry site at the posterior part of the aorta

Δ.Δ. Δύσπνοια, Θωρακικός πόνος, ζάλη



ΠΝΕΥΜΟΝΙΚΗ ΕΜΒΟΛΗ

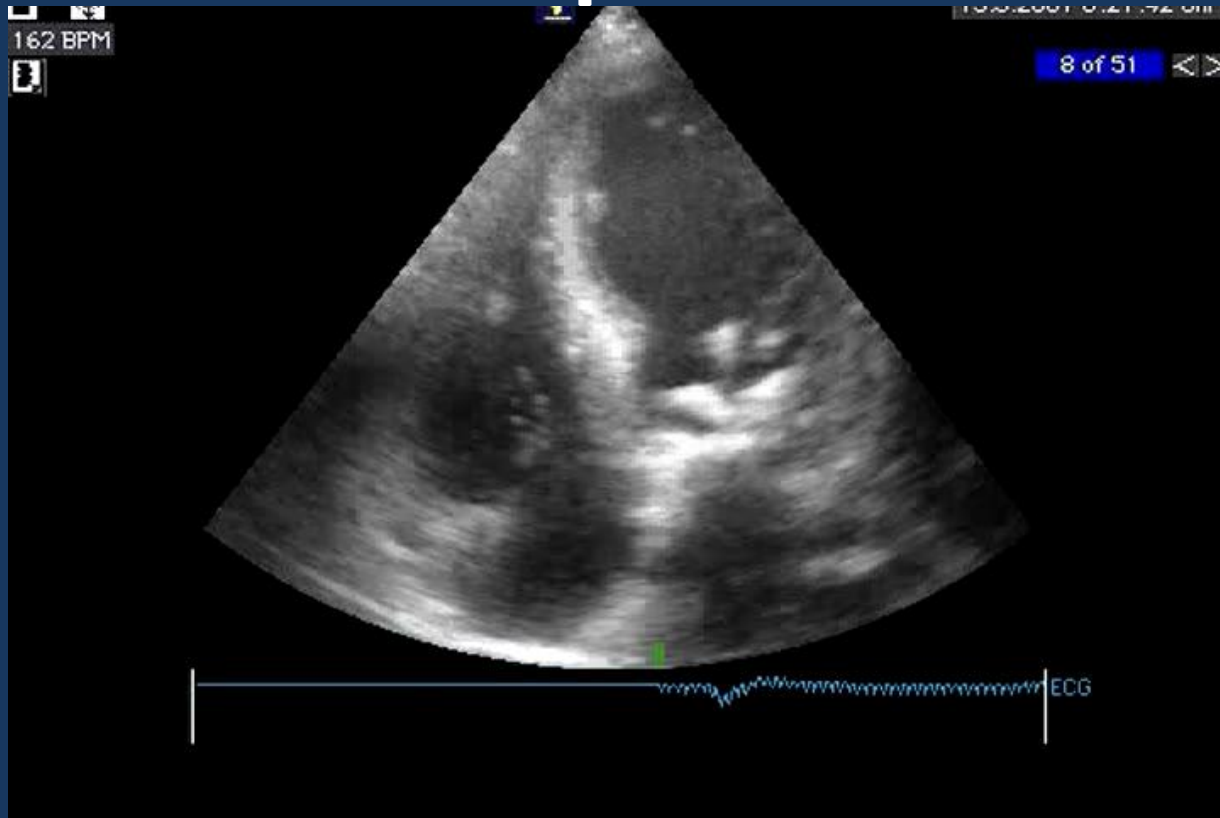


Δ.Δ. ΑΕΕ-εμβολικού επεισοδίου



Θρόμβος αριστερής κοιλίας

Δ.Δ. Εμβολικού επεισοδίου μετά πυρετού



Κυματίζουσα δομή/Εκβλάστηση στη μιτροειδή
Πιθανή ενδοκαρδίτιδα

