Left Atrial Pressures

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Methods available to determine LV preload in the critically ill

- clinical examination ;skin turgor,UO, etc
- cvp as guide to LVEDP
- response to headtown tilt, fluid challenge
- arterial wave form analysis
- Pulmonary artery catheter
- PiCCO
- echocardiography

Echo assessment of LV preload

Downside

- need good Doppler signals
- specificity mediocre
- negated in atrial fibrillation
- time consuming

QuickTimeª and aVideo decompressorare needed to see this picture.

Good reasons for assessing LAP by echo . . . .

- often clinically useful
- reasonably reliable
- use of different methods adds to accuracy
- noninvasive

assumptions ------

- LV preload = LVEDP
- LVEDP = LAP

Methods of measuring left atrial pressure

Left chamber sizes

Mitral inflow Doppler
& MR velocity

TDI mitral
annulus

IAS
movement

QuickTimeª and aVideo decompressorare needed to see this picture.

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Left atrial and ventricular size as a guide to LAP

- Subjective review LV and LA size crude but often very useful re hypovolaemia
- LVEDA reasonable guide to fluid status in OT setting [1]
- LVEDA not so useful in critical care setting in that not influenced by fluid challenge [2]

1. Cheung AT et al 1994 Anesth81:376

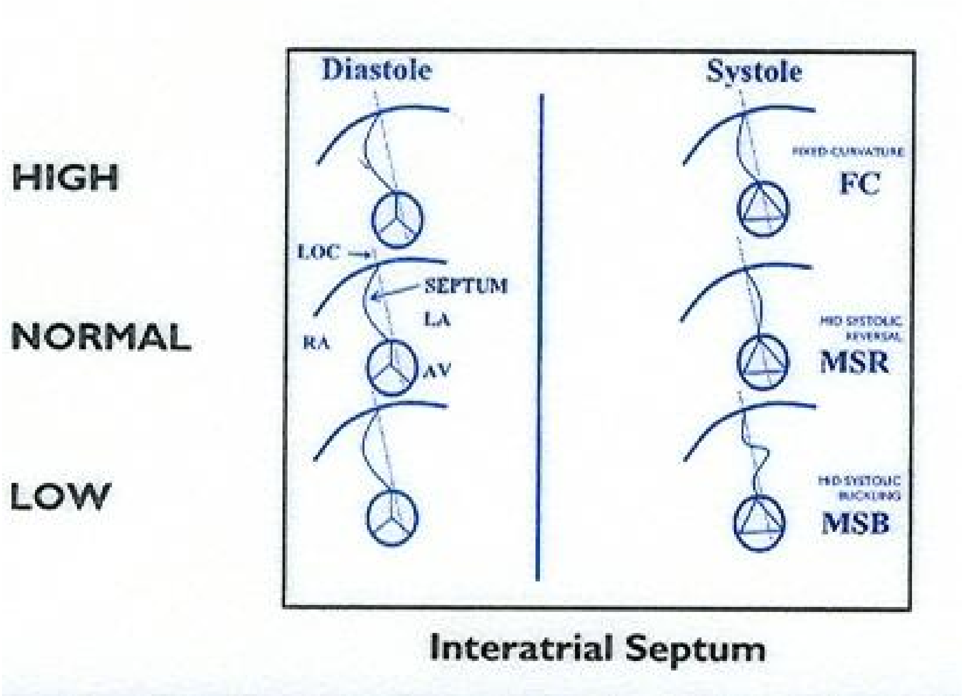
2. Axler O et al 1996 J Crit Care 11:109

Interatrial septum motion as a guide to LAP

- IAS usual motion is towards RA during diastole, towards LA early systole
- LA is less compliant than RA and an equal change in pressure will result in more marked change in the LA compared to the RA
- IAS motion will reflect this change

