

ΔΙΕΡΕΥΝΗΣΗ ΔΕΞΙΑΣ ΚΑΡΔΙΑΚΗΣ ΑΝΕΠΑΡΚΕΙΑΣ

ΧΩΡΙΣ ΠΝΕΥΜΟΝΙΚΗ ΥΠΕΡΤΑΣΗ

ΣΕΜΙΝΑΡΙΟ ΟΜΑΔΩΝ ΕΡΓΑΣΙΑΣ

18-20 ΦΕΒΡΟΥΑΡΙΟΥ 2010

ΘΕΣΣΑΛΟΝΙΚΗ

**ΖΑΧΑΡΑΚΗ ΑΓΓΕΛΙΚΗ
ΚΑΡΔΙΟΛΟΓΟΣ
Ηράκλειο, Κρήτη**

European Accreditation in Transthoracic and Transesophageal Echocardiography

Right-sided Heart Failure: **What is it?**

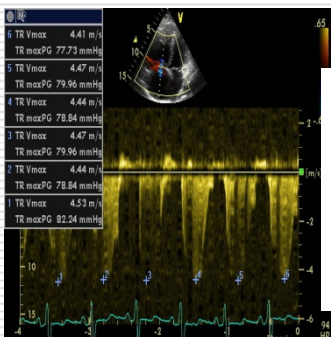
- RV failure is a **complex clinical syndrome** that can result from any **structural or functional cardiovascular disorder** that impairs the **ability of the RV to fill or to eject blood.**



Pulmonary hypertension: mean pulmonary arterial pressure by right heart catheterization

$$\text{PASP} = 4\text{TRV}^2\text{max} + \text{RAP}$$

$$\text{mean PAP} = 0.61 \times \text{PASP} + 2 \text{ mmHg}$$



Estimates RA pressure: (mm Hg)*

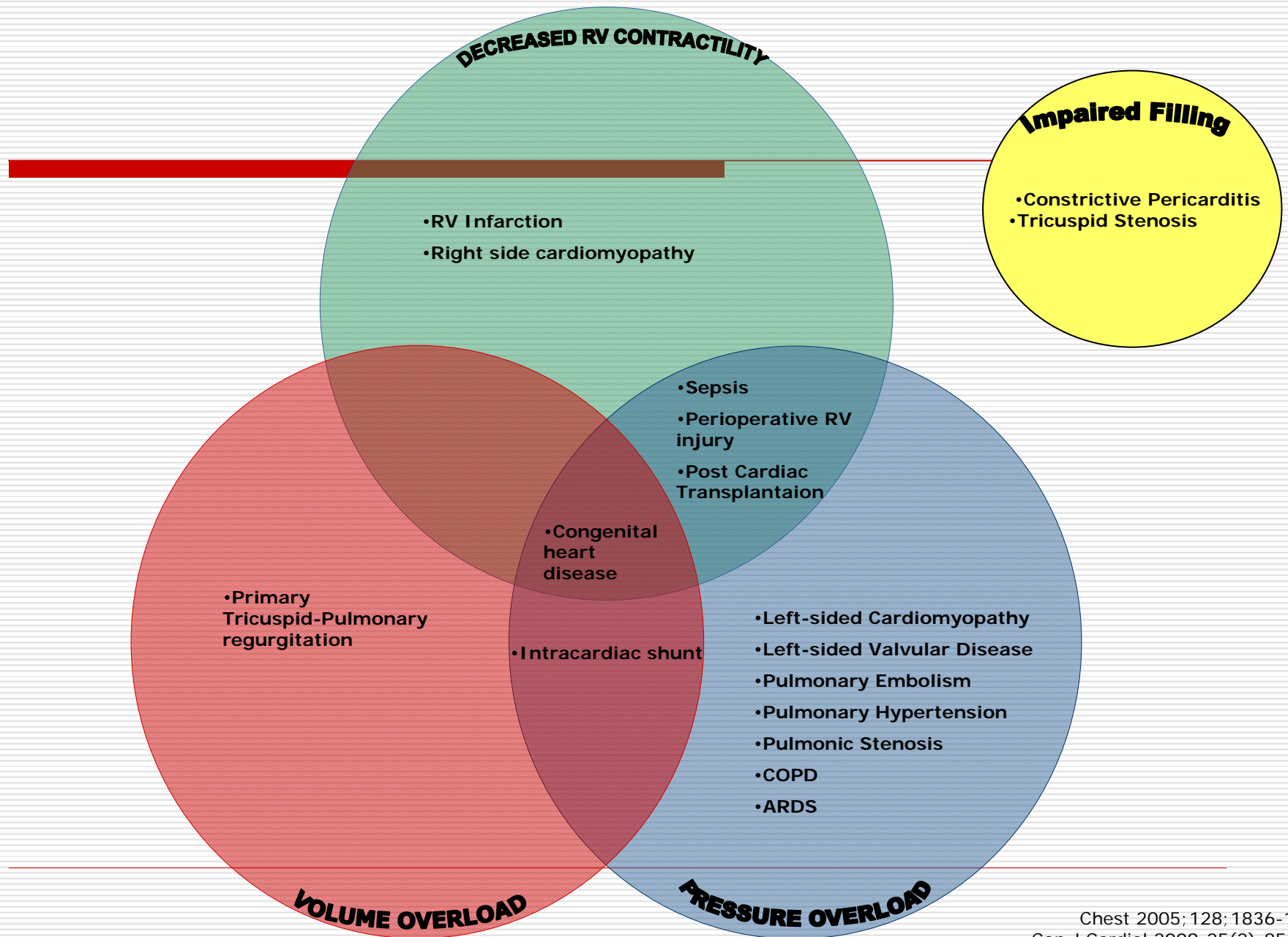
- IVC ≤ 1.7 cm, CI $\geq 50\%$: 0–5
- IVC > 1.7 cm, CI $\geq 50\%$: 6–10
- IVC > 1.7 cm, CI $< 50\%$: 10–15
- IVC > 1.7 cm, fixed: ≥ 15



Table 9 Arbitrary criteria for estimating the presence of PH based on tricuspid regurgitation peak velocity and Doppler-calculated PA systolic pressure at rest (assuming a normal right atrial pressure of 5 mmHg) and on additional echocardiographic variables suggestive of PH