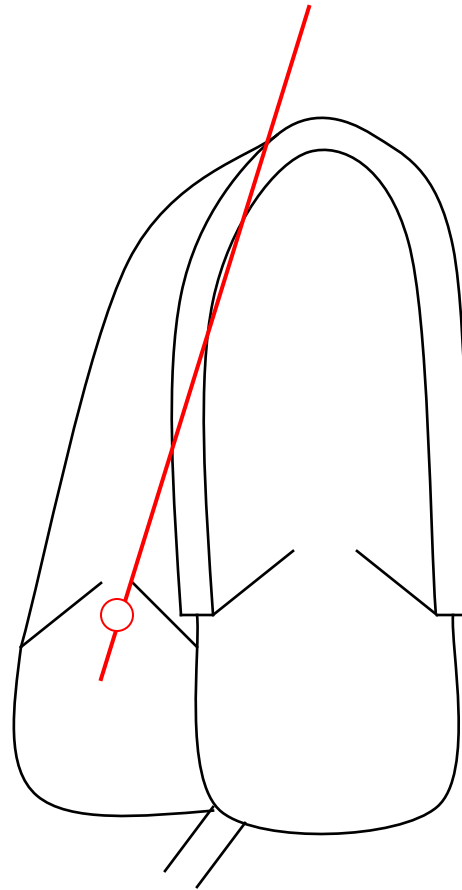
Δ.Δ. ΑΕΕ-εμβολικού επεισοδίου



Μύξωμα

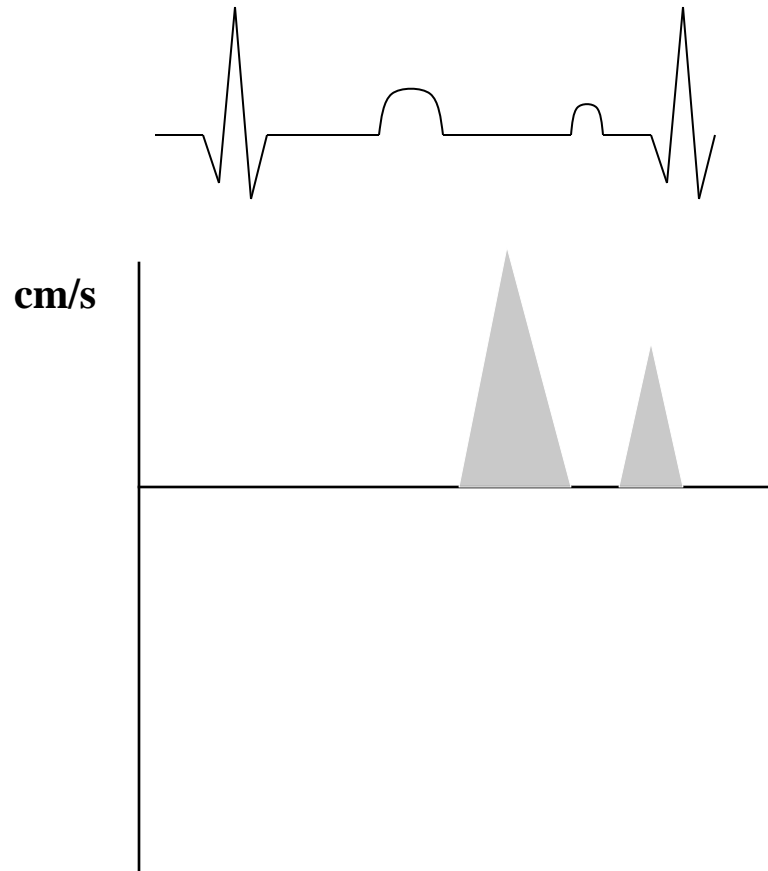
**What about doppler?
Is it useful?**

Tricuspid Inflow - CWD



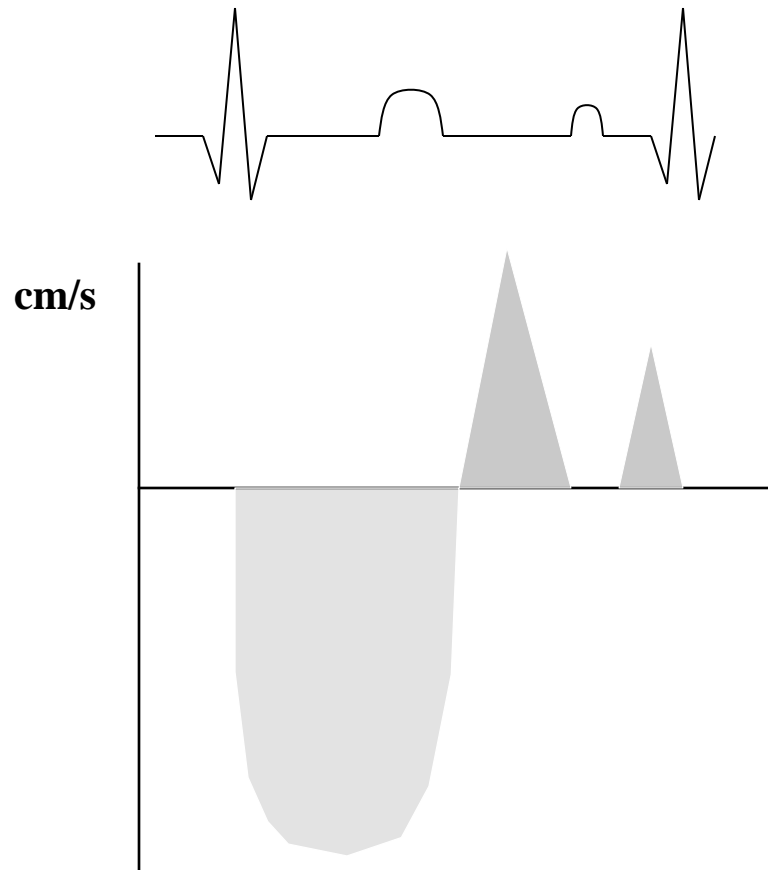
ΥΠΟΛΟΓΙΣΜΟΣ ΠΙΕΣΗΣ ΠΝΕΥΜΟΝΙΚΗΣ

Tricuspid Regurgitation



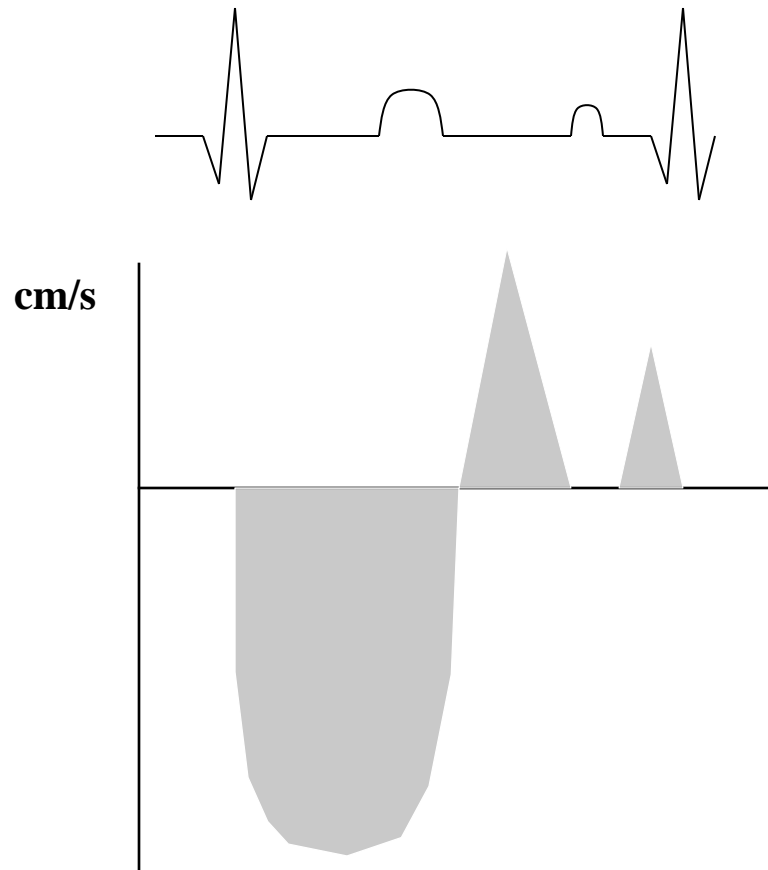
