Pulmonary Embolus

Brussels Echo September 2007

Anthony Mclean
Nepean Intensive Care
Professor
Sydney University
Australia

The University of Sydney

THE NEPEAN HOSPITAL PENRITH

Pulmonary Embolus


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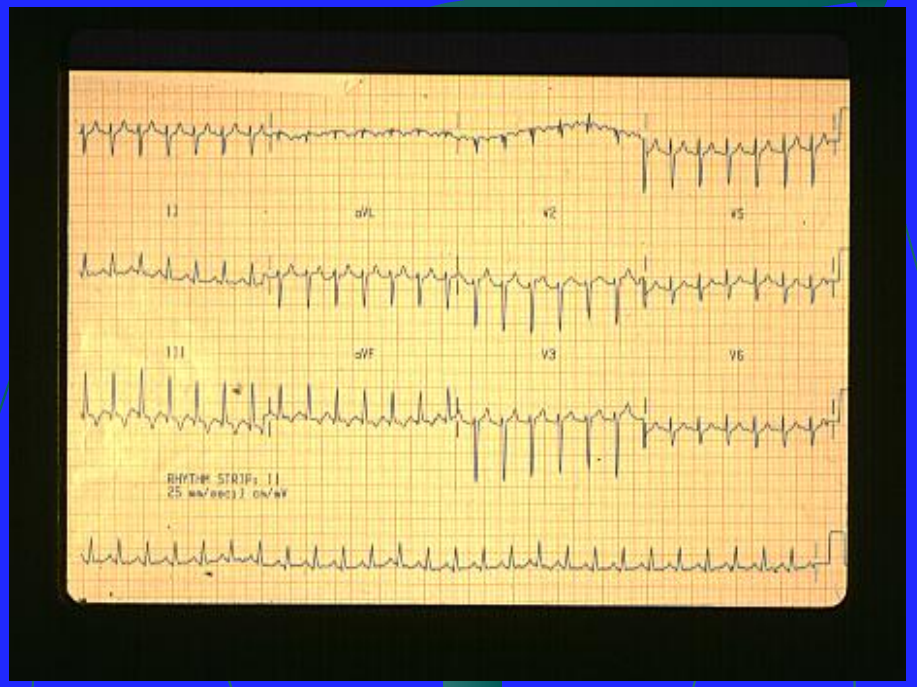
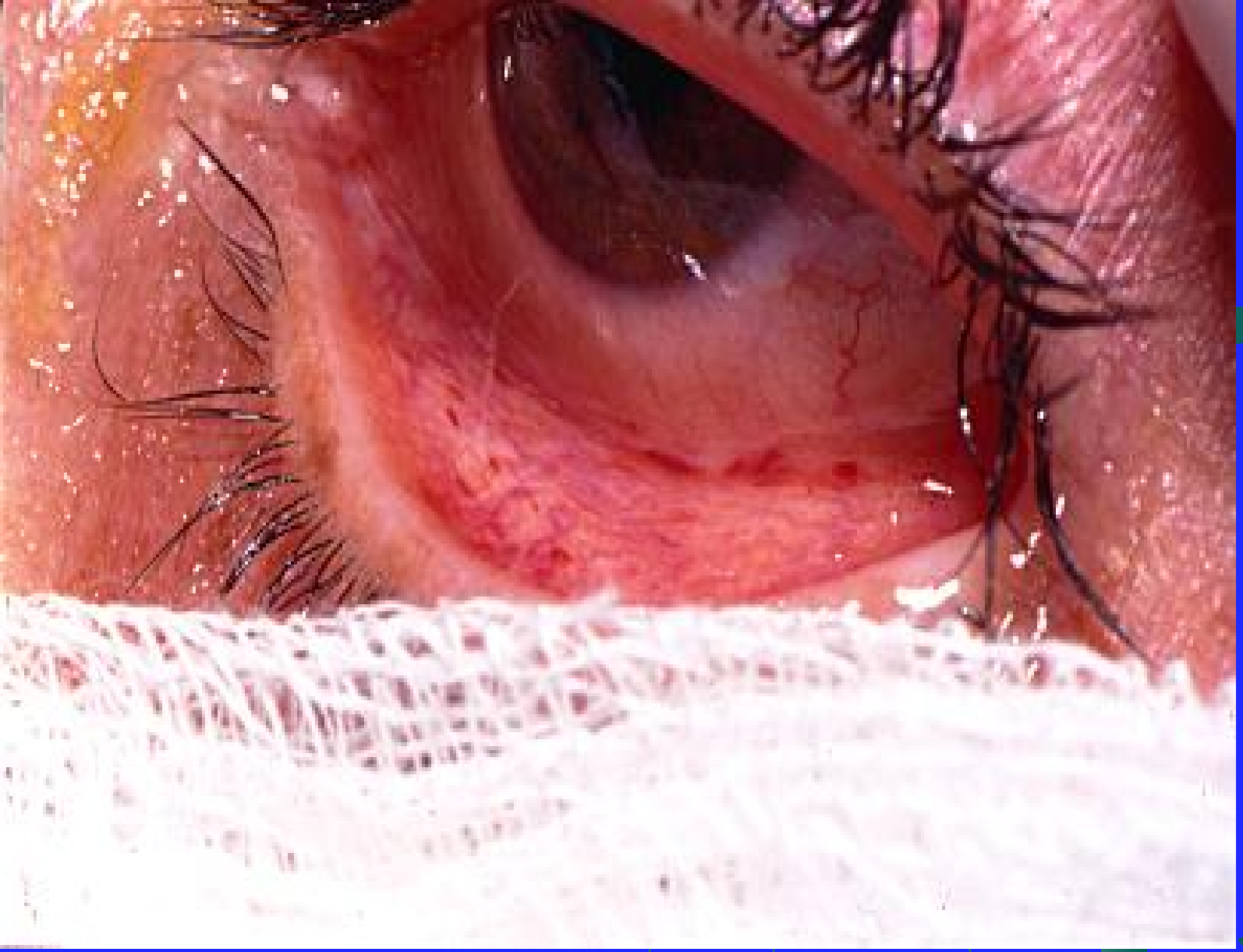
Massive pulmonary embolus

- no perfusion to right lung
- S1Q3T3





Fat embolus

Accuracy of Serum Biomarkers for the Prediction of in-hospital death in Acute Pulmonary Embolus

Study	Patients, No.	Biomarker	Assay	Cutoff Level	Positive Test Result	Sens	Spec	NPV	PPV
Konstantinides et al[23]	106	cTnI	Centaur (Bayer‡)	0.07 ng/mL	41	86	62	98	14
Konstantinides et al[23]	106	cTnT	Elecsys (Roche§)	0.04 ng/mL	37	71	66	97	12
Giannitsis et al[24]	56	cTnT	TropT (Roche)	0.10 ng/mL	32	88	78	97	44
Janata et al[25]	106	cTnT	Elecsys (Roche)	0.09 ng/mL	11	80	92	99	34
Pruszczyk et al[27]	64	cTnT	Elecsys (Roche)	0.01 ng/mL	50	100	57	100	25
ten Wolde et al[31]	110	BNP	Shionoria (CIS Bio‖)	21.7 pmol/L	33	86	71	99	17
Kucher et al[30]	73	Pro-BNP	Elecsys (Roche)	500 pg/mL	58	95	57	100	12
Kucher et al[29]	73	BNP	Triage (Biosite¶)	50 pg/mL	58	95	60	100	12
Pruszczyk et al[26]	79	Pro-BNP	Elecsys (Roche)	153–334 pg/mL†	66	100	33	100	23

*Values are given as %, unless otherwise indicated. Sens = sensitivity; Spec = specificity; NPV = negative predictive value; PPV = positive predictive value; cTnI = cardiac troponin I; cTnT = cardiac troponin T. Adapted with permission from Kucher and Goldhaber.[22]

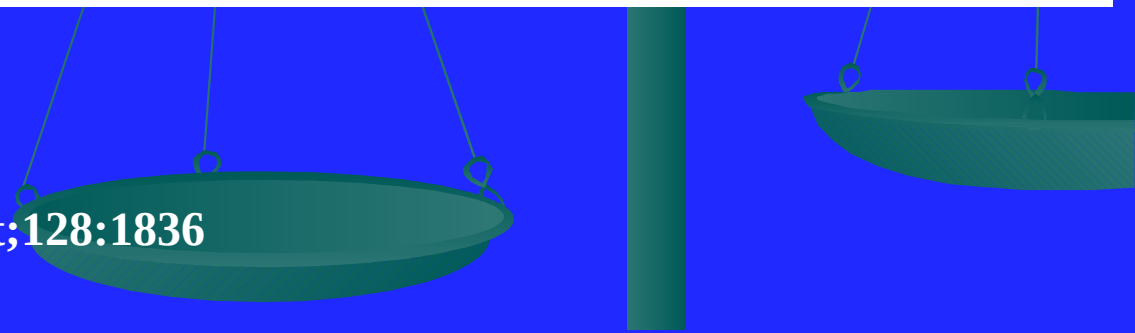
†Age- and gender-adjusted cutoff levels according to manufacturer.

‡Leverkusen, Germany.

§Nutley, NJ.

‖Bagnols Sur Ceze, France.

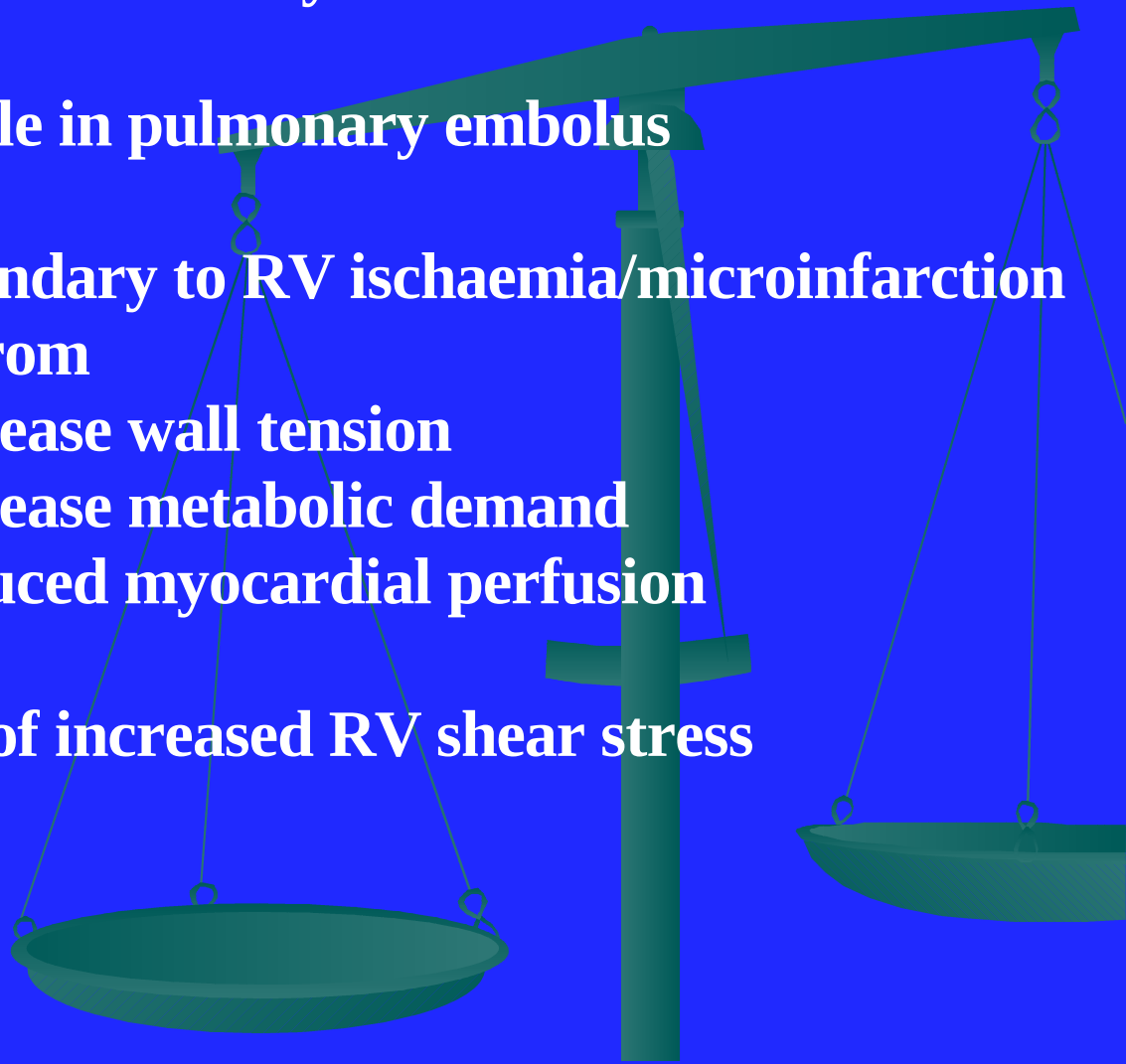
¶San Diego, CA.