Interatrial septum motion as a guide to LAP

- IAS motion will reflect LAP



Study [1]
TOE/PAC
N= 71

Fixed Curvature IAS
(L ---> R)
= PCWP > 18 mm Hg

1.Royce C et al 2000 J Cardiothorac Vasc Anaes

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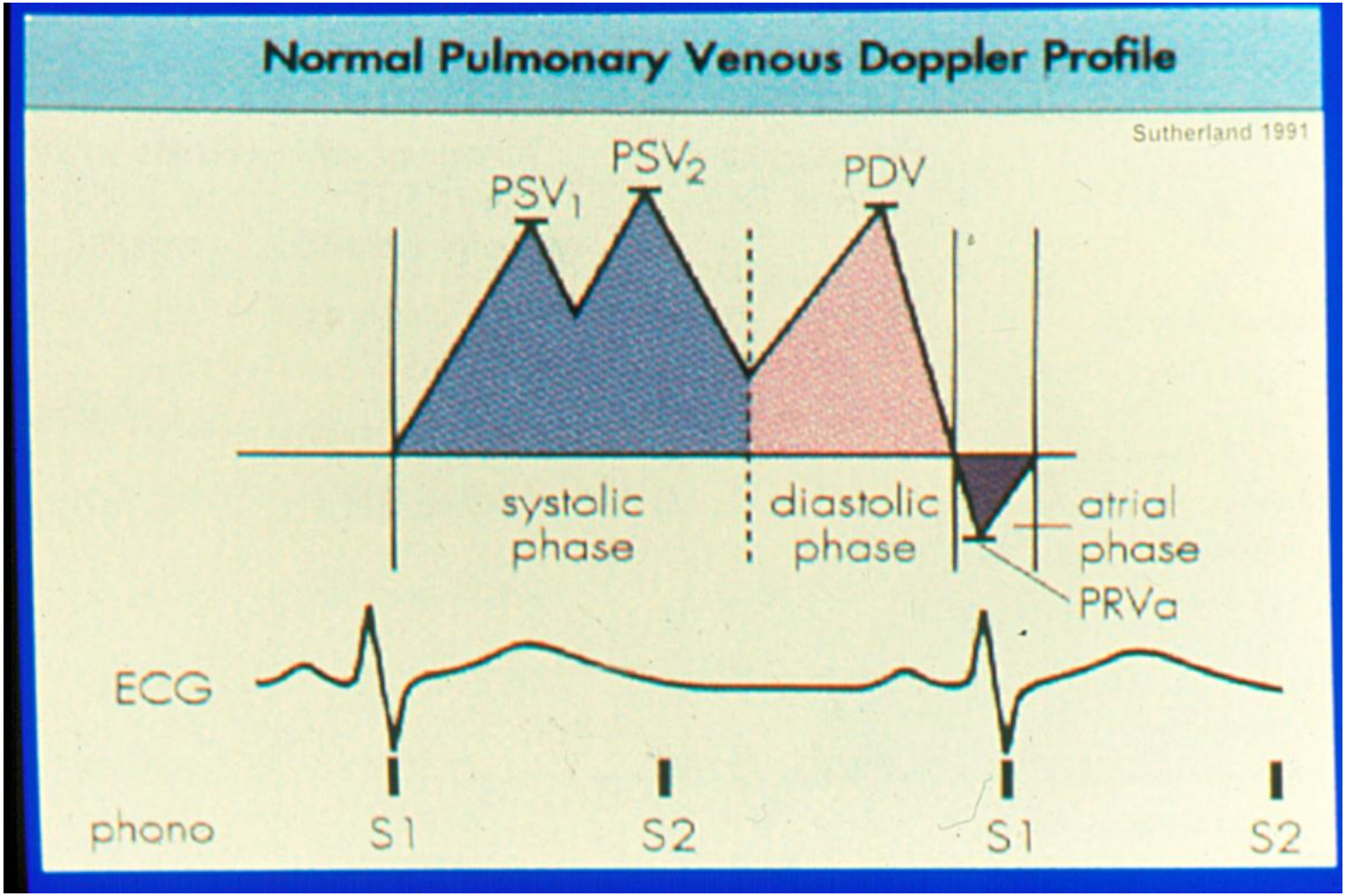
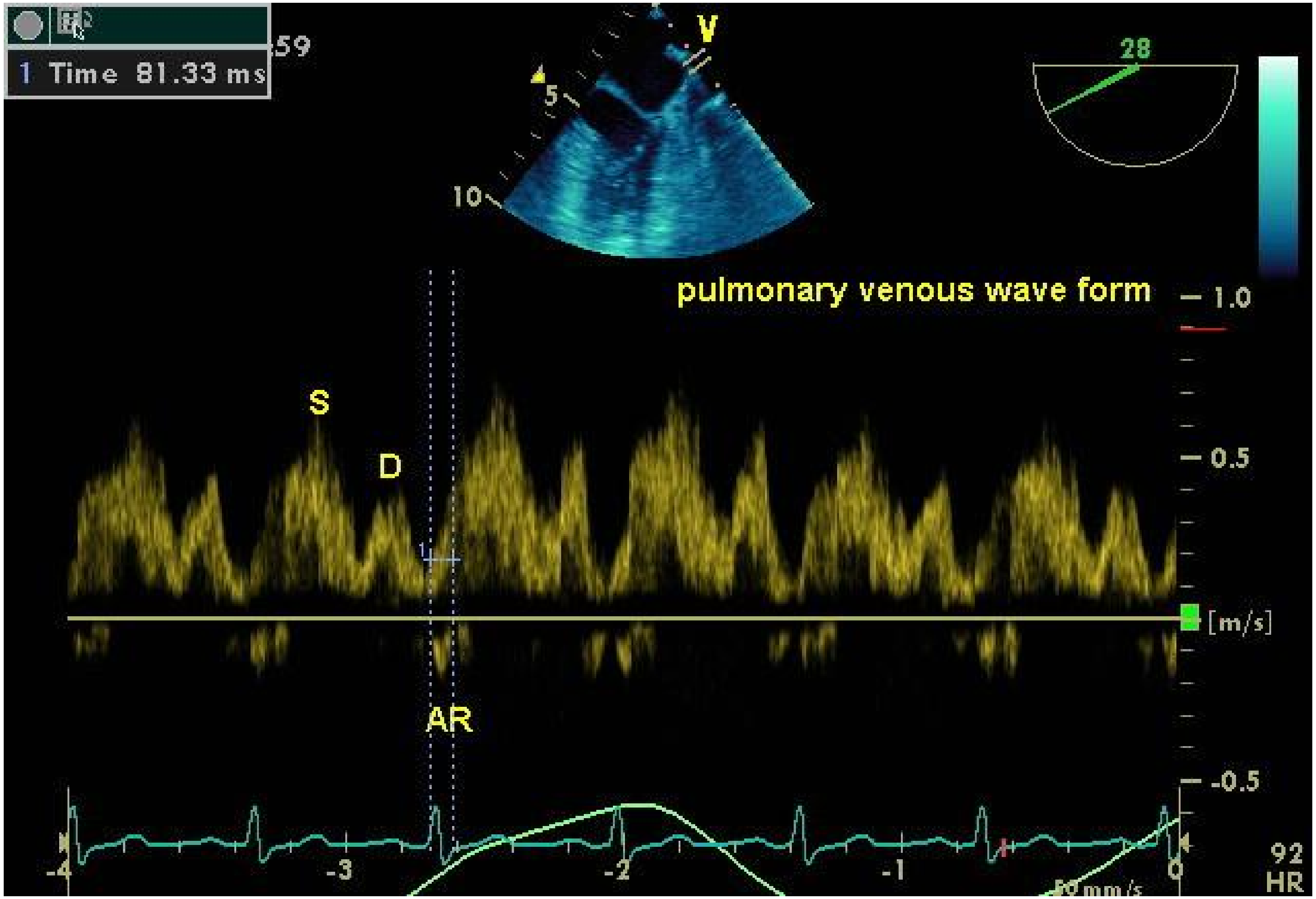
Pulmonary venous wave patterns as a guide to LAP