ΥΠΟΛΟΓΙΣΜΟΣ ΠΙΕΣΗΣ ΠΝΕΥΜΟΝΙΚΗΣ

Tricuspid Regurgitation



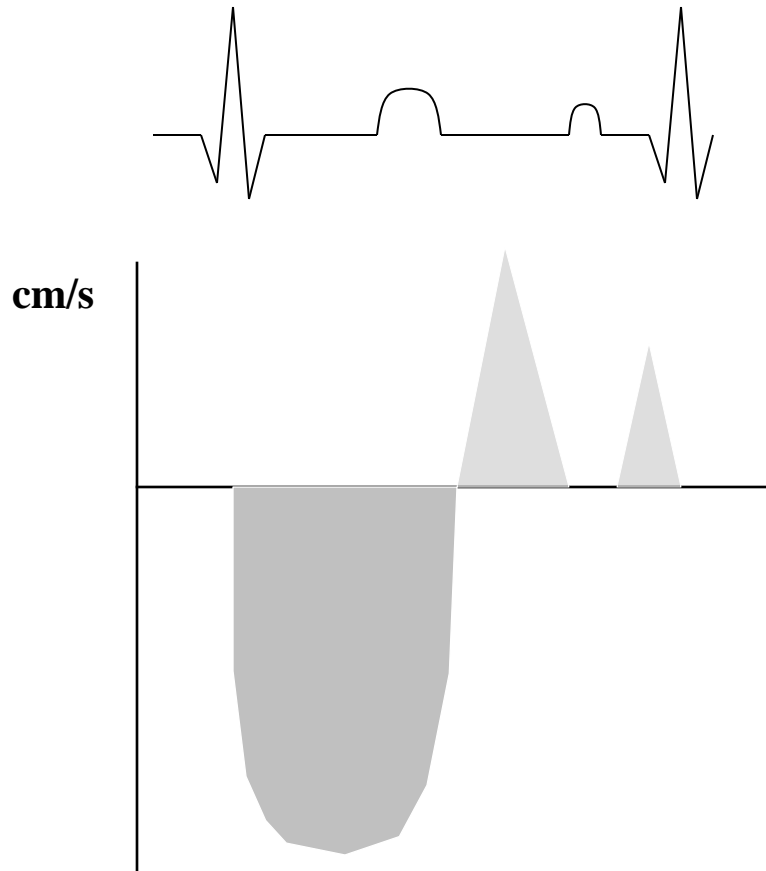
ΥΠΟΛΟΓΙΣΜΟΣ ΠΙΕΣΗΣ ΠΝΕΥΜΟΝΙΚΗΣ

Tricuspid Regurgitation



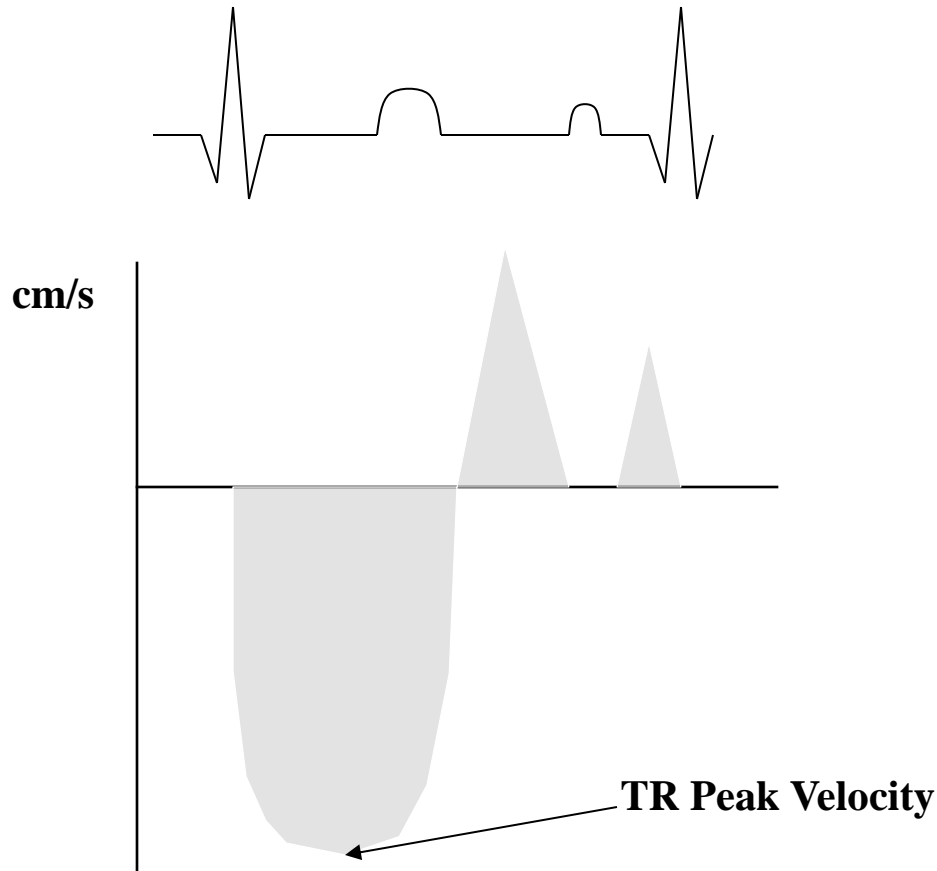
ΥΠΟΛΟΓΙΣΜΟΣ ΠΙΕΣΗΣ ΠΝΕΥΜΟΝΙΚΗΣ

Tricuspid Regurgitation



ΥΠΟΛΟΓΙΣΜΟΣ ΠΙΕΣΗΣ ΠΝΕΥΜΟΝΙΚΗΣ

Tricuspid Regurgitation



ΥΠΟΛΟΓΙΣΜΟΣ ΠΙΕΣΗΣ ΠΝΕΥΜΟΝΙΚΗΣ