Reference: Piazza G Chest;128:1836

Serum Biomarkers in the diagnosis and assessment of RHF

- Troponins and BNP elevated in RV dysfunction
- Particular emphasis on role in pulmonary embolus
- Troponins - elevated secondary to RV ischaemia/microinfarction resulting from
  - increase wall tension
  - increase metabolic demand
  - reduced myocardial perfusion
- BNP - released as result of increased RV shear stress



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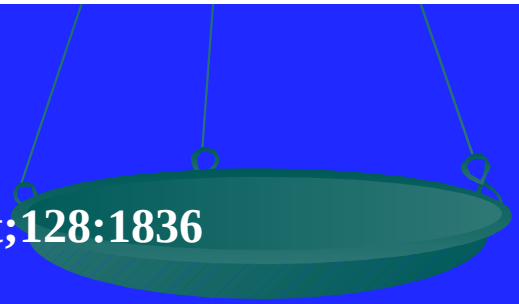
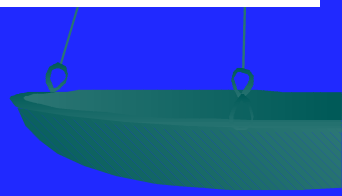
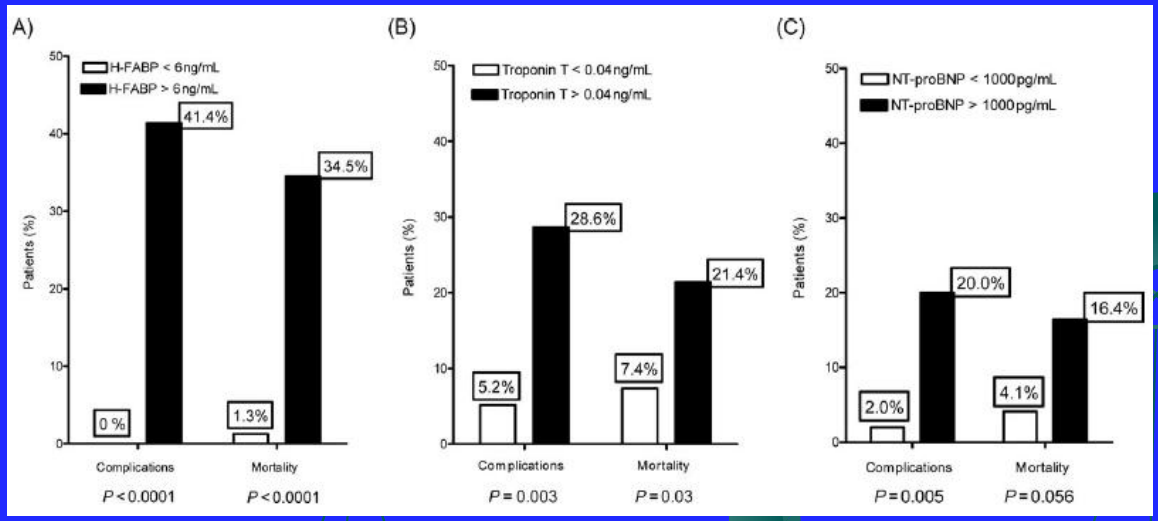




Reference: Piazza G Chest;128:1836

H-FABP in risk stratification in pulmonary embolism

Correlation of elevated biomarker level on admission with PE complication or death at 30 days



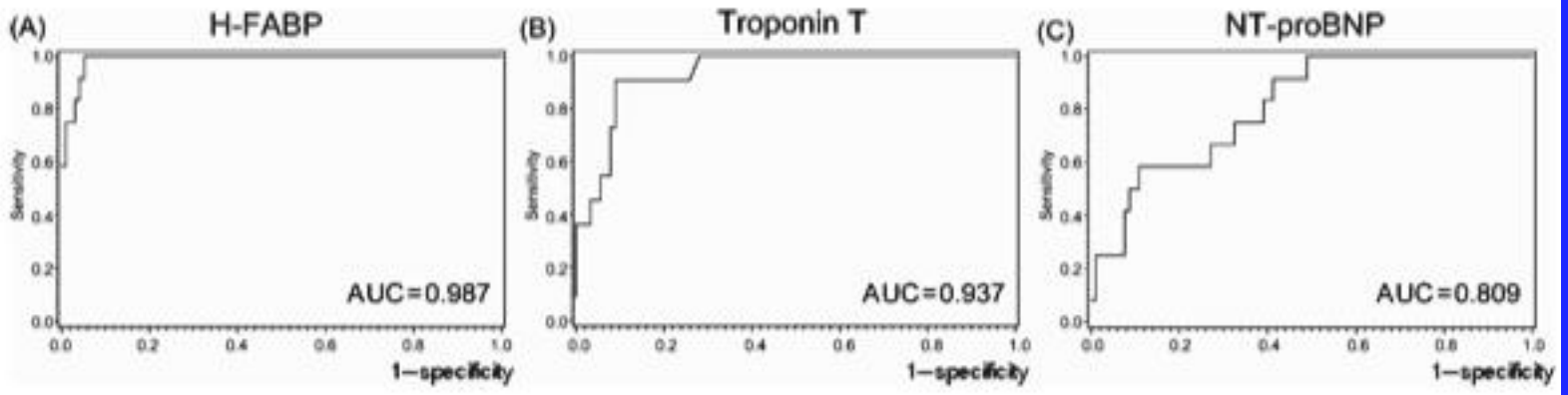
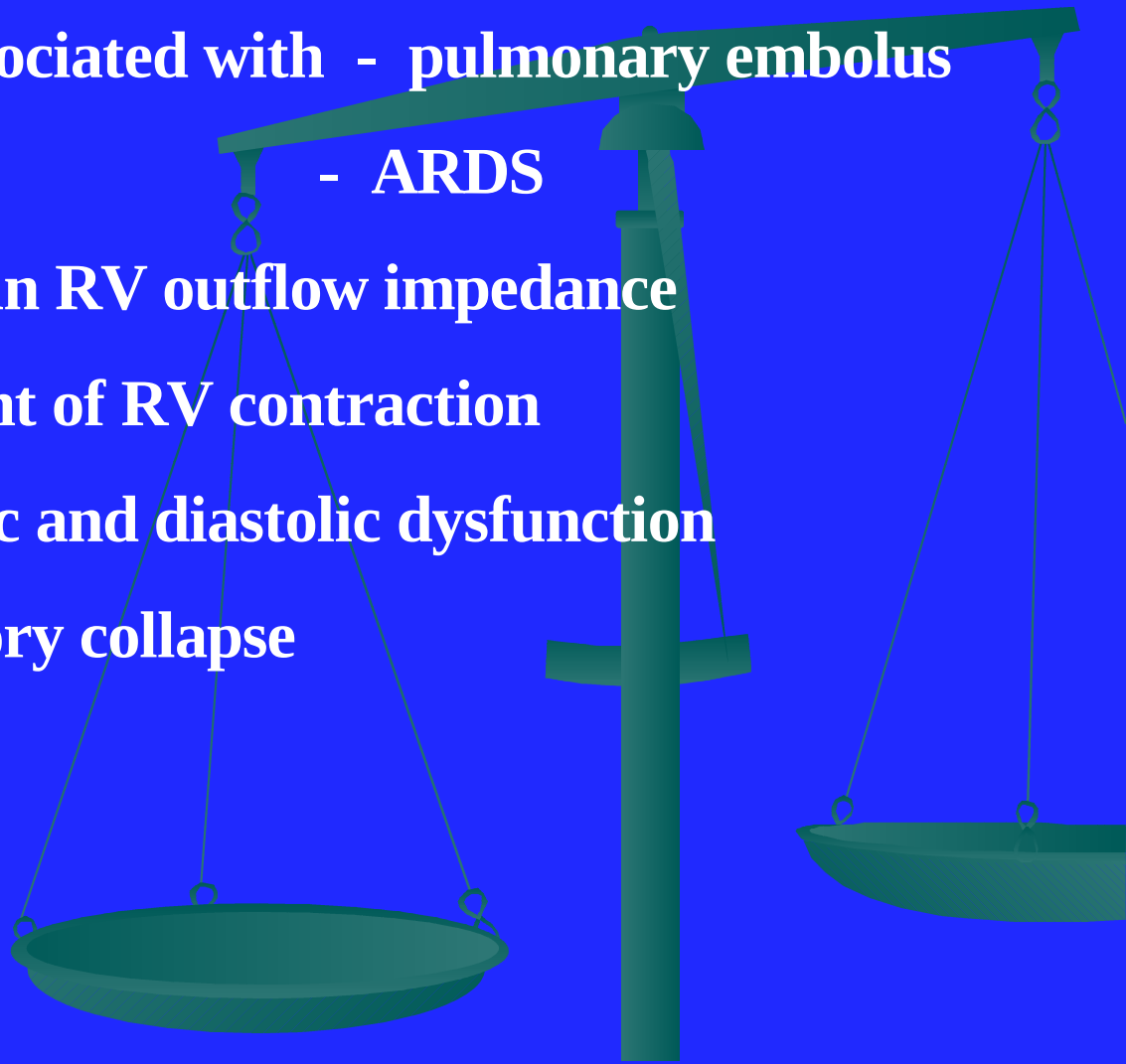


Figure 3 Displayed are the ROC curves of H-FABP levels on admission (*A*), maximal troponin T concentrations over the first 24 h (*B*), and NT-proBNP levels on admission (*C*) with the corresponding AUC values. H-FABP on admission yielded the largest area under the curve.