	Class ^a	Level ^b
Echocardiographic diagnosis: PH unlikely		
Tricuspid regurgitation velocity ≤ 2.8 m/s, PA systolic pressure ≤ 36 mmHg, and no additional echocardiographic variables suggestive of PH	I	B
Echocardiographic diagnosis: PH possible		
Tricuspid regurgitation velocity ≤ 2.8 m/s, PA systolic pressure ≤ 36 mmHg, but presence of additional echocardiographic variables suggestive of PH	IIa	C
Tricuspid regurgitation velocity 2.9–3.4 m/s, PA systolic pressure 37–50 mmHg with/without additional echocardiographic variables suggestive of PH	IIa	C
Echocardiographic diagnosis: PH likely		
Tricuspid regurgitation velocity > 3.4 m/s, PA systolic pressure > 50 mmHg, with/without additional echocardiographic variables suggestive of PH	I	B
Exercise Doppler echocardiography is not recommended for screening of PH	III	C

Conditions associated with RV failure categorized by initial pathophysiology



Κλινικό σενάριο 1

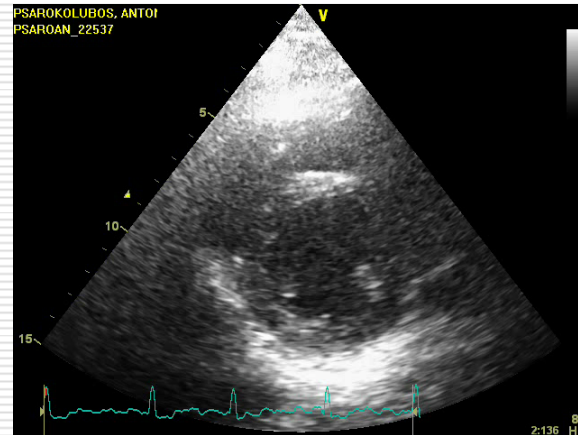
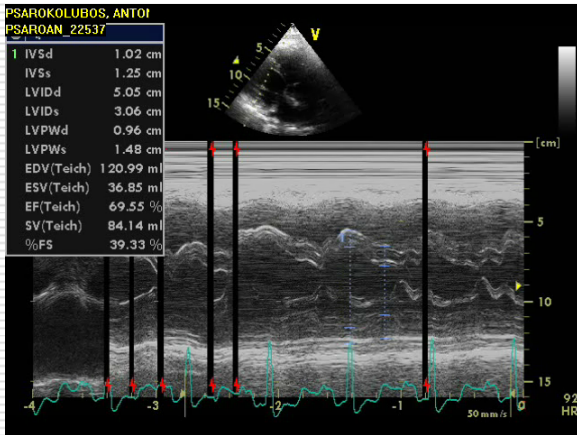
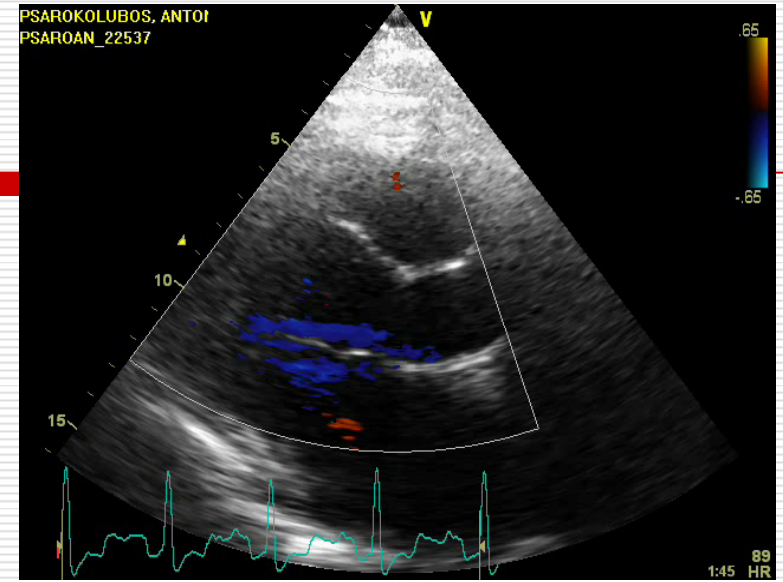
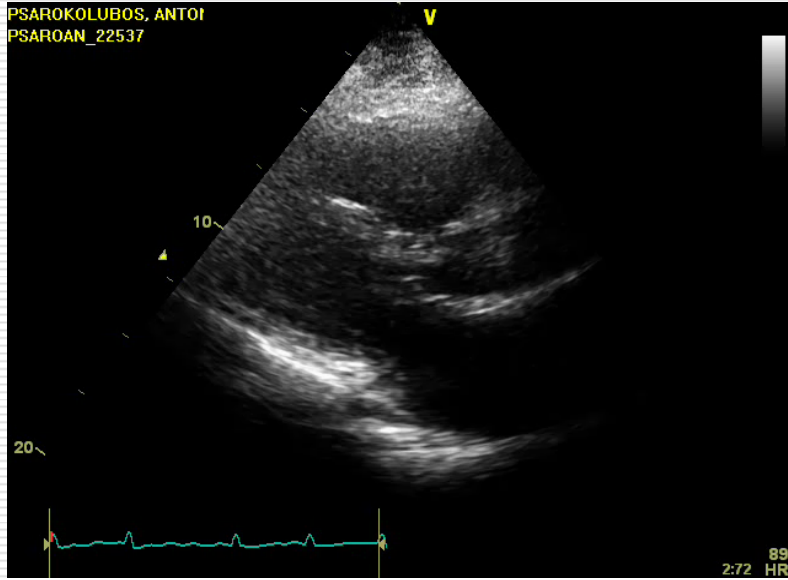
- Άνδρας 30 ετών.
 - Ιστορικό περικαρδίτιδας προ 15 έτη.
 - Οιδήματα κ.άκρων, κόπωση από 3μήνου.

 - Ηπατομεγαλία, διάταση σφαγίτιδων.
 - ΑΠ: 100/70 mmHg.
 - S1-S2: άρρυθμοι, ευκρινείς.
 - Αναπνευστικό ψιθύρισμα:κφ.

 - ΗΚΓ: AF 95 bpm
 - Ro Θώρακος:κφ.
 - Εργαστηριακός έλεγχος: Ήπια τρανσαμιναιμία, λοιπά κφ.