Tricuspid Regurgitation

$$RVSP = SPAP = 4 (TR_{jet})^2 + RAP$$

ΥΠΟΛΟΓΙΣΜΟΣ ΠΙΕΣΗΣ ΠΝΕΥΜΟΝΙΚΗΣ

TR – RVSP/SPAP

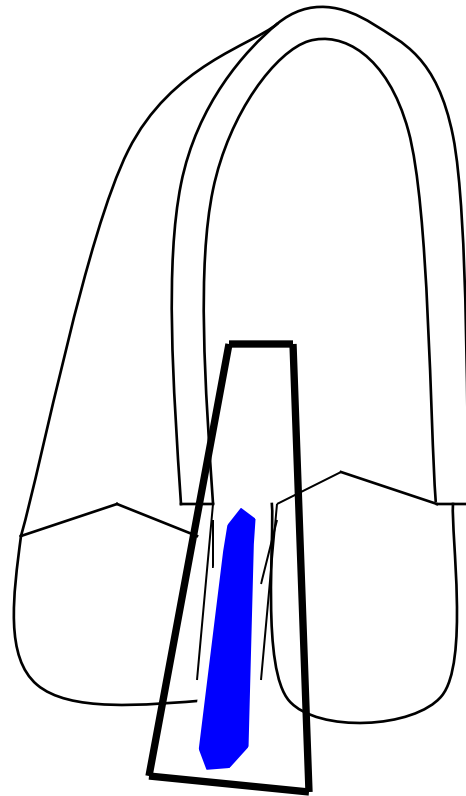
	RVSP/SPAP
Normal	18 to 25 mmHg
Mild	30 to 40 mmHg
Moderate	40 to 70 mmHg
Severe	>/= 70 mmHg
Eisenmenger's Physiology	>/= 120 mmHg SPAP = Systemic Pressure