Puls M Eur Heart J 2007;28,224-229

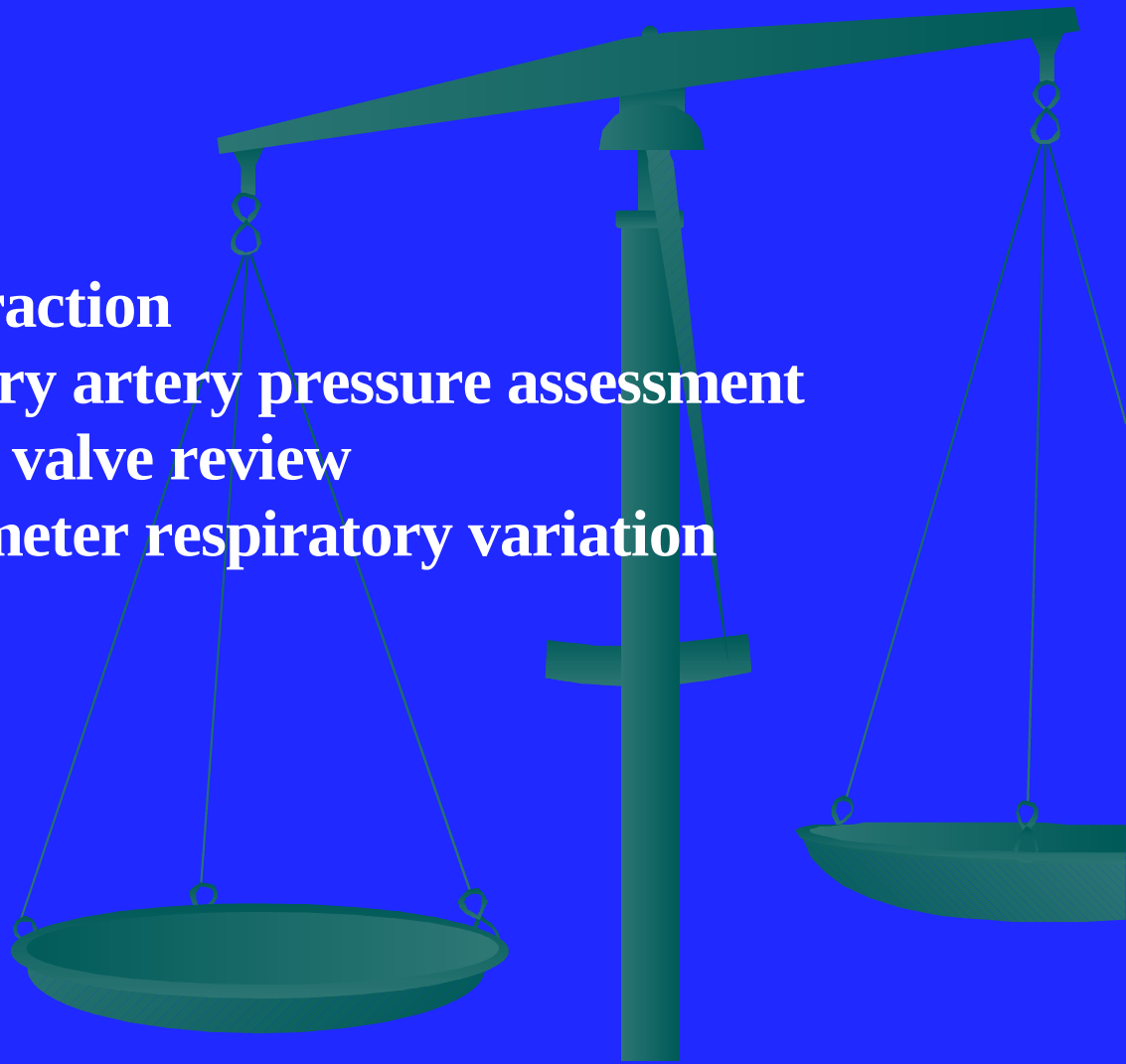
Acute Cor Pulmonale:

- sudden increase in right ventricular afterload
- most commonly associated with - pulmonary embolus
  - ARDS
- results in increase in RV outflow impedance
  - impairment of RV contraction
  - RV systolic and diastolic dysfunction
- may cause circulatory collapse



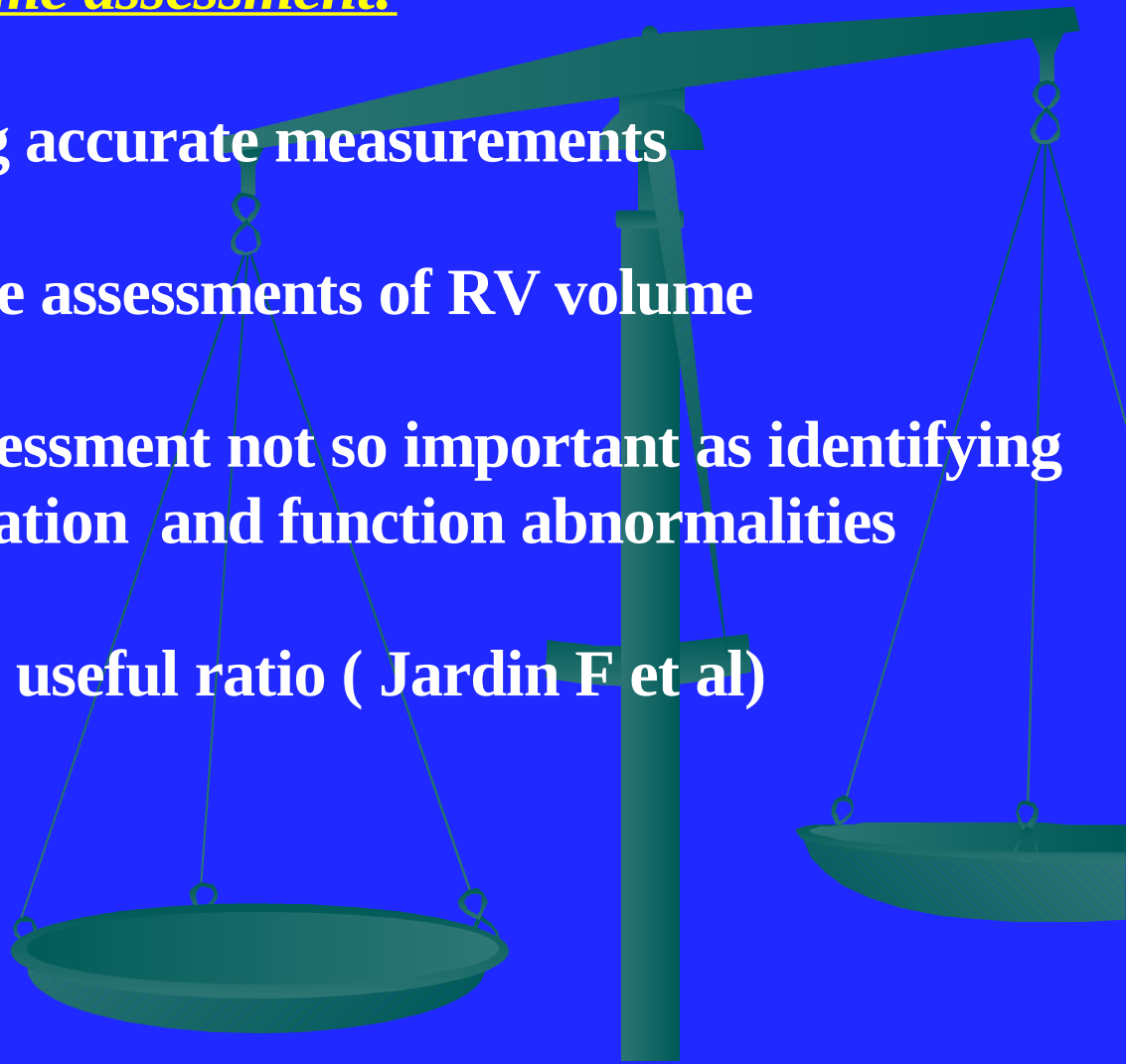
ACP - rapid echoDoppler assessment:

- RV size
- RA size
- RV contraction
- Pulmonary artery pressure assessment
- tricuspid valve review
- IVC diameter respiratory variation

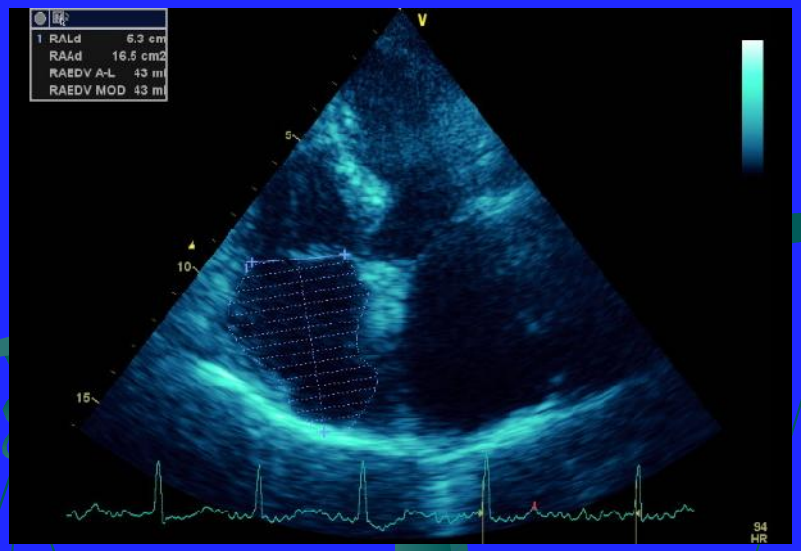


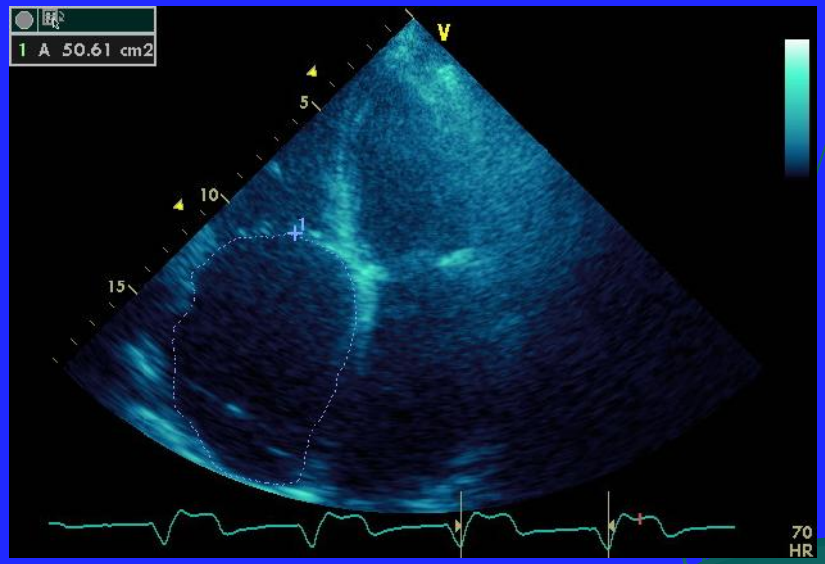
Right ventricular Volume assessment:

- **difficult in obtaining accurate measurements**
- **be wary of subjective assessments of RV volume**
- **accurate volume assessment not so important as identifying the presence of dilatation and function abnormalities**
- **LVEDA/ RVEDA - useful ratio (Jardin F et al)**



Dilated Right Atrium





Dilated RV

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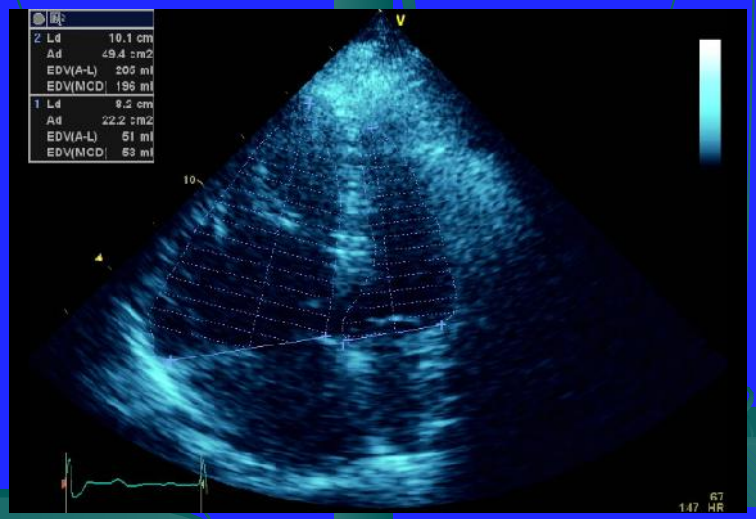
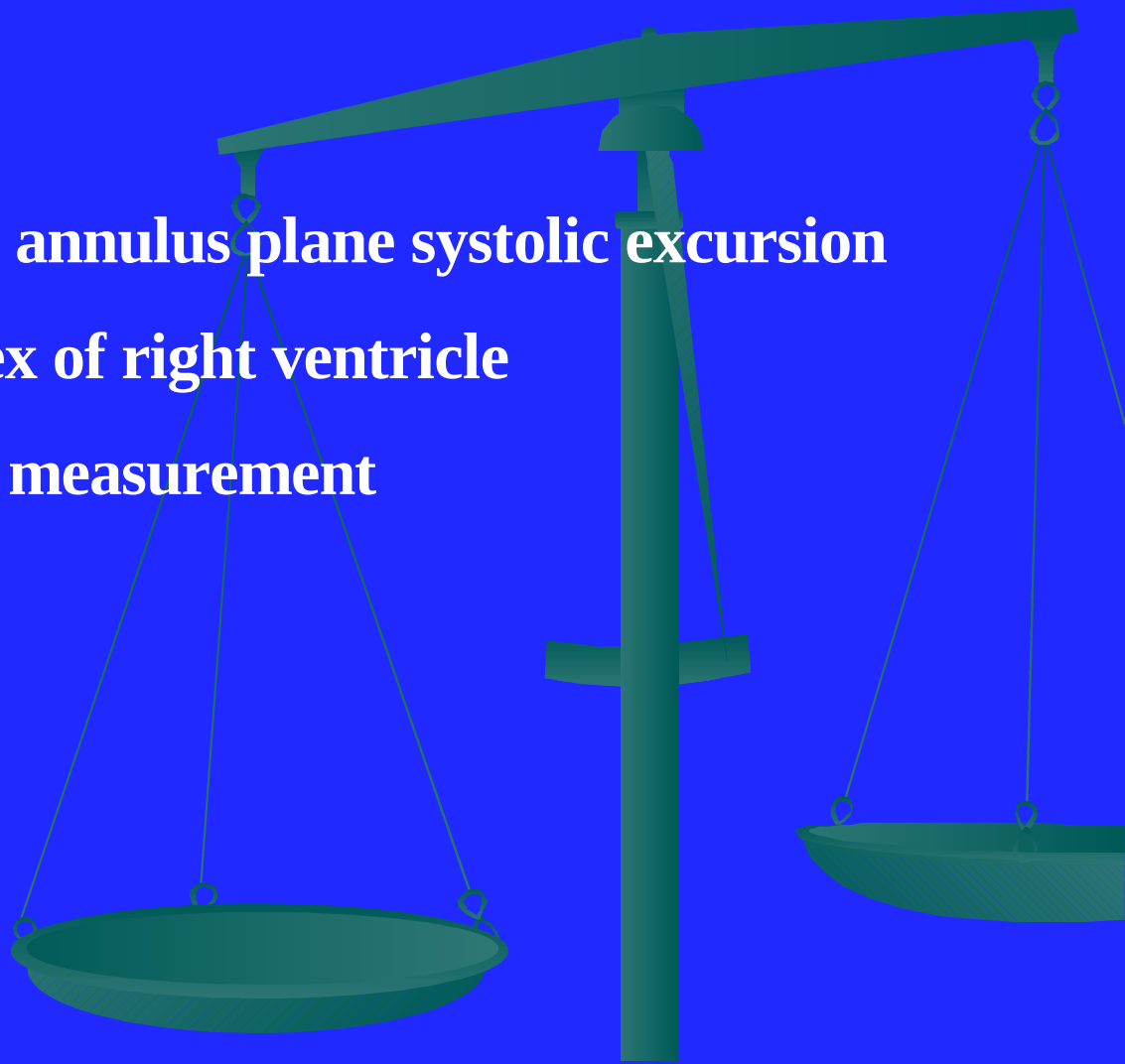


PAH - dilated pulmonale artery trunk

PAX view by TTE

Right ventricular contractility :

- eyeballing
- TAPSE - tricuspid annulus plane systolic excursion
- MPI or Tei Index of right ventricle
- TDI - using Sm measurement

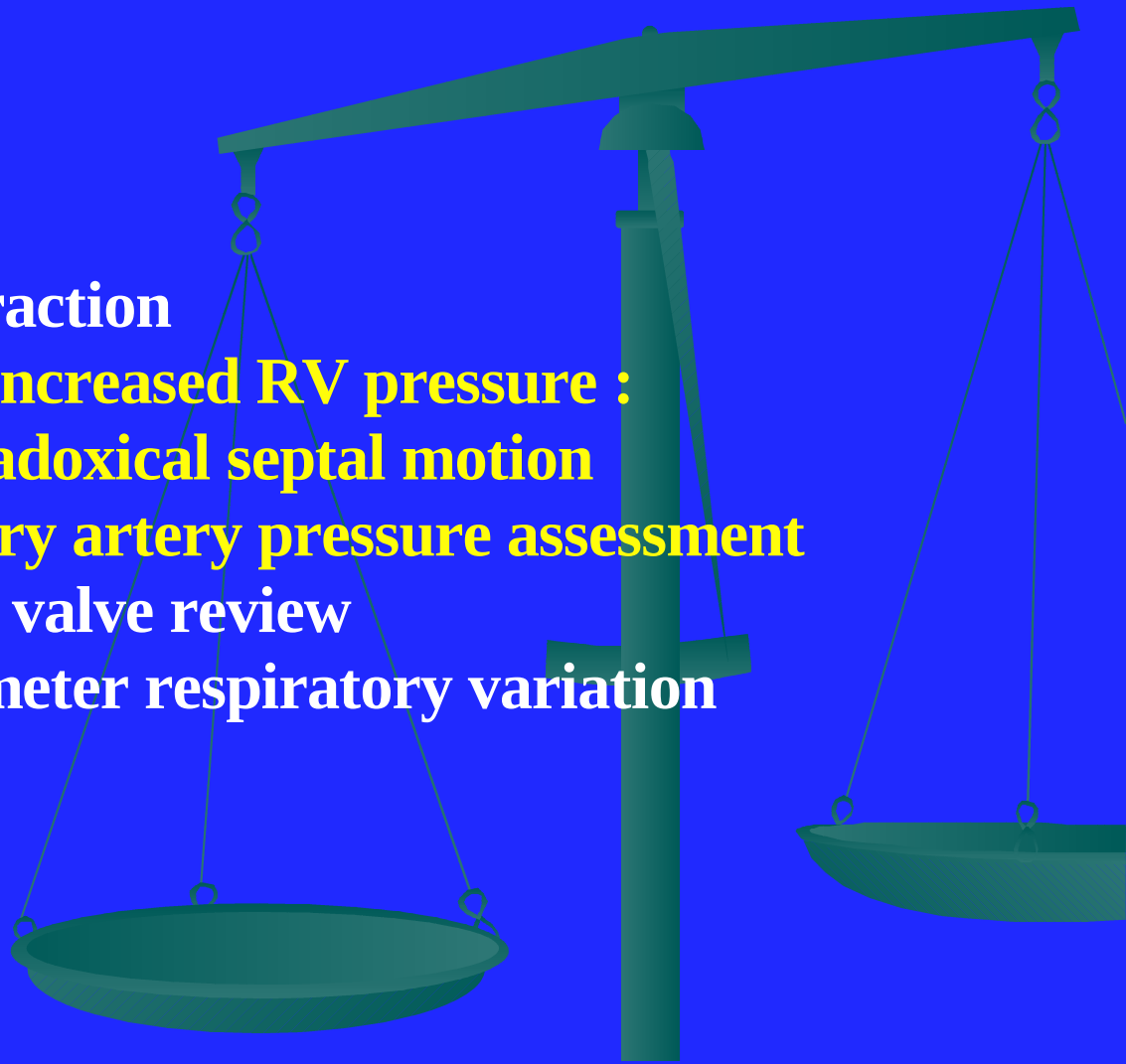


TAPSE

Right heart

Tricuspid annulus displacement is a good tool for assessing right ventricular contraction