 - ECHO
-

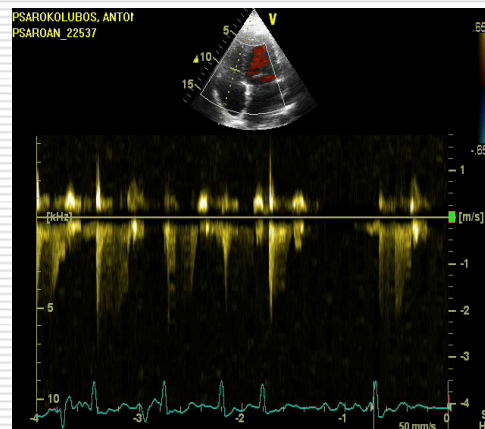
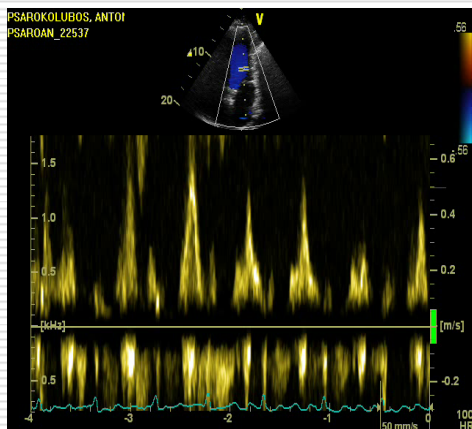
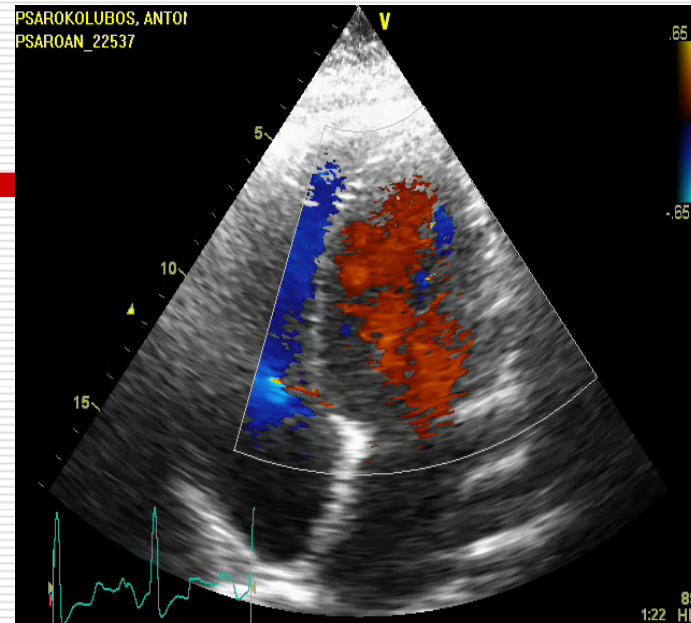
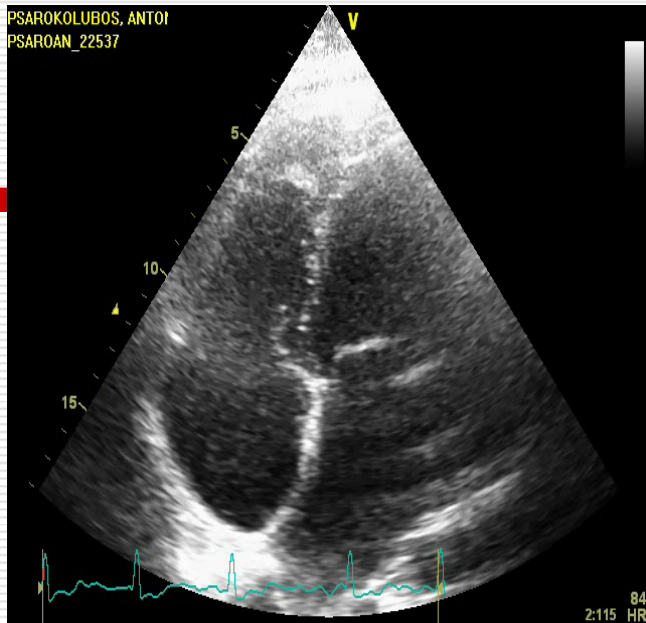
Κλινικό σενάριο 1



ECHO

- Παθολογική κίνηση IVS
- Διαστολική επιπέδωση PW
- Υπερηχογένεια περικαρδίου,
- Διάταση LA

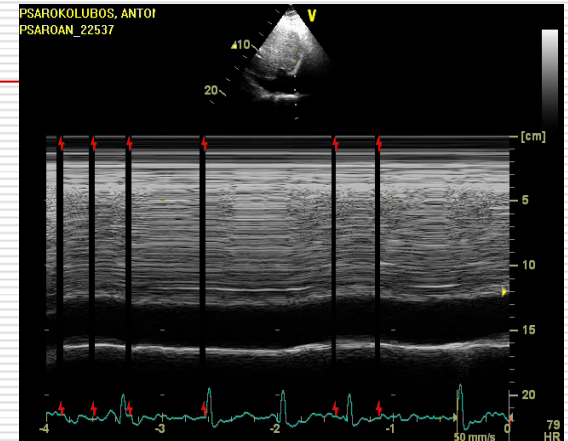
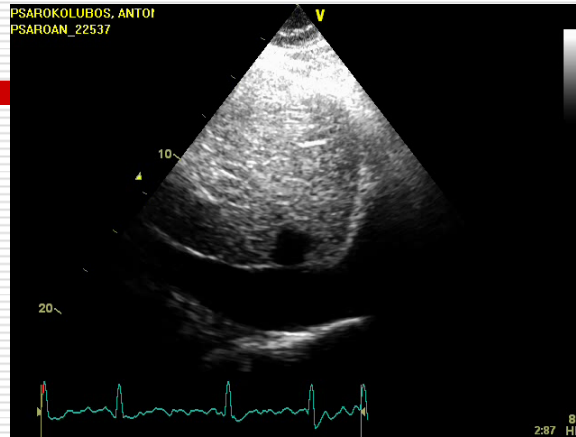
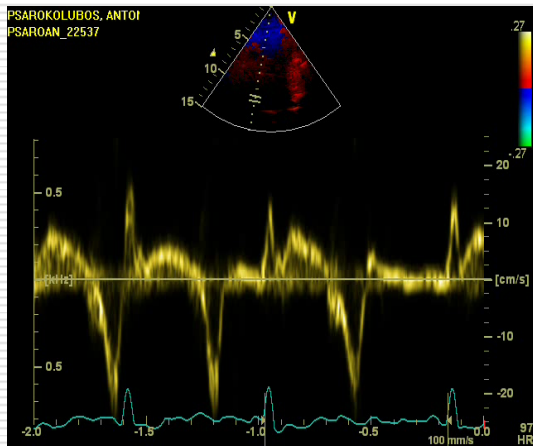
Κλινικό σενάριο 1