ΥΠΟΛΟΓΙΣΜΟΣ ΠΙΕΣΗΣ ΠΝΕΥΜΟΝΙΚΗΣ

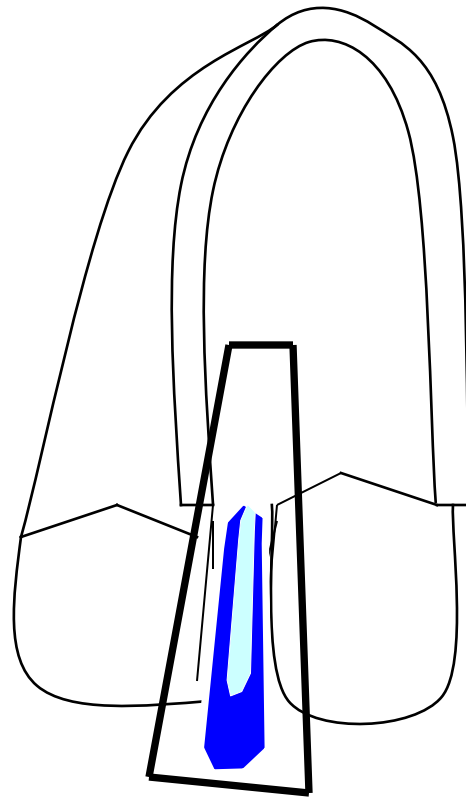
Apical 5 Chamber

ΕΚΤΙΜΗΣΗ ΑΟΡΤΙΚΗΣ ΣΤΕΝΩΣΗΣ

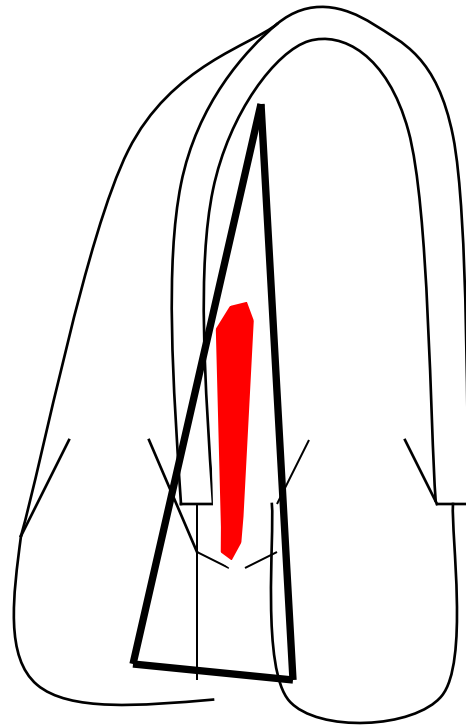
Aortic – Normal Flow



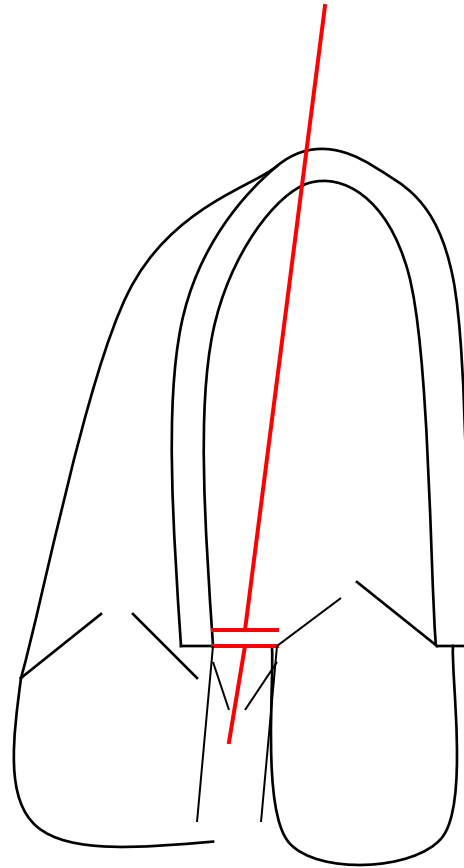
Aortic Stenosis



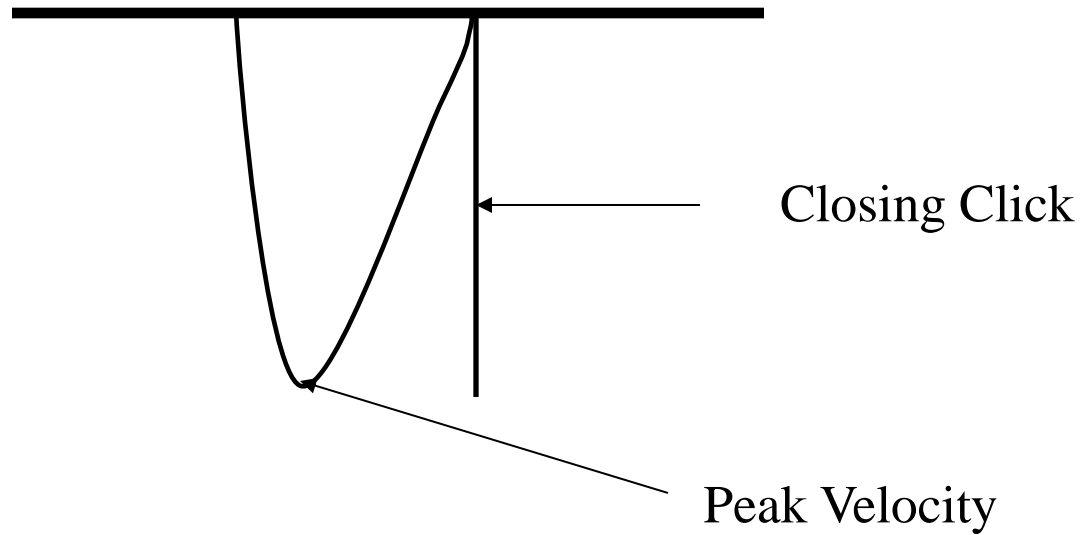
Aortic Regurgitation



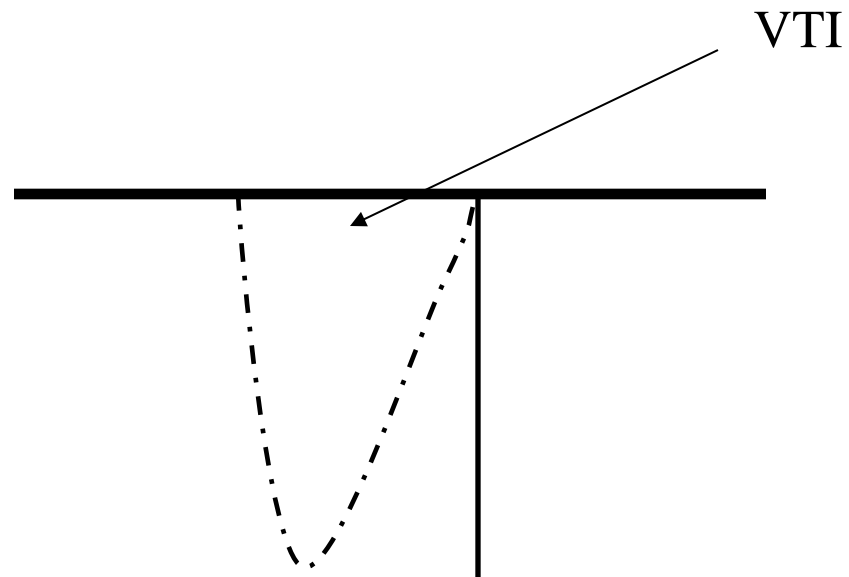
Outflow – LVOT - PWD



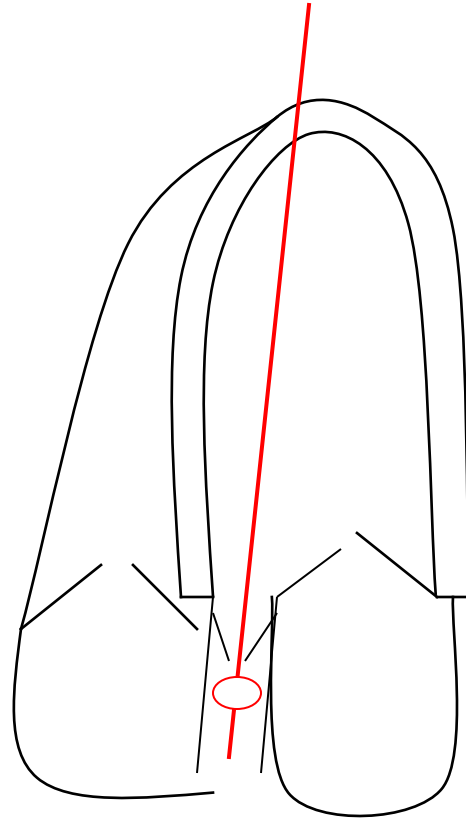
Outflow – LVOT - PWD



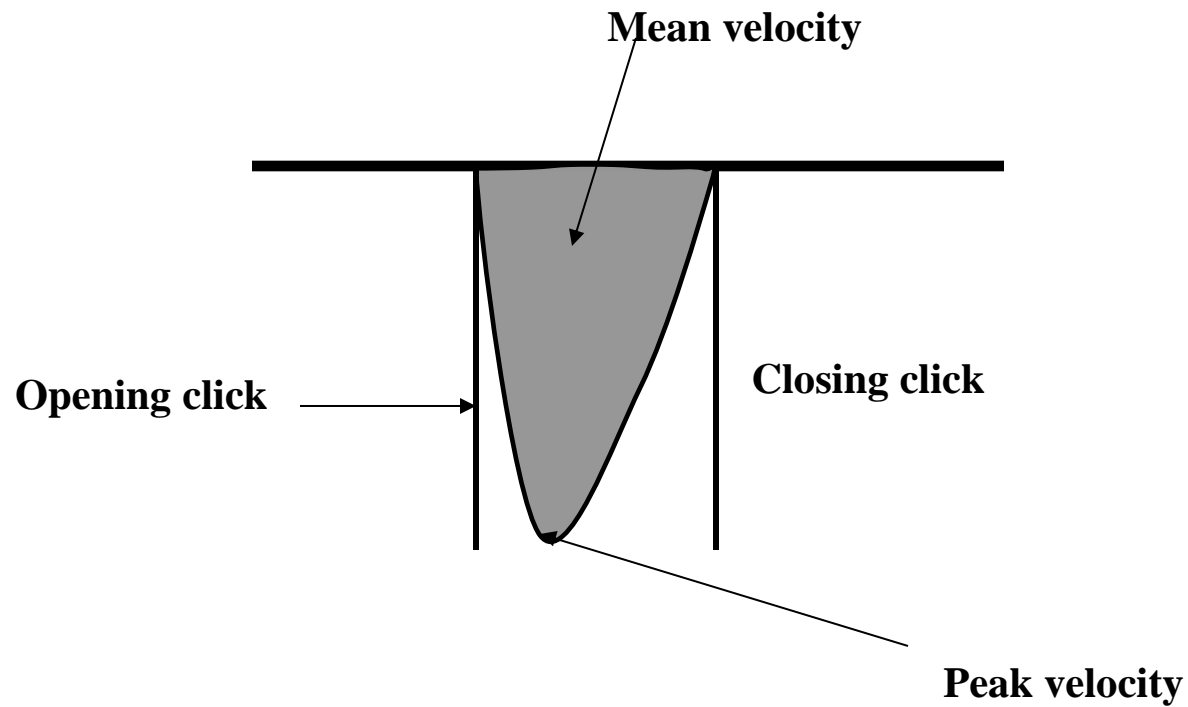
Outflow – LVOT - PWD



Outflow – Aortic - CWD



Outflow – Aortic - CWD



Aortic Stenosis

Severity	Peak Aortic Valve Velocity
Mild	< 3.0 m/s
Moderate	3.0 to 4.0 m/s
Severe	> 4.0 m/s

Aortic Stenosis

Severity	Maximum Instantaneous Pressure Gradient
Mild	16 to 36 mmHg
Moderate	36 to 50 mmHg
Moderately Severe	50 to 64 mmHg
Severe	> 64 mmHg

Aortic Stenosis