Pulmonary venous wave patterns as a guide to LAP



Pulmonary venous wave patterns as a guide to LAP

- Systolic forward flow velocity is strongly and inversely related to LV filling pressures (exceptions eg eccentric MR)

- Methods i) Systolic fraction
  ii) Ar/Adur
  iii) DT diastolic flow

Pulmonary venous wave patterns as a guide to LAP

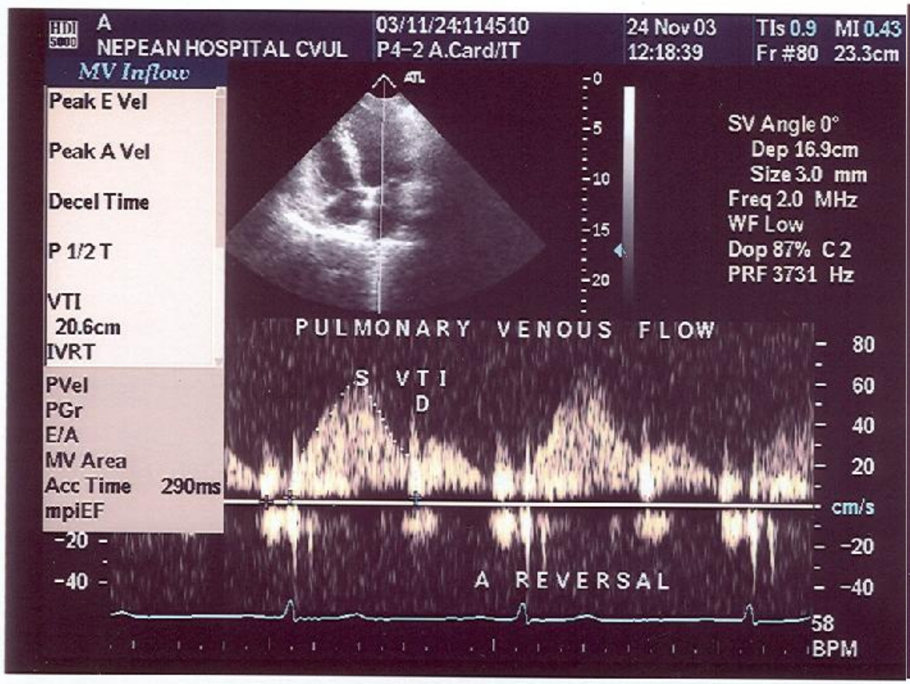