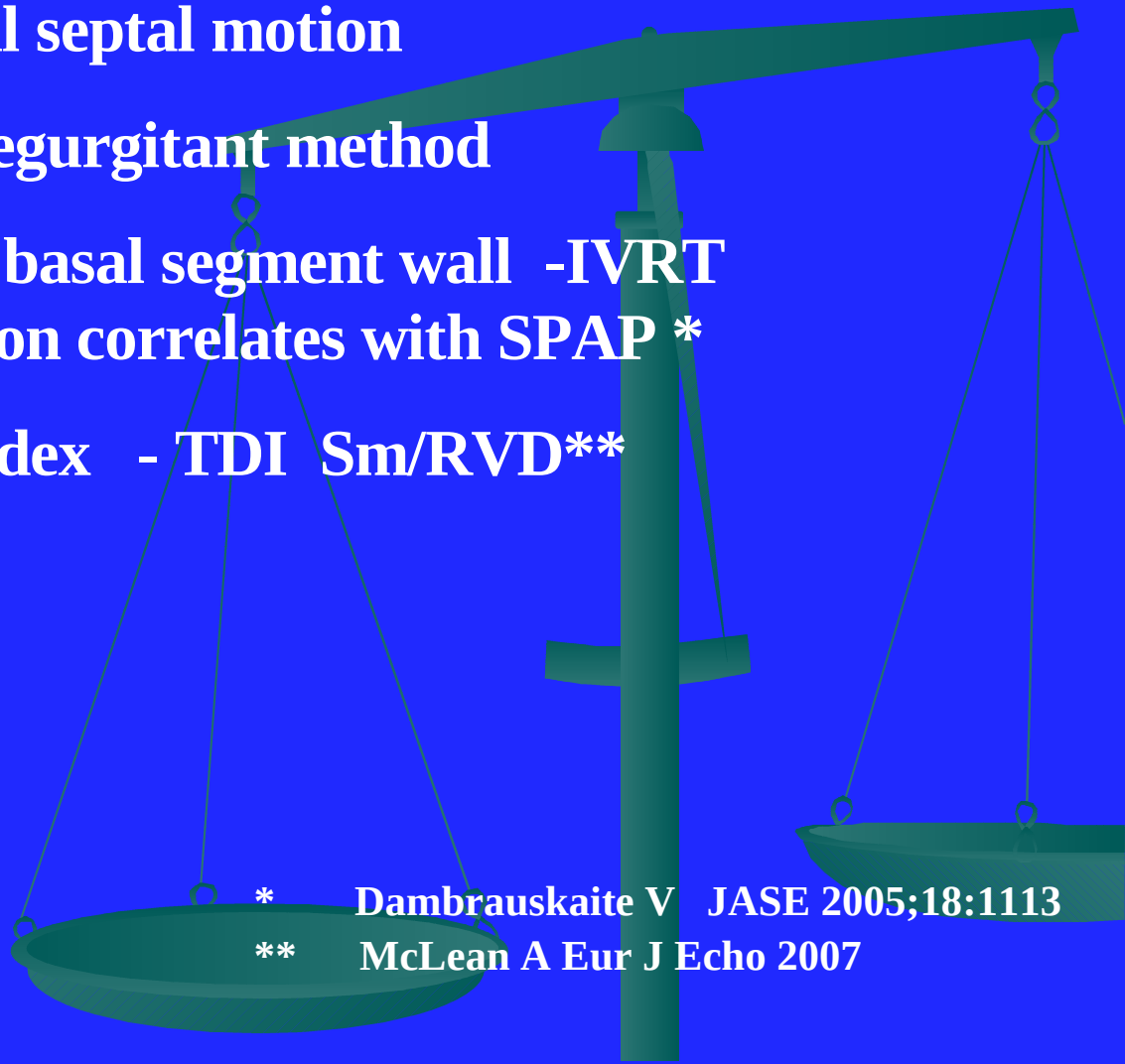
ACP - rapid echoDoppler assessment:



- RV size
- RA size
- RV contraction
- Signs of increased RV pressure :
  paradoxical septal motion
- Pulmonary artery pressure assessment
- tricuspid valve review
- IVC diameter respiratory variation

Pulmonary Artery Pressure assessment:

3. paradoxical septal motion
4. tricuspid regurgitant method
5. TDI of RV basal segment wall -IVRT prologation correlates with SPAP *
6. Nepean Index - TDI Sm/RVD**
7. others



* Dambrauskaite V JASE 2005;18:1113

** McLean A Eur J Echo 2007

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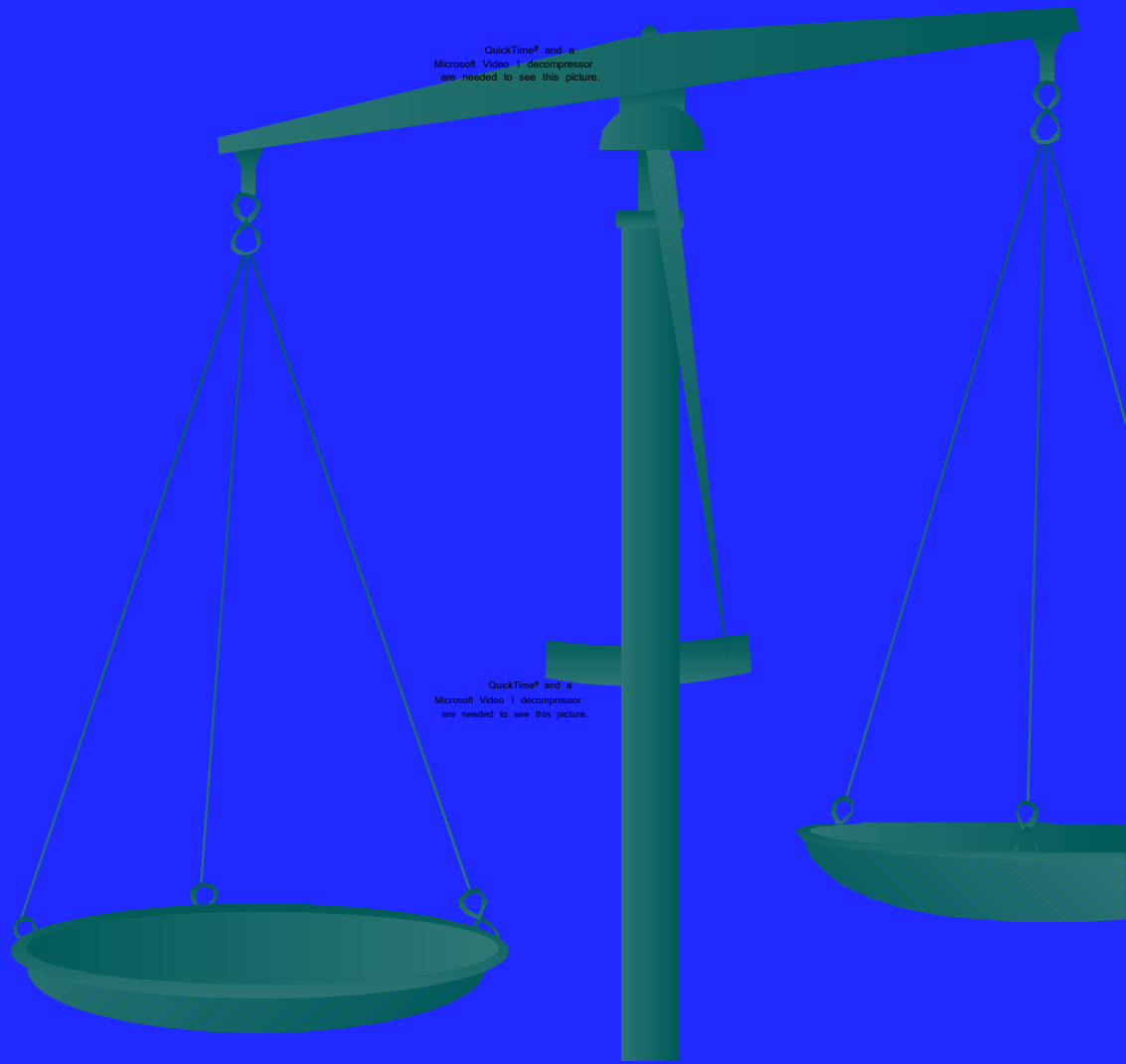

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Tricuspid Regurgitation - Colour Flow Doppler