Severity	Peak Transvalvular Pressure Gradient
Mild	< 30 mmHg
Moderate	30 to 50 mmHg
Severe	> 50 mmHg

**Είναι δύσκολο να μάθει ένας
παθολόγος echo?**



**Εξαρτάται από την
εκπαίδευση και την θέληση
ΤΟΥ...**

LEVEL 1 COMPETENCY

Training requirements have been designed in order to address these different components of the knowledge required to perform an echocardiographic study.

The minimum training required for autonomous interpretation of transthoracic echocardiographic studies is summarised in Table 2. Exposure to transoesophageal and stress echocardiography is recommended. Of the 600 transthoracic echocardiograms with which the trainee is involved (300 performed and interpreted, 300 interpreted only), at least 50 studies should involve the ~~interpretation of transoesophageal echocardiograms and~~ at least 25 studies should involve the interpretation of stress echocardiograms. The possibility of a

Level 1 Training (3 Months, At Least 75 Examinations Personally Performed, 150 Examinations Interpreted)

Level 2 Training (3 Months Of Additional Training, At Least 75 Additional Examinations Personally Performed, At Least 150 Additional Examinations Interpreted)

Who can perform echo?

- Obviously Echocardiologists as categorized by ASE (American Society of Echocardiography)
- Cardiac Sonographers with proper and formal training in the field (USA, Britain)

ΣΥΜΠΕΡΑΣΜΑΤΙΚΑ ένα παθολόγος θα μπορούσε να μάθει να εκτιμά..

- Συστολική λειτουργία αριστερής και δεξιάς κοιλίας
- ΔΔ εμφράγματος, περικαρδιακή συλλογή-επιπωματισμός, διαχωρισμός αορτής, πνευμονική εμβολή
- Αιμοδυναμική κατάσταση, προφόρτιο, πλευριτικές συλλογές