i) Systolic fraction

$$\frac{\text{VTI systolic}}{\text{VTI systolic + diastolic}} < 40\%$$

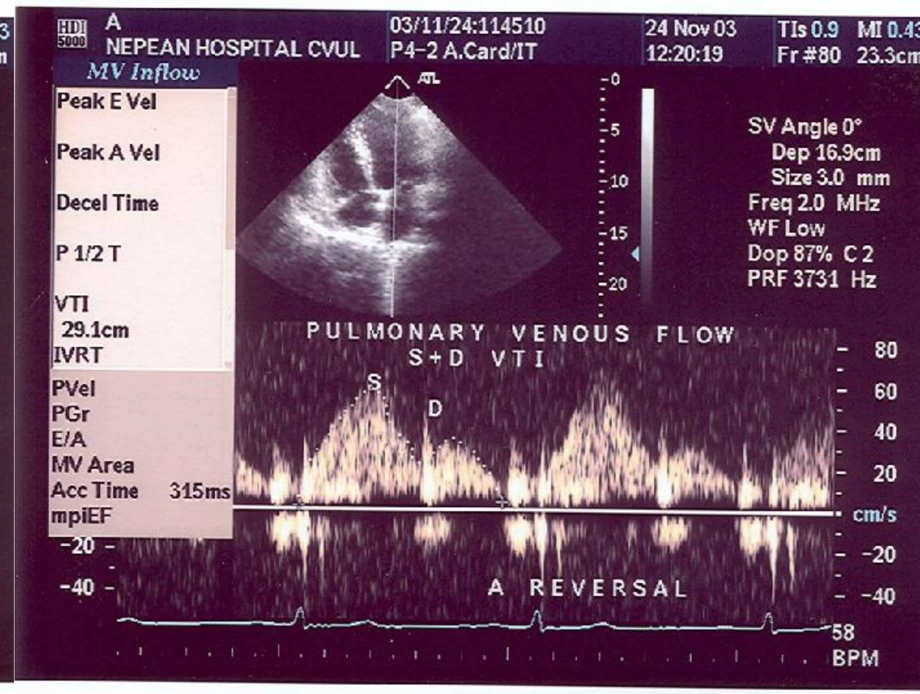
= LAP > 18 mm Hg

Ref: Kuecherer H et al Circulation 1990;82:1127

Pulmonary venous wave patterns as a guide to LAP



S = 10



S + D = 15.9

SF = 10/15.9 ie > 40%. LAP<18

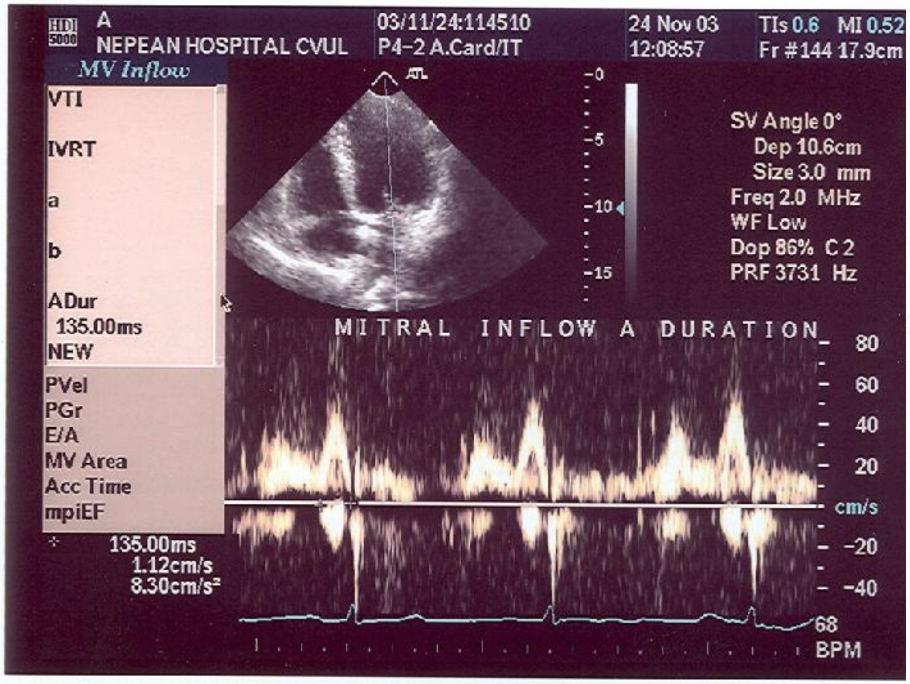
Pulmonary venous wave patterns as a guide to LAP