Mild

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Severe

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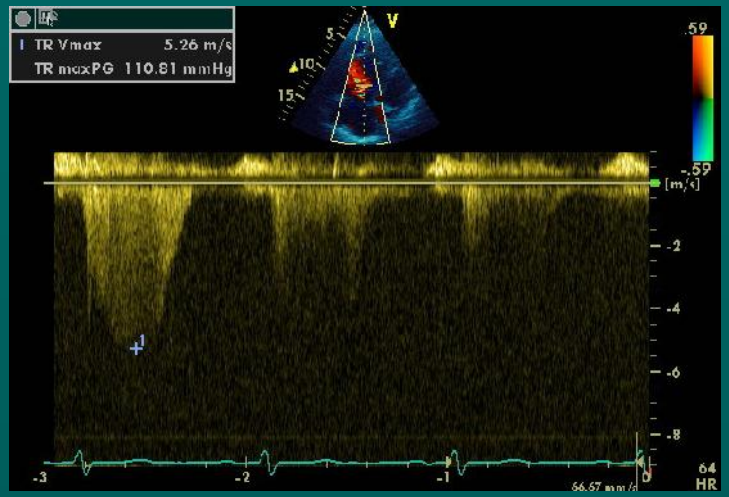
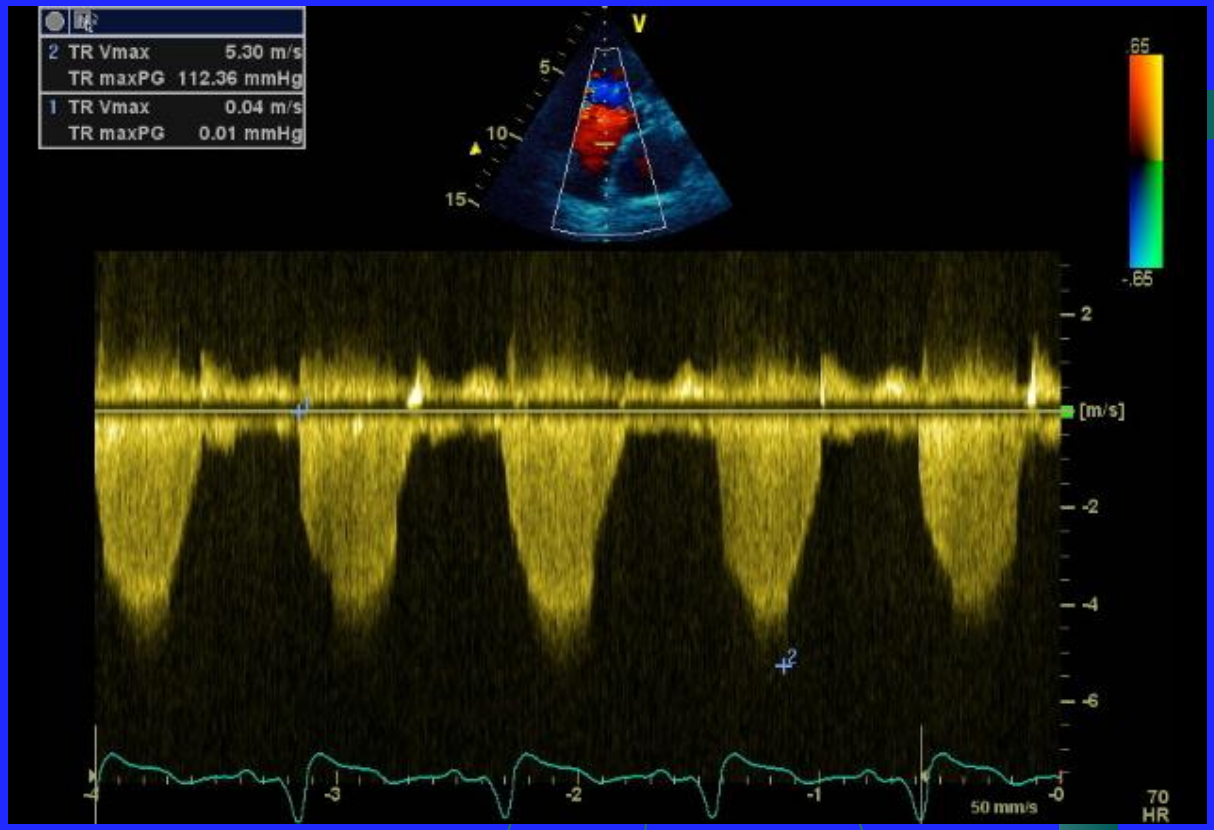
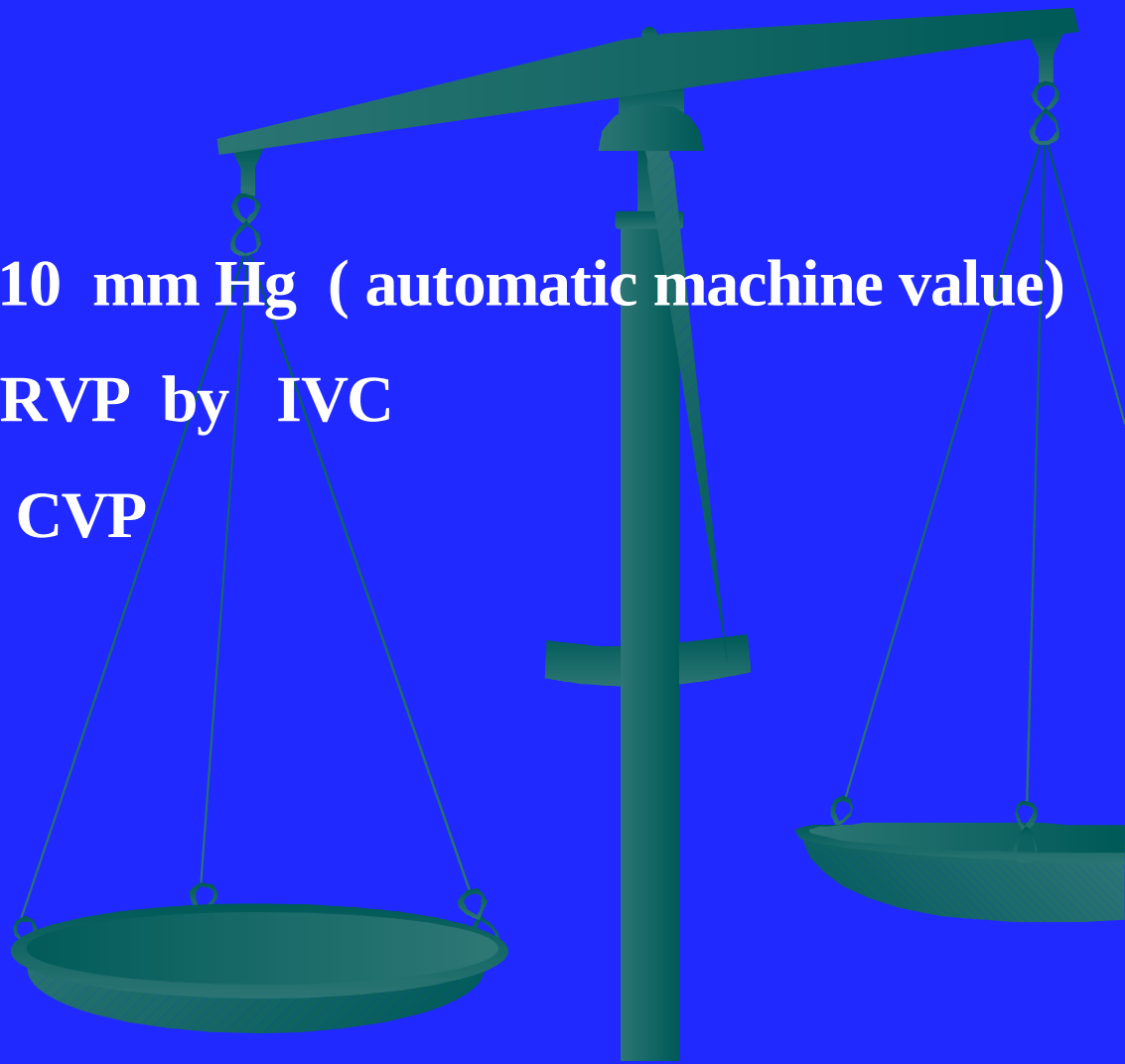


TR CW Doppler

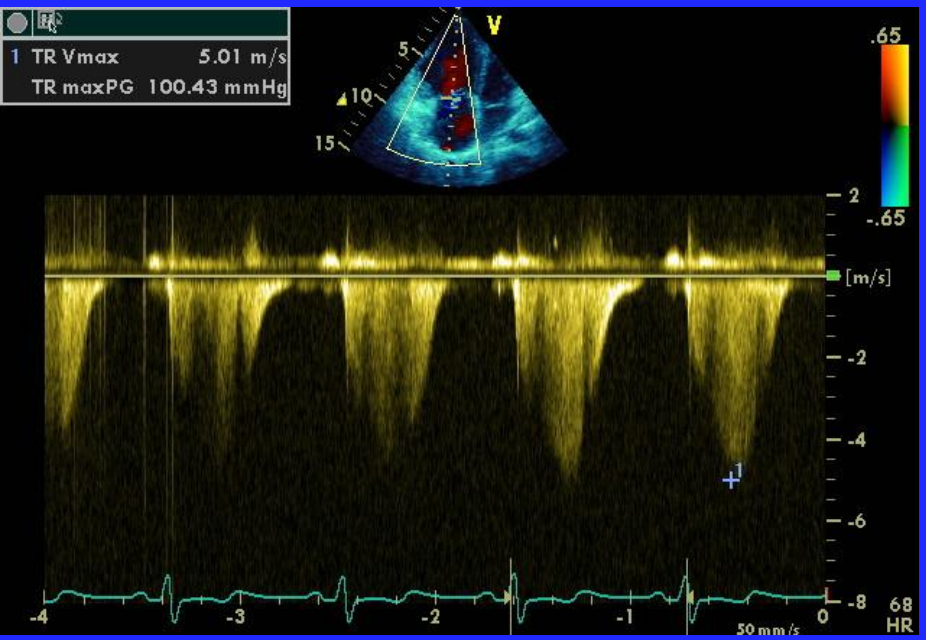

2 TR Vmax 5.30 m/s
TR maxPG 112.36 mmHg
1 TR Vmax 0.04 m/s
TR maxPG 0.01 mmHg
V
5
10
15
.65
-.65
2
[m/s]
-2
-4
-6
-3
-2
-1
-0
50 mm/s
70
HR

SPAP =

- **RV - RA + 10 mm Hg (automatic machine value)**
- **+ RVP by IVC**
- **+ CVP**



Calculation of PAP using tricuspid regurgitation



Gradient across Tricuspid valve
= RV - RA pressure

(Bernoulli Equation: $P = 4 V^2$)

PAP = peak RV + RAP

- ***0 to 5 mm Hg*** *if the IVC is normal in dimension (1.2 to 2.3 cm) and collapses at least 50% upon inspiration*
- ***5 to 10 mm Hg*** *if the ICV is normal in dimension but does not collapse upon inspiration*
- ***10 to 15 mm Hg*** *if the IVC is dilated but collapses upon inspiration*
- ***15 to 20 mm Hg*** *if the IVC is dilated and does not collapse upon inspiration*

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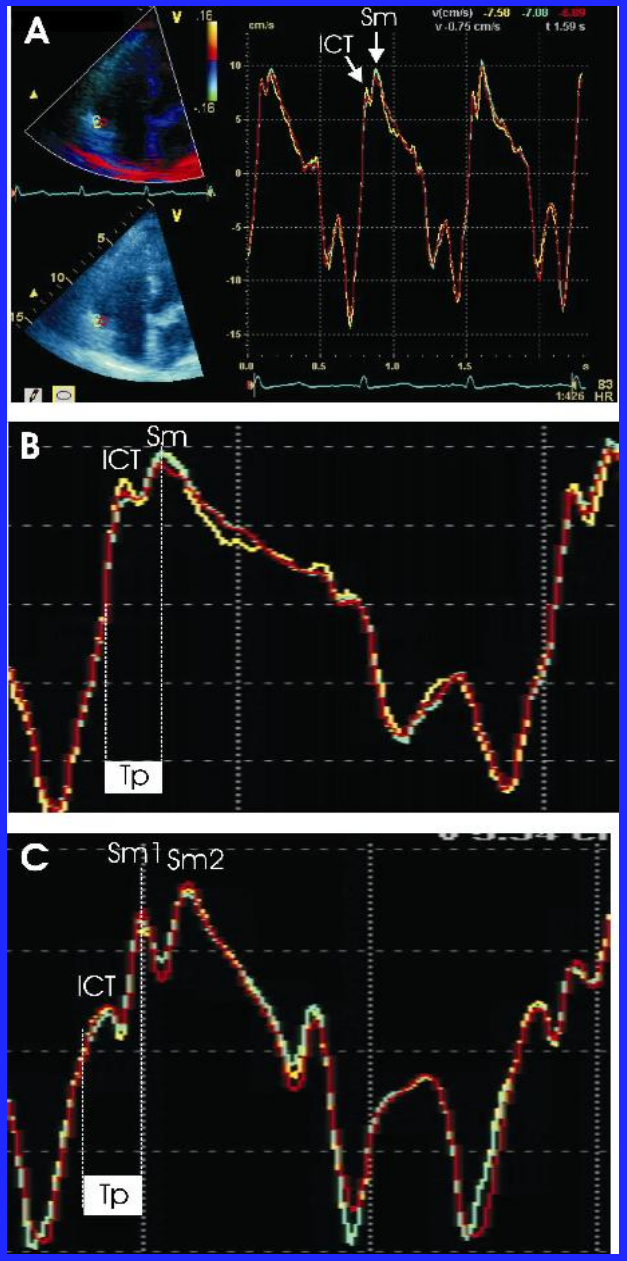
inspiration **expiration**



Calculating Pulmonary Artery Systolic Pressure in the absence of a TR signal.