- ECHO
- Μεταβλητότητα της διαμτροειδικής ροής > 25%
- $V_{max} TR = 2m/sec$

Atrial fibrillation complicates the interpretation of respiratory variation of Doppler velocities, but respiratory variation can still be appreciated regardless of cardiac cycle length. Usually, this requires longer recording periods of Doppler tracings.
J Am Soc Echocardiogr 2009;22:24-33

Κλινικό σενάριο 1



- **ECHO**
- TDI E = 20 cm/sec
- Διατεταμένη IVC, απουσία εισπν. συμπίεσης

ECHO:

- Αναπήδηση IVS
- Διαστολική επιπέδωση PW
- Μεταβολή του καρδιακού περιγράμματος
- Διάταση LA
- Υπερηχογένεια, ακινησία περικαρδίου
- Μεταβλητότητα της διαμτροειδικής ροής >25%
- $V_{max} TR = 2m/sec$
- $TDI E = 20cm/sec$
- Διάτεταμένη IVC, απουσία εισπν. συμπίεσης

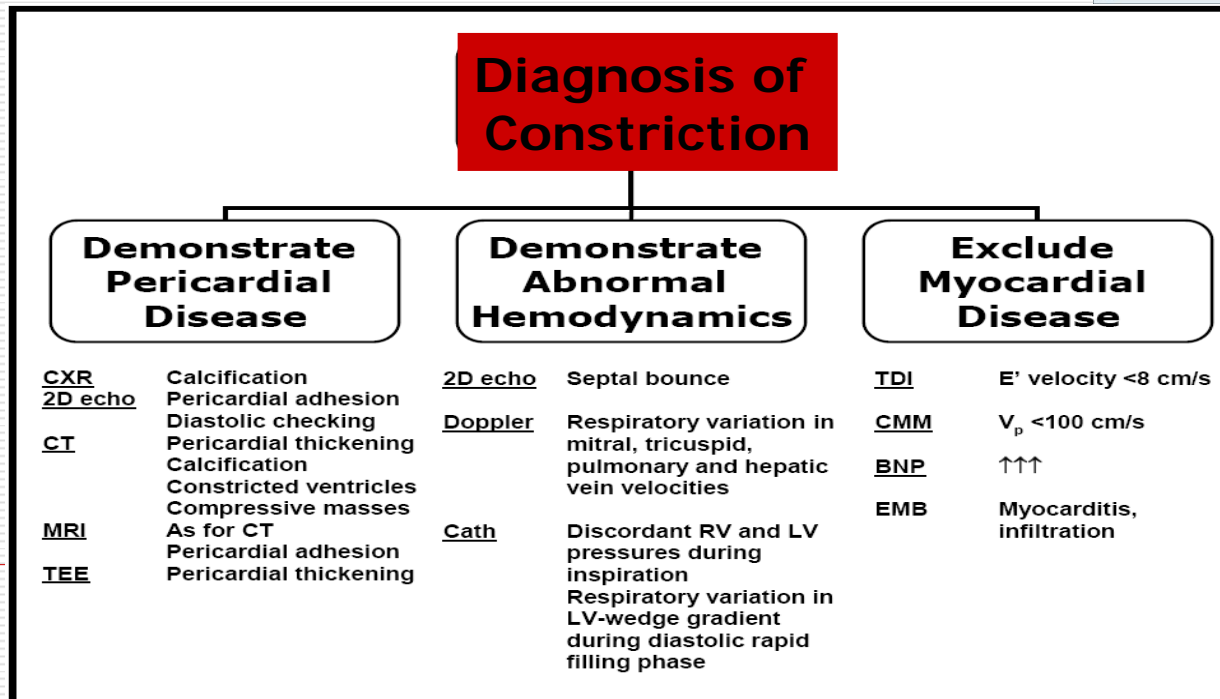
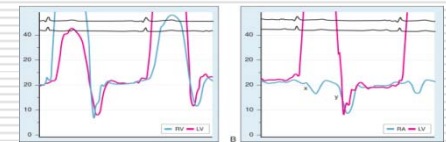
CT θώρακος:

Περικάρδιο: ήπια αποπιάνωση, πάχος 4mm.

Καθετηριασμός:

- Εξομοίωση αριστερών και δεξιών πιέσεων πλήρωσης
- Προεξάρχουσα κάθοδος γ στη μορφολογία των κυμάτων των συστηματικών φλεβών
- Σημείο της τετραγωνικής ρίζας στην κοιλιακή πίεση

Circulation 93:834, 1996



Echocardiographic diagnosis of constrictive pericarditis

Table 1 Sensitivities and specificities of echocardiographic markers for CP

Marker	Study	n	Secondary CP	Sensitivity	Specificity
<u>Doppler echocardiography</u>					
≥25% respiratory variation of peak early diastolic MV inflow velocity; augmented hepatic vein diastolic flow reversals after the onset of expiration; ≥ 25% of forward diastolic velocity	Oh et al ²¹	28	13	88%	67%
≥10% respiratory variation of peak early diastolic MV inflow velocity	Rajagopalan et al ³⁰	19	6	84%	91%
Color M-mode MV inflow propagation; first aliasing contour ≥ 100 cm/s	Prasad et al ³⁰	40	6	74%	94%
Respiratory variation in PV systolic/diastolic flow ratio ≥ 65% in inspiration + % change of early mitral peak diastolic flow ≥ 40%					
Respiratory variation in PV peak diastolic flow velocity ≥ 18%					
Dilated hepatic veins, "W" wave pattern (reverse flow in late systole and diastasis)					
<u>LV septal/posterior wall radial motion</u>					
IVS bounce					
M-mode					
M-mode					
2-dimensional					
Biphasic early diastolic IVS motion by color DTI (≥7 cm/s) motion					
Biphasic early diastolic IVS motion by pulsed tissue Doppler					
LV posterior wall flattening					
M-mode					
M-mode					
M-mode					
<u>Miscellaneous echocardiographic findings</u>					
Pericardial thickening					
M-mode	Engel et al ³¹	40	NA	53%	100%
M-mode	Hatle et al ¹⁸	7	4	100%	50%
2-dimensional	Oh et al ²¹	28	19	36%	NA
Left atrial enlargement, M-mode	Engel et al ³¹	40	NA	75%	100%
Premature PV opening, M-mode	Engel et al ³¹	40	NA	14%	100%