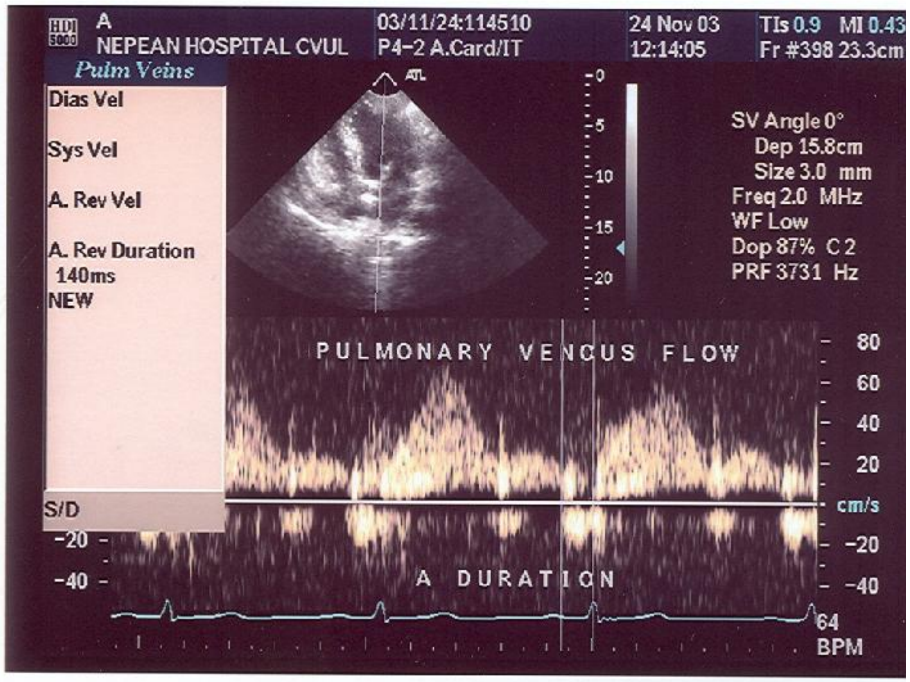
i) Ar/Adur

$A_r > A_{dur}$ predicts a LAP > 15 mm Hg

Ref: Rossvol O, Hatle LK. JACC 1993; 21:1687

Pulmonary venous wave patterns as a guide to LAP





A_{dur} = 135 ms

A_r = 140 msec

ie LAP elevated

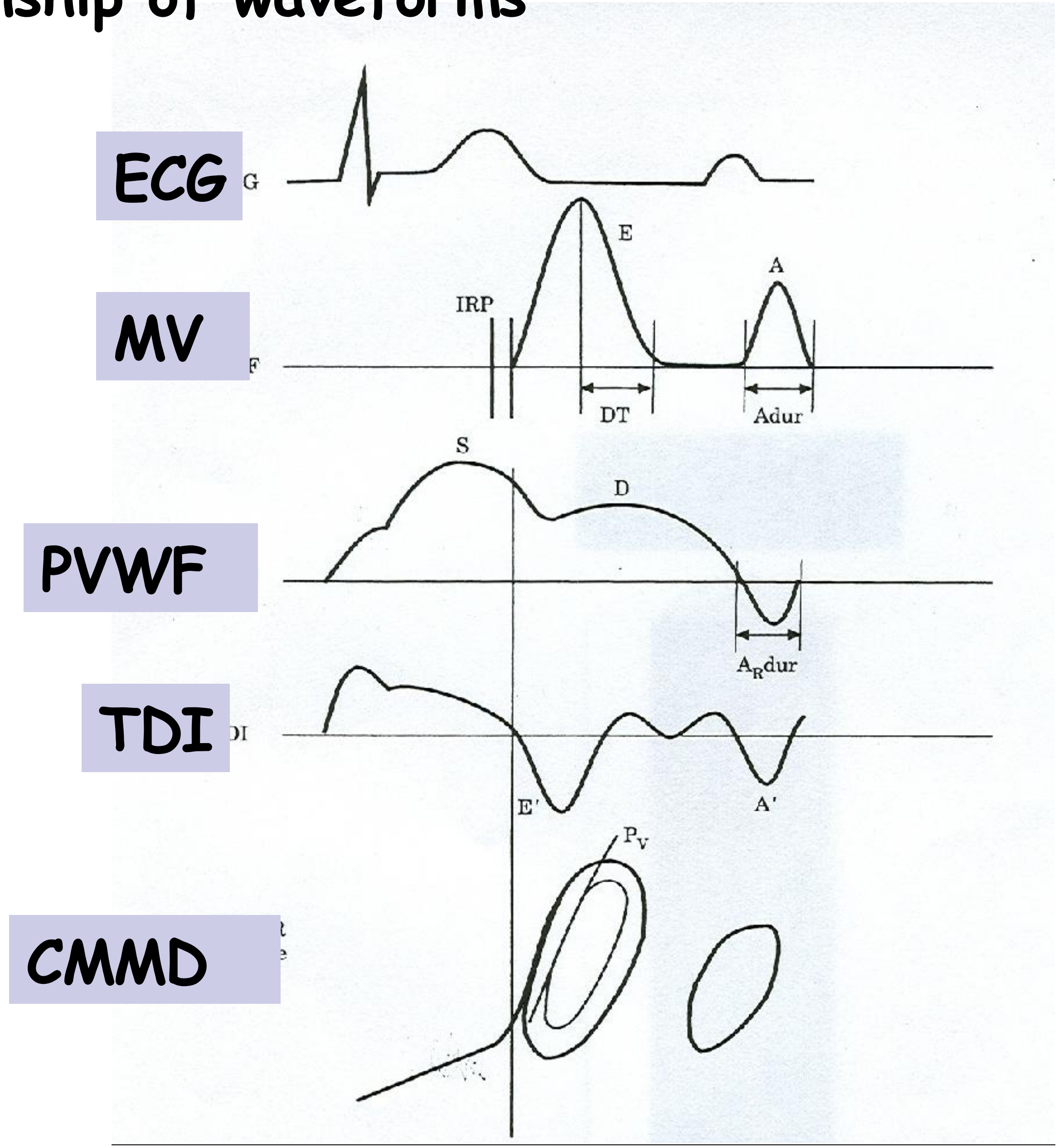
Pulmonary venous wave patterns as a guide to LAP

iii) Deceleration Time PV diastolic flow.