- Πίεση πνευμονικής, εκτίμηση αορτικής βαλβίδας

ΣΥΜΠΕΡΑΣΜΑΤΙΚΑ

- Υπάρχει πάντα η συνεχής και βαθύτερη εκπαίδευση
- Δεν πρέπει να υπάρχουν στεγανά στην ιατρική. Η διάγνωστική και η θεραπευτική υπάρχουν για τον ασθενή και μόνο και όχι για να ικανοποιούν την αλαζονία των ιατρών
- Υπάρχει και η τηλειατρική και η συμβουλή από εμπειρότερο

ΣΥΜΠΕΡΑΣΜΑΤΙΚΑ

- Η ηχοκαρδιογραφία μπορεί να είναι το 2^ο στηθοσκόπιο στα χέρια του κλινικού ιατρού και όχι Το Στηθοσκόπιο
- Μπορεί να λειτουργήσει συμπληρωματικά στην κλινική εξέταση ώστε να βελτιστοποιήσει τις επιδόσεις της Ιατρικής Τέχνης
- Δεν μπορεί να υποκαταστήσει την επικοινωνία, την επαφή και την σχέση που δημιουργείται κατά την διάρκεια μιας κλινικής εξέτασης
- Ο Ιατρός δεν θα γίνει ένας απρόσωπος τεχνικός, αλλά οφείλει να διεκδικεί το ρόλο του Μάγου της Φυλής..

Field in Argenteuil, Claude Monet