Multiple echocardiographic findings are used to confirm a diagnosis of CP, but demonstration of enhanced cardiac intracavitary blood flow variations during respiration, abnormal interventricular septal motion, and normal longitudinal mitral annular velocity provide the greatest diagnostic yield

J Am Soc Echocardiogr 2009;22:24-33

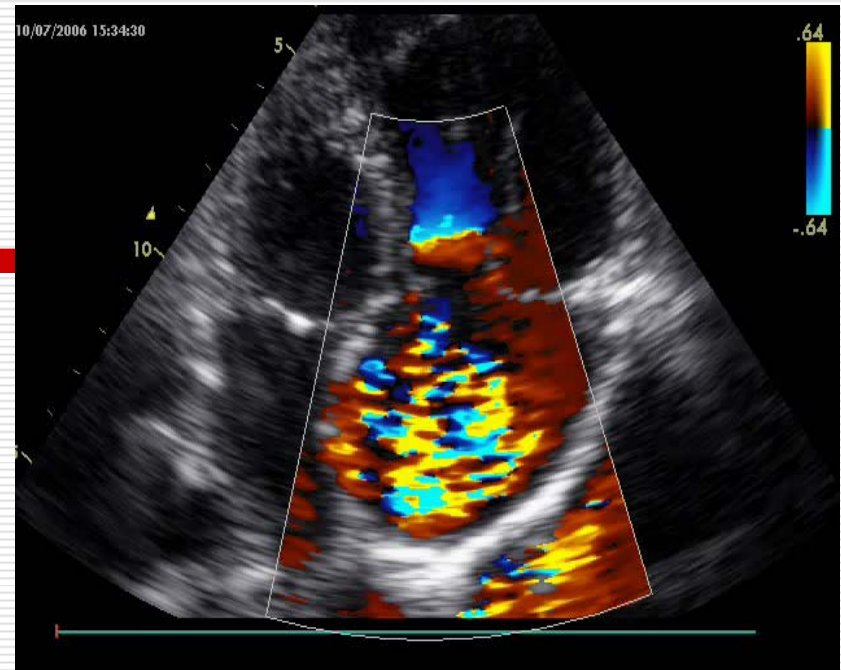
Κλινικό σενάριο 2

- ❑ Γυναίκα 20 ετών
 - ❑ Ιστορικό τροχαίου ατυχήματος με δίκυκλο όχημα προ 3μήνου, τραυματισμός στο θώρακα.
 - ❑ Οιδήματα κ.άκρων, κόπωση από 2 μήνου.

 - ❑ Διάταση σφαγίτιδων, ηπατομεγαλία, οιδήματα με εντύπωμα κ.άκρων.
 - ❑ ΑΠ: 100/70mmHg.
 - ❑ Ολοσυστολικό φύσημα με εισπνευστική επίταση αρ. παραστερνικά
 - ❑ Αναπνευστικό ψιθύρισμα: κφ

 - ❑ ΗΚΓ: SR 95 bpm.
 - ❑ Ρο Θώρακος: Διάταση δεξιού κόλπου.
 - ❑ Εργαστηριακός έλεγχος: Χωρίς αξιοσημείωτα παθολογικά ευρήματα.
 - ❑ ECHO
-

Κλινικό σενάριο 2



LEFT

RIGHT

ECHO

- **FLAIL** septal tricuspid leaflet
- Dilated RA and RV
- Paradoxical septal movement.
- Vmax TR=1.8 m/s.
- Reverse S hepatic veins.

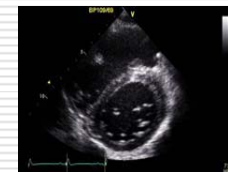
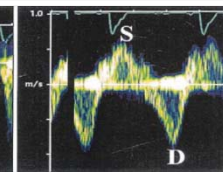
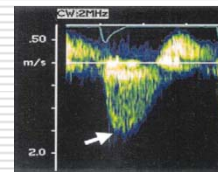


Table 8 Echocardiographic and Doppler parameters used in grading tricuspid regurgitation severity

Parameter	Mild	Moderate	Severe
Tricuspid valve	Usually normal	Normal or abnormal	Abnormal, Flail leaflet/Poor coaptation
RV/RA/IVC size	Normal*	Normal or dilated	Usually dilated**
Jet area-central jets (cm ²) [§]	< 5	5-10	> 10
VC width (cm) [Ⓞ]	Not defined	Not defined, but < 0.7	> 0.7
PISA radius (cm) ^ψ	≤ 0.5	0.6-0.9	> 0.9
Jet density and contour-CW	Soft and parabolic	Dense, variable contour	Dense, triangular with early peaking
Hepatic vein flow†	Systolic dominance	Systolic blunting	Systolic reversal

**PRIMARY
TRICUSPID
REGURGITATION**

JASE 2003;16: 777-802.

Europ. J. of Echocardiography (2008) 9, 119-120

Primary Tricuspid Valve Disease

Table 1. Causes of Tricuspid Regurgitation

Primary causes (25%)

Rheumatic

Myxomatous

Ebstein anomaly

Endomyocardial fibrosis

Endocarditis

Carcinoid disease

Traumatic (blunt chest injury, laceration)

Iatrogenic (pacemaker/defibrillator lead, RV biopsy)

Secondary causes (75%)

Left heart disease (LV dysfunction or valve disease) resulting in pulmonary hypertension

Any cause of pulmonary hypertension (chronic lung disease, pulmonary thromboembolism, left to right shunt)

Any cause of RV dysfunction (myocardial disease, RV ischemia/infarction)

The most common mechanisms involved associate an **antero-posterior compression** of the chest with a sudden **increase in the right ventricular pressure** during the enddiastolic phase, when the main pulmonary vessels are compressed. This generates a **marked traction** on both the valvular and subvalvular apparatus