DTd < 175 msec predicts a LAP >17 mm Hg

Ref: Kinnard T et al 2001. JACC 37(8):2025

Relationship of waveforms



Methods of measuring left atrial pressure

Mitral inflow Doppler

Left chamber size

& MR velocity

TDI mitral annulus

IAS movement

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Mitral inflow Doppler patterns as a guide to LAP

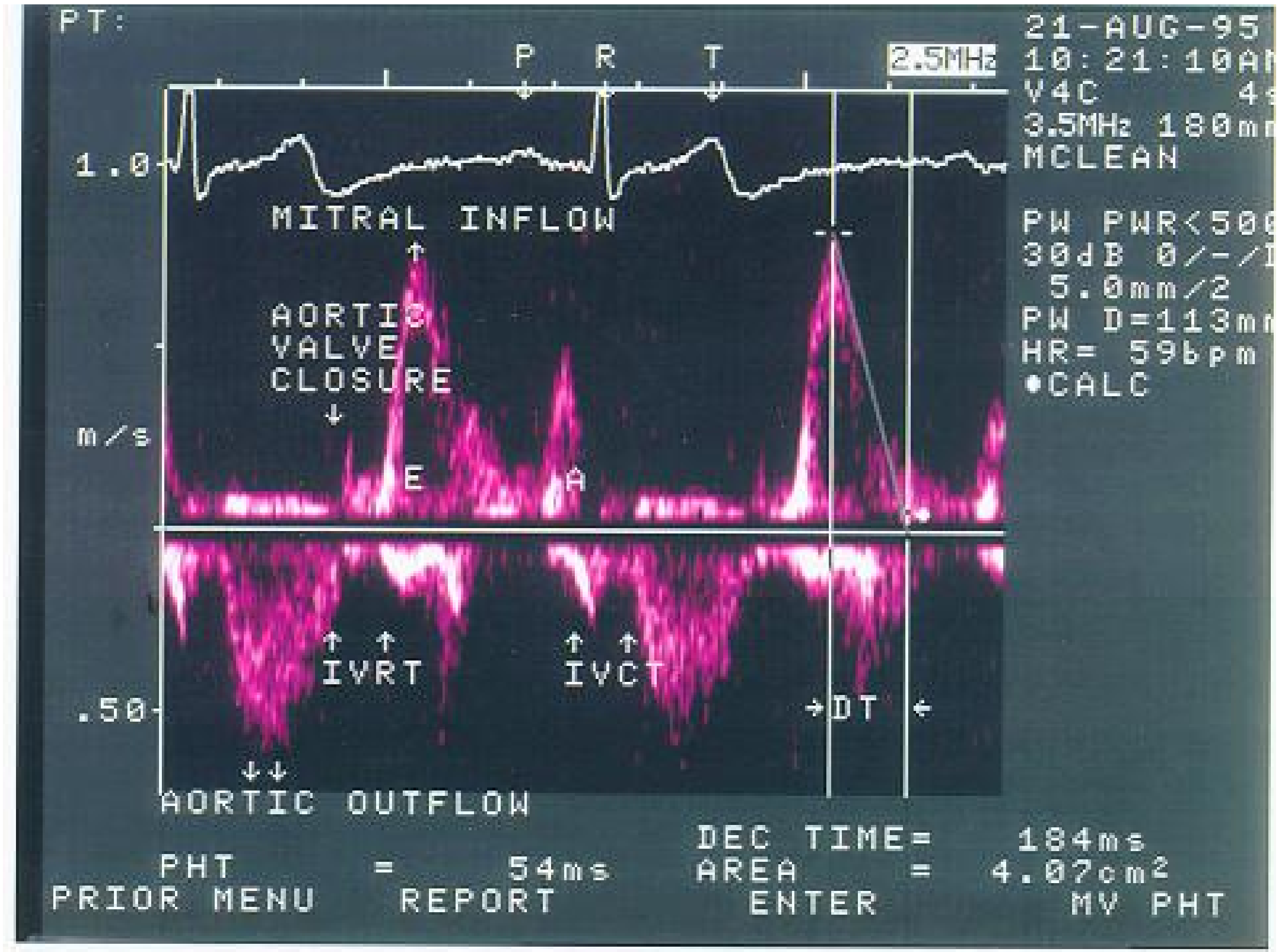
Methods

ii) E/A >2 predicts LAP >20 mm Hg

iv) Deceleration Time of E wave