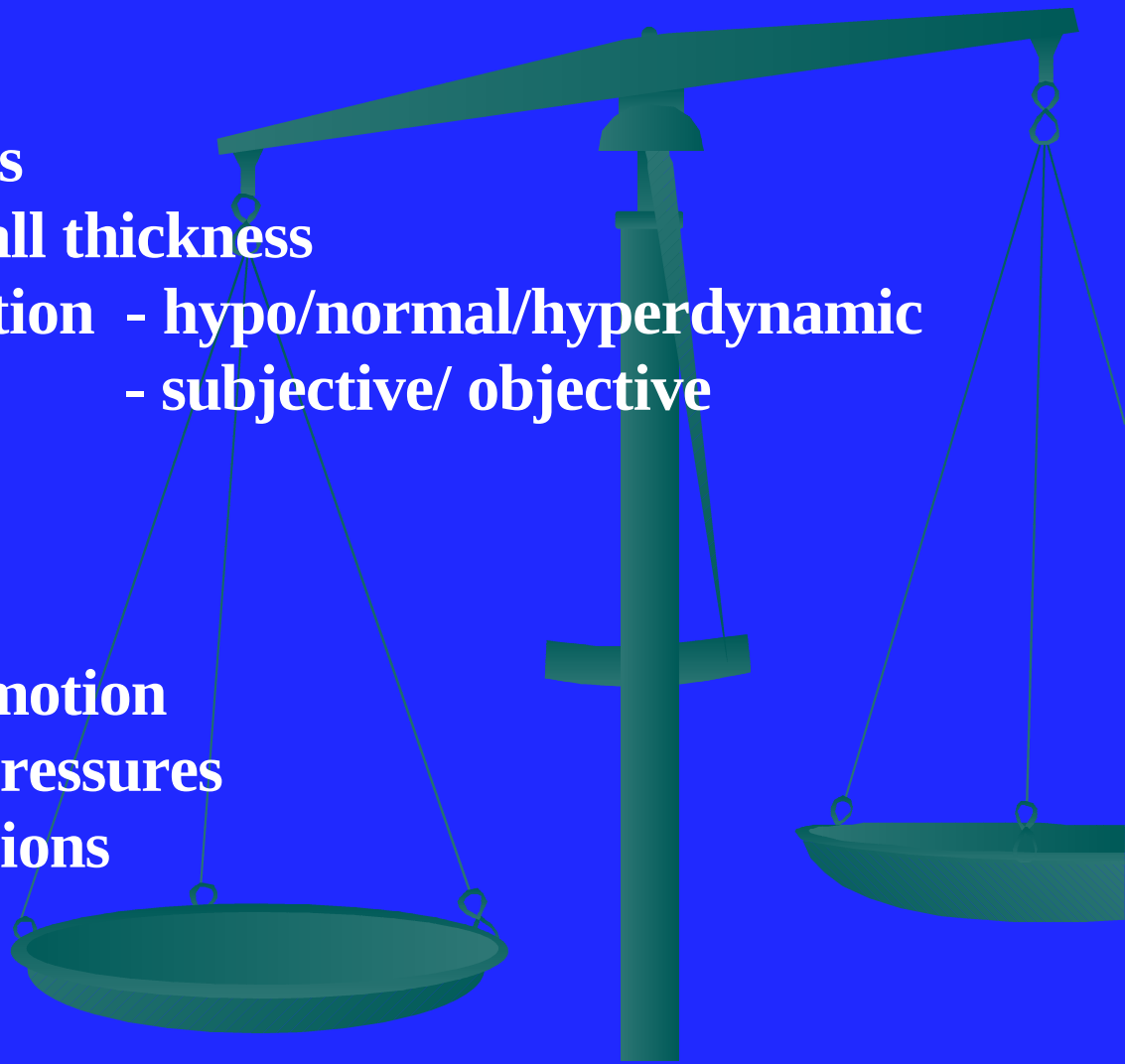
$$\text{Index} = \frac{\text{RVD}}{T_{peak}}$$

Nepean < 22 cm/sec PASP <35 mmHg

Index > 22 cm/sec PASP >35 mmHg

Ref: Mclean A,Ting I, Huang S, Wesley S Eur J Echo 2007;8(2):128-136

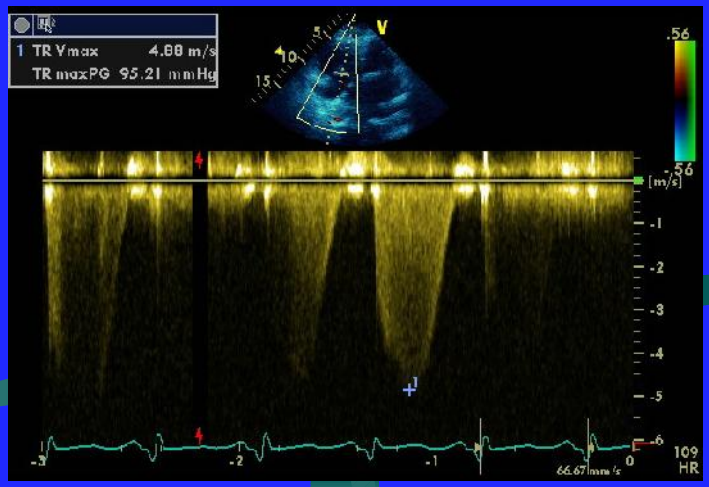
Echocardiographic Assessment of the right heart



- chamber dimensions
- right ventricular wall thickness
- ventricular contraction - hypo/normal/hyperdynamic
  - subjective/ objective
- intracardiac shunts
- tricuspid valve
- pulmonary valve
- paradoxical septal motion
- pulmonary artery pressures
- hepatic vein dimensions
- **left atrial pressure**

48 year woman

- asthma since 20s
- admitted to ICU - ? intubation
- August 2007.
- trainee performs echo- Sunday



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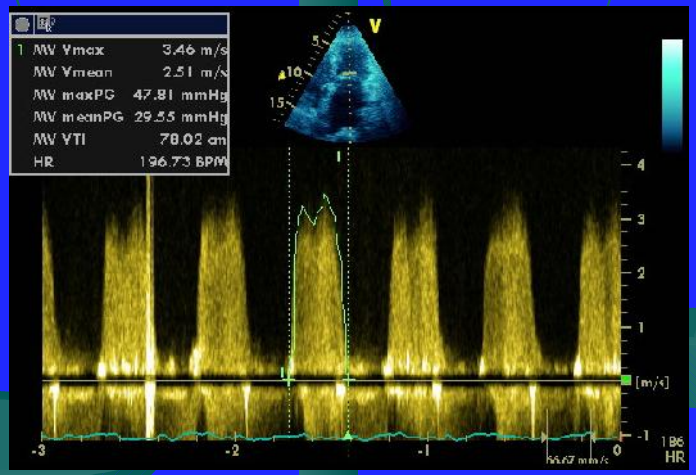
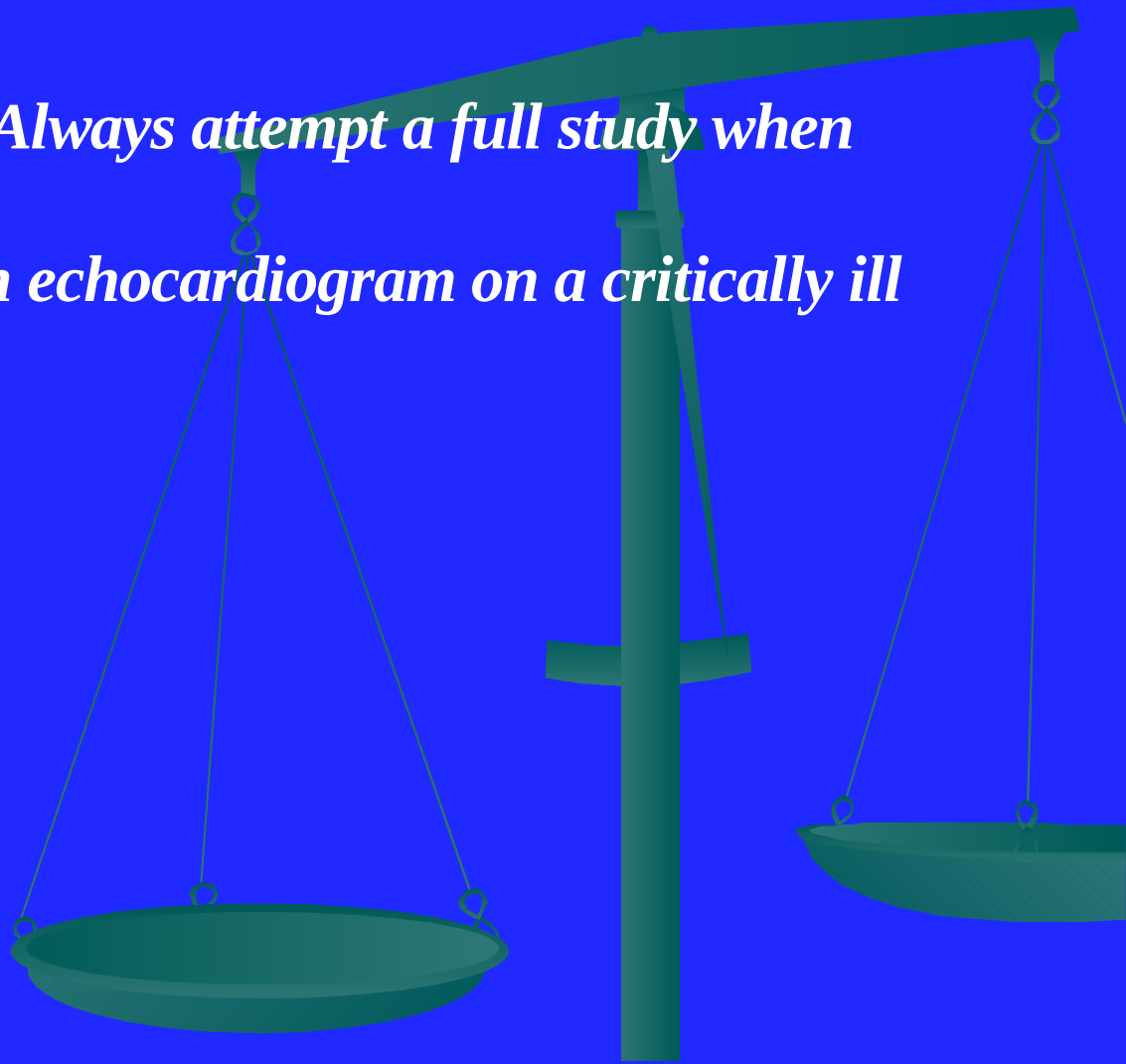


Severe mitral stenosis !!