European Journal of Cardio-thoracic Surgery 16 (1999) 587±589

Κλινικό σενάριο 3

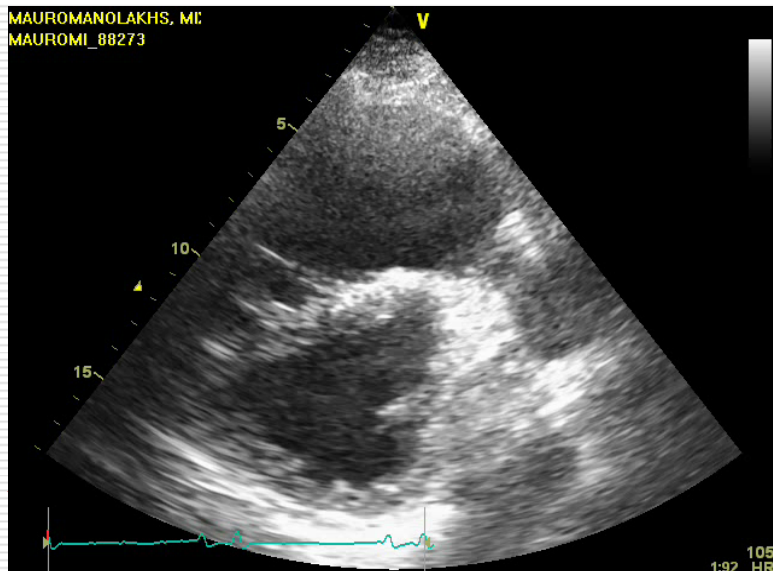
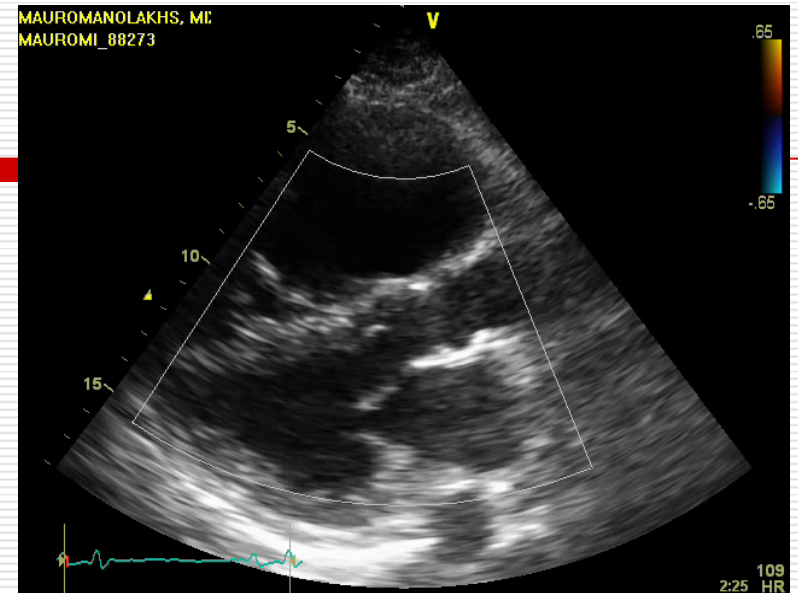
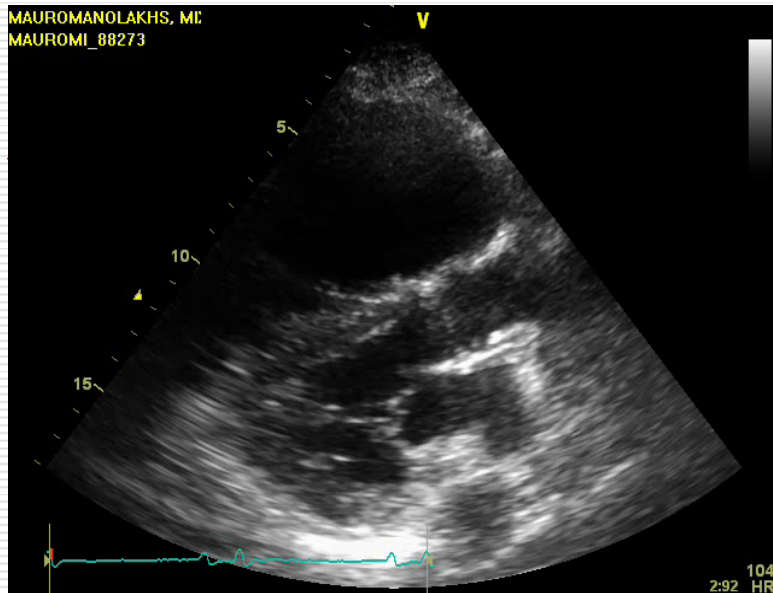
- Άνδρας 50 ετών.
 - Συγκοπτικό επεισόδιο, εύκολη κόπωση από 1 έτος, οιδήματα κ.άκρων, γαστρεντερικές διαταραχές.

 - Ηπατομεγαλία, διάταση σφαγίτιδων.
 - ΑΠ: 90/60 mmHg.
 - S1-S2: Ρυθμικοί ευκρινείς.
 - Αναπνευστικό ψιθύρισμα: Μείωση αναπνευστικού ψιθυρίσματος Δε βάση.

 - ΗΚΓ: SR 95 bpm, αρνητικά T V1-V3, δεξιός άξονας.
 - Ρο Θώρακος: Αύξηση ΚΘΔ, Πλευριτική συλλογή δεξιά.
 - Εργαστηριακός έλεγχος: Ήπια τρανσαμιναιμία, αύξηση BNP, λοιπά κφ.
 - Holter ρυθμού 24 h: NST VT μορφολογία LBBB.
 - U/S άνω κοιλίας: Ηπατομεγαλία, ασκίτης.

 - ECHO**
-

Κλινικό σενάριο 3

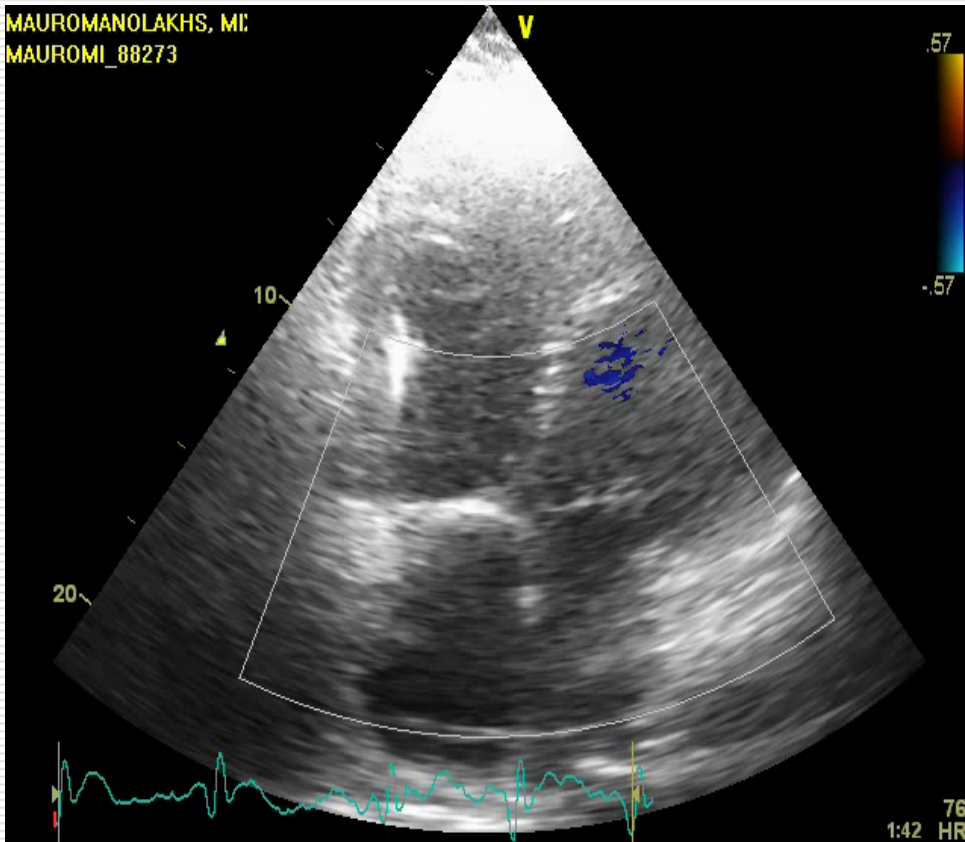


PLAX RVOT = 50 mm

ECHO

- Διάταση RV
- Ανώμαλη κίνηση του ΜΚΔ
- Διάταση και ακινησία RVOT

Κλινικό σενάριο 3



ECHO

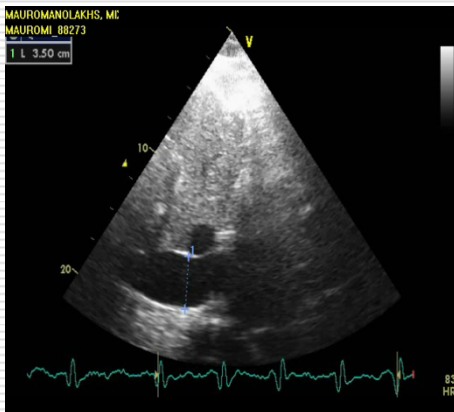
- Ανεύρυσμα πλάγιο τοίχωμα RV
- Διάταση IVC
- TR Vmax=1.2m/sec

TEE

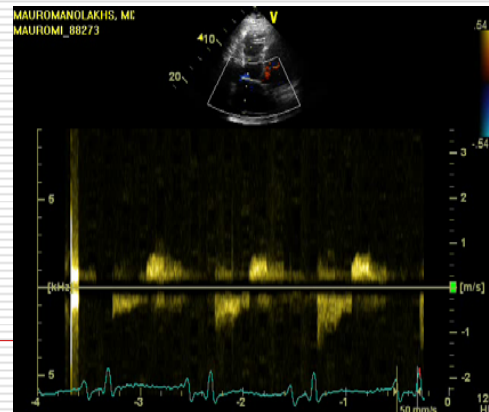
Χωρίς παθολογικές επικοινωνίες

Στεφανιογραφικός έλεγχος

Φυσιολογικά στεφανιαία αγγεία



IVC



TR Vmax=1.2m/sec

Criteria for the diagnosis of arrhythmogenic right ventricular dysplasia

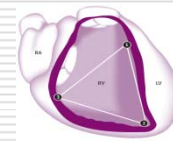
Family history
Major
Familial disease confirmed at necropsy or surgery
Minor
Family history of premature sudden death (<35 years) caused by suspected ARVD
Family history (clinical diagnosis based on present criteria)
ECG depolarization/conduction abnormalities
Major
Epsilon waves or localized prolongation (>110 ms) of the QRS complex in the right precordial leads (V1 to V3)
Minor
Late potentials seen on signal averaged ECG
Repolarization abnormalities
Minor
Inverted T waves in right precordial leads (V2 and V3) in people >12 years and in the absence of right bundle branch block
Tissue characterisation of walls
Major
Fibrofatty replacement of myocardium on endomyocardial biopsy
Global and/or regional dysfunction and structural alterations
(detected by echocardiography, angiography, magnetic resonance imaging scintigraphy)
Major
Severe dilatation and reduction of right ventricular ejection fraction with ventricular impairment
Localized right ventricular aneurysms (akinetic or dyskinetic areas with diastolic dilatation)
Severe segmental dilatation of the right ventricle
Minor
Mild global right ventricular dilatation and/or ejection fraction reduction with normal left ventricle
Mild segmental dilatation of the right ventricle
Regional right ventricular hypokinesia
Arrhythmias
Minor
Left bundle branch block type ventricular tachycardia (sustained or nonsustained) documented on ECG, Holter monitoring or during exercise testing
Frequent ventricular extrasystoles (more than 1000/24 h) on Holter monitoring

Αρρυθμιόγόνος δυσπλασία της δεξιάς κοιλίας

Data from McKenna WJ, Thiene G, Nava A, et al. Br Heart 1994; 71:215

Diagnosis is established when two major, one major plus two minor, or four minor criteria from different groups are fulfilled

Arrhythmogenic right ventricular cardiomyopathy (ARVC)



•Arrhythmogenic RV dysplasia is an unusual myopathy that involves predominantly the RV and results in fibrofatty replacement of the myocardium

•Despite the fact that RV dysfunction is a common feature of arrhythmogenic RV dysplasia, **symptoms of HF are uncommon (6%)**

•RV Dilatation (regional or global)

•Wall motion abnormalities (regional or global)

•Trabecular derangement

•Hyperreflective moderator band

•Sacculations

	Number	Percent
RV global function		
Normal	11	38
Mildly reduced	8	28
Severely reduced	10	34
RV regional WMA	23	79
RVOT	13	45
Anteroseptal	16	55
Anterior	20	70
Apex	21	72
Septal	16	55
Inferior basal	17	59
Inferior apical	15	52
Hyperreflective moderator band	9	31
Excessive/abnormal trabeculations	15	54
Sacculations	5	17

•All the cardiac imaging methods **lack quantitative criteria** to define the sensitivity and the specificity of any single modality.