Basic Rule : ***Always attempt a full study when performing an echocardiogram on a critically ill patient.***



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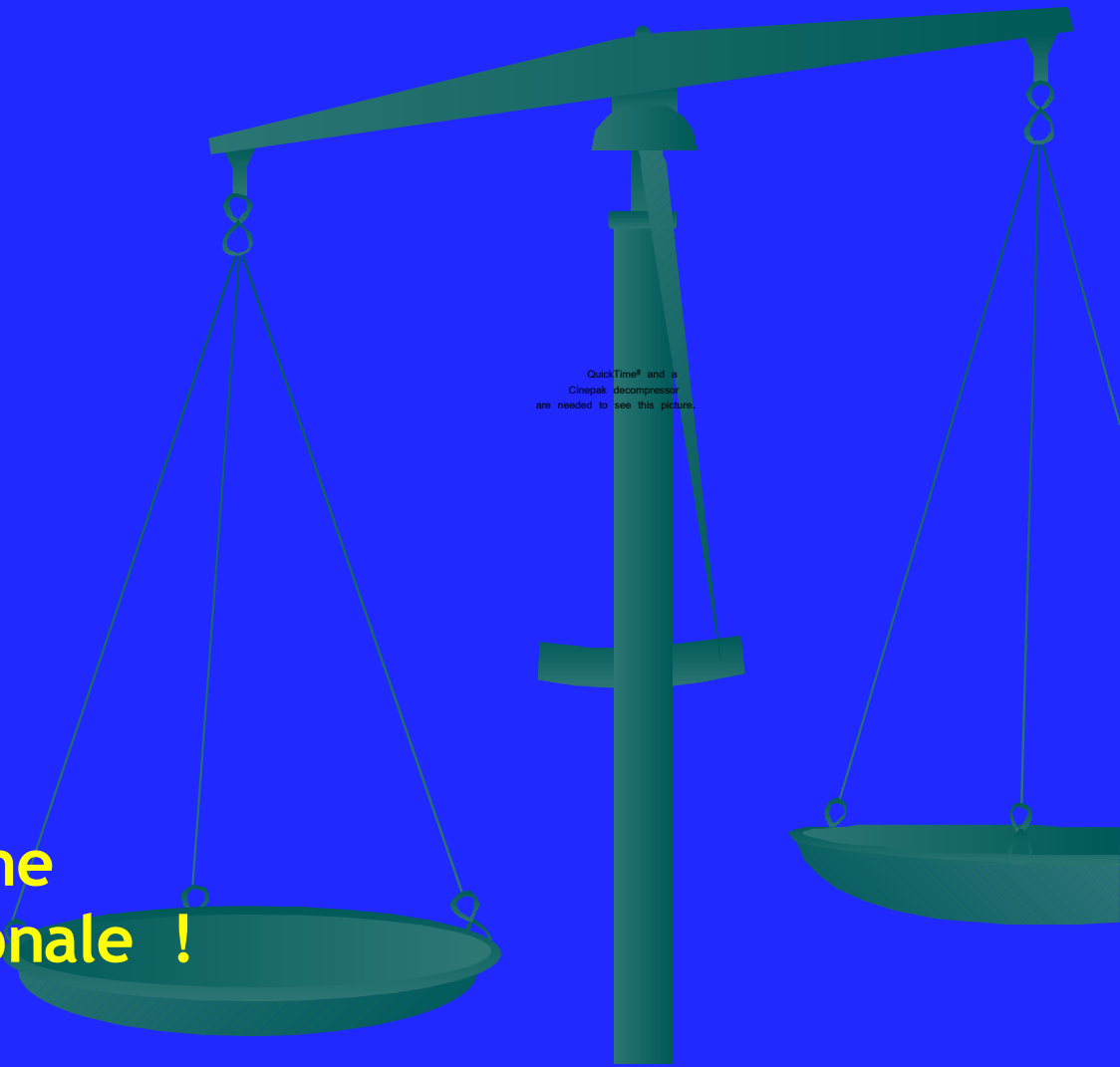
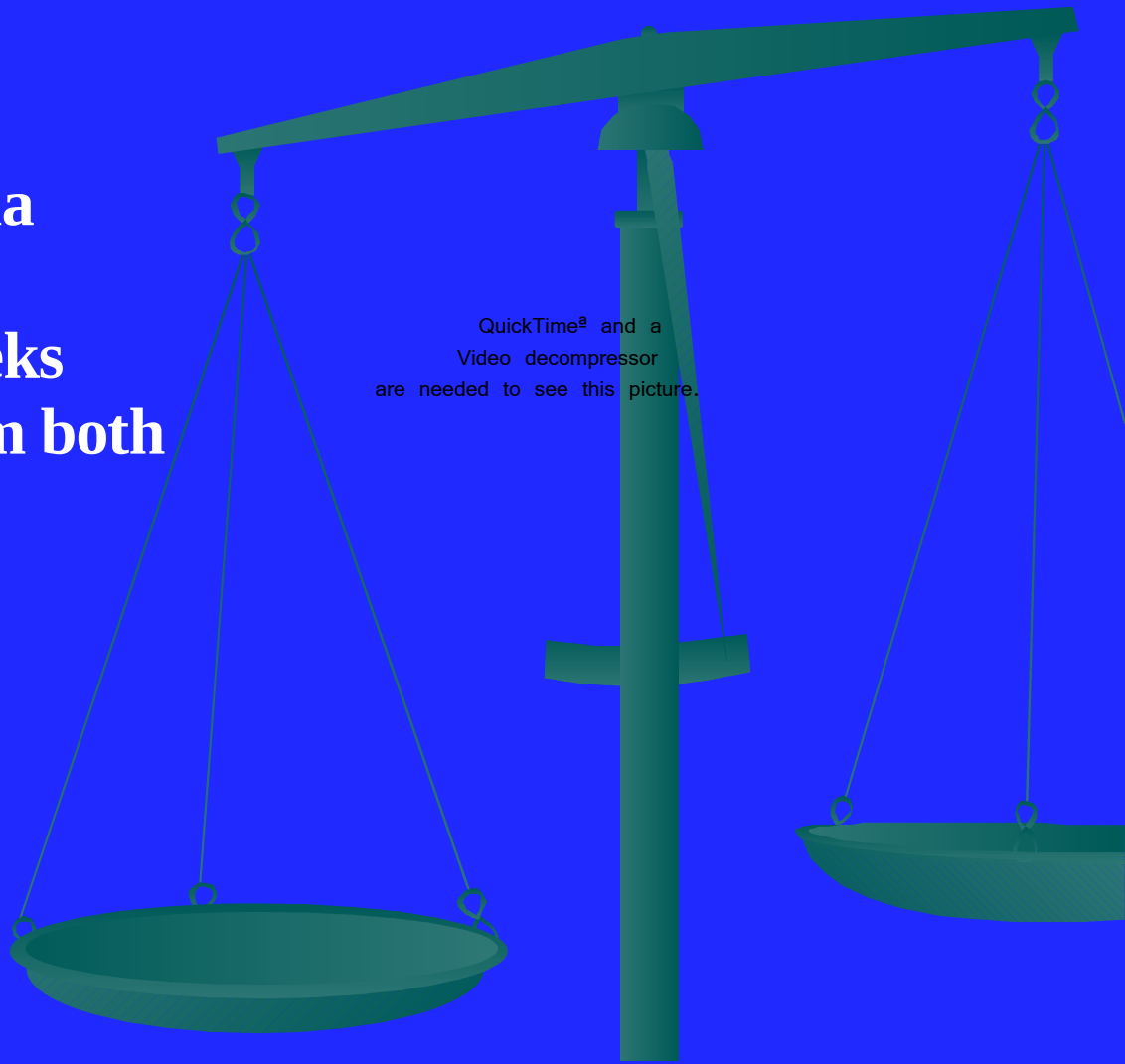


The right heart may be the source of acute cor pulmonale !

Examine tricuspid valve routinely

1 year man
Persistent staph pneumonia
CVVHD
ventilator dependant - weeks
vegetectomy - weaned from both within days



Nepean ICU

-- call from ward : 67 year old man sudden collapse

cyanotic, apnoeic

9 days post lumbar spine surgery

leg Dopplers 2 days previously - NAD

brought to ICU within 15 minutes, CPR en route

output only with CPR

Dx: Acute massive PE - treatment included metalyse 50 mg

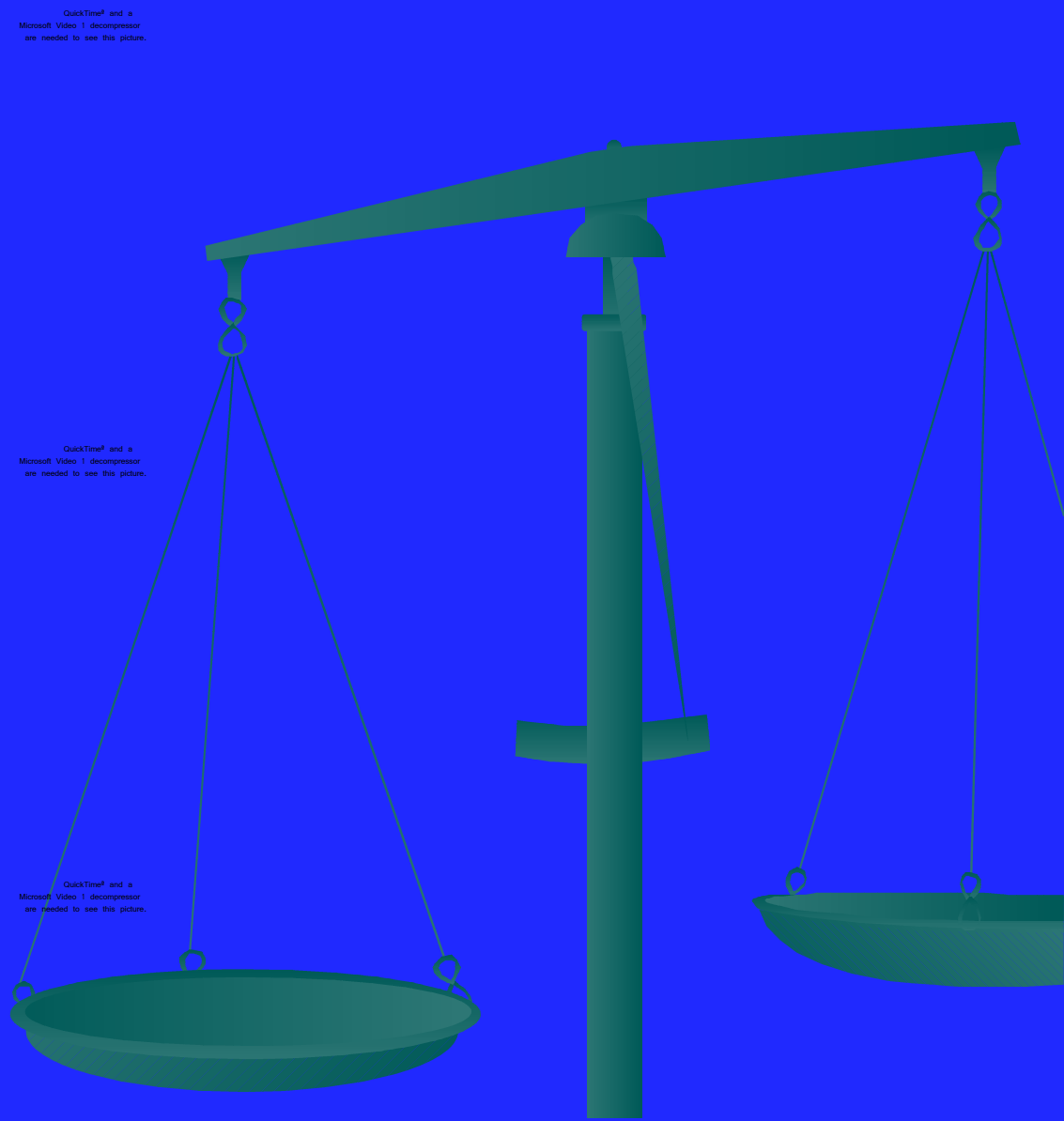
No definite improvement - echo during CPR

TIME

1106

1247

1355



Rapid Echo Diagnosis of Pulmonary embolus leads to rapid goal directed treatment.

42 year man postoperative bowel surgery. Obese ++ dyspnoeic, hypotension.

Rx : analgesia, O^2, IV fluid failure to improve, admitted ICU. Rapid deterioration.

Cardiorespiratory arrest

Asia-Pacific Critical Care 2008
Sydney Australia

The 15th APACCM

In conjunction with:

Australian and New Zealand Intensive Care Society

Thursday 30th October – Sunday 2nd November 2008


the end