Κλινικό σενάριο 4

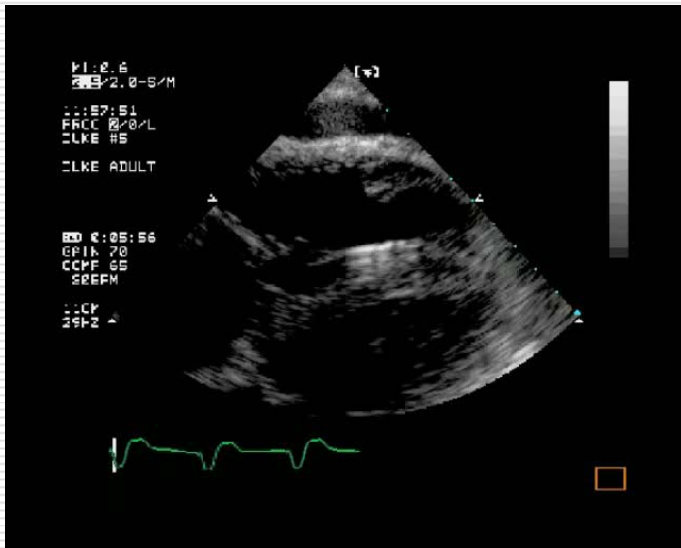
- Άνδρας 60 ετών, διαβητικός, καπνιστής, υπερλιπιδαιμικός.
 - Οπισθοστερνικό άλγος από 2 ώρου, με αιμωδία βραχίονα, ναυτία.

 - Διάταση σφαγίτιδων.
 - ΑΠ:95/60mmHg.
 - S1, S2 ρυθμικοί, ταχείς.
 - Αναπνευστικό ψιθύρισμα :κφ.

 - ΗΚΓ: SR 110 bpm, Ανάσπαση ST II, III, aVF, RV3, RV4.
 - Ro Θώρακος:ΚΦ.
 - Εργαστηριακός έλεγχος: Αυξημένη Τροπονίνη, αυξημένα WBC, υποξαιμία.

 - ECHO
-

Κλινικό σενάριο 4



ECHO

- Διάταση δεξιών κοιλοτήτων, τμηματικές διαταραχές κινητικότητας
- Επηρεασμένη συστολική λειτουργικότητα
TDI S RV=9cm/sec, FAC=25%, TAPSE=11
- Ακίνησια κατωτέρου τοιχώματος LV με καλή συστολική λειτουργικότητα
- Ηπίου βαθμού TR
- PASP<30mmHg

□ Καθετηριασμός:

Αυξημένη CVP, CVP/PWCP>0.8

□ Στεφανιογραφικός έλεγχος:

υφολική απόφραξη της RCA εγγύς.

Right Ventricular Infarction: Echocardiographic Findings

Diagnosis

- Predominant RV **dilation** with or without segmental **wall motion abnormalities**
- Predominant RV asynergy
- Asynergy of RV free wall, RV posterior wall
- Asynergy of inferior ventricular septum
- Asynergy of inferoposterior LV wall
- Paradoxical septal motion
- Disproportionate **reduction in RV ejection fraction**
- Plethora of the inferior vena cava**
- Decreased descent of the right ventricle base**

Complications

- Tricuspid regurgitation
- RA dilation
- RV aneurysm
- RV thrombus
- Right-to-left shunting (patent foramen ovale)
- Loss of RA transport
- RA thrombus
- RA rupture
- Acute ventricular septal rupture

CONCLUSIONS

Evaluation of RV failure

History and physical suggestive of RV failure

EKG
Chest X-ray
Cardiac biomarkers

Transthoracic echocardiogram

Symptoms Fatigue
Hepatic congestion
Right upper quadrant discomfort
Anorexia/early satiety
Peripheral edema
Cough
Shortness of breath/orthopnea*

Physical signs Elevated jugular venous pulsation, positive hepatojugular reflux or Kussmaul's sign
Peripheral or sacral edema
Ascites
Hepatomegaly or liver tenderness
Right-sided third heart sound
Murmur of tricuspid regurgitation

EKG: Right axis deviation, right ventricular hypertrophy, p pulmonale pattern
low-voltage QRS, incomplete or complete right bundle branch block
Chest x-ray: Right-sided cardiac enlargement, enlargement of pulmonary arteries (uncommon), oligemic peripheral lung fields (rare), right-sided pleural effusion*

RV failure with ↑ PA pressure

RV failure without ↑ PA pressure

Decreased RV Contractility

RV Volume Overload

RV Impaired Filling

Table 9 Arbitrary criteria for estimating the presence of PH based on tricuspid regurgitation peak velocity and Doppler-calculated PA systolic pressure at rest (assuming a normal right atrial pressure of 5 mmHg) and on additional echocardiographic variables suggestive of PH

	Class ^a	Level ^b
Echocardiographic diagnosis: PH unlikely		
Tricuspid regurgitation velocity ≤2.8 m/s, PA systolic pressure ≤36 mmHg, and no additional echocardiographic variables suggestive of PH	I	B
Echocardiographic diagnosis: PH possible		
Tricuspid regurgitation velocity ≤2.8 m/s, PA systolic pressure ≤36 mmHg, but presence of additional echocardiographic variables suggestive of PH	IIa	C
Tricuspid regurgitation velocity 2.9–3.4 m/s, PA systolic pressure 37–50 mmHg with/without additional echocardiographic variables suggestive of PH	IIa	C
Echocardiographic diagnosis: PH likely		
Tricuspid regurgitation velocity >3.4 m/s, PA systolic pressure >50 mmHg, with/without additional echocardiographic variables suggestive of PH	I	B
Exercise Doppler echocardiography is not recommended for screening of PH	III	C

ΕΥΧΑΡΙΣΤΩ