DT < 120 msec predicts LAP >20 mm Hg

Ref: Gianuzzi P et al 1994 JACC 23(7);1630



Mitral inflow analysis

Methods of measuring left atrial pressure

Left chamber size

Mitral inflow Doppler & MR velocity

TDI mitral annulus

IAS movement

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Colour M Mode of the mitral inflow as a guide to LAP

Method

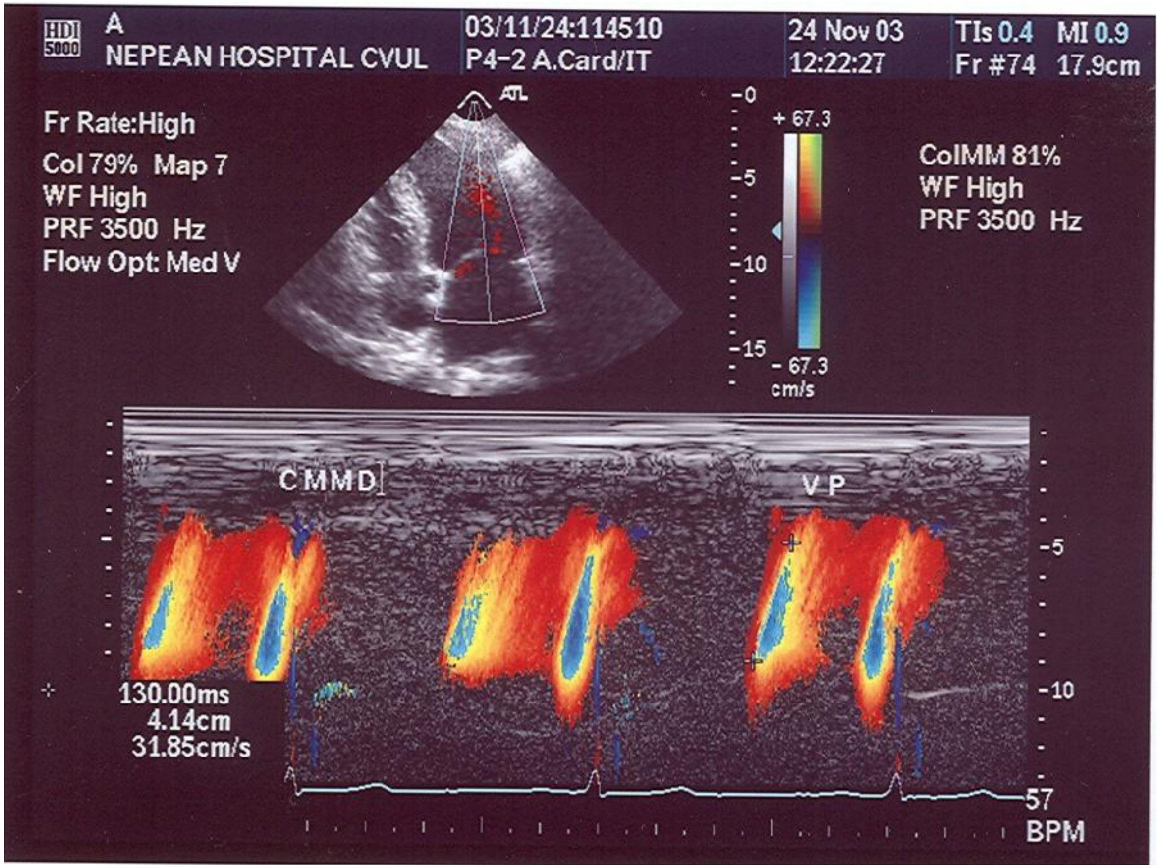
combines colour M Mode of mitral inflow
+
Peak E wave velocity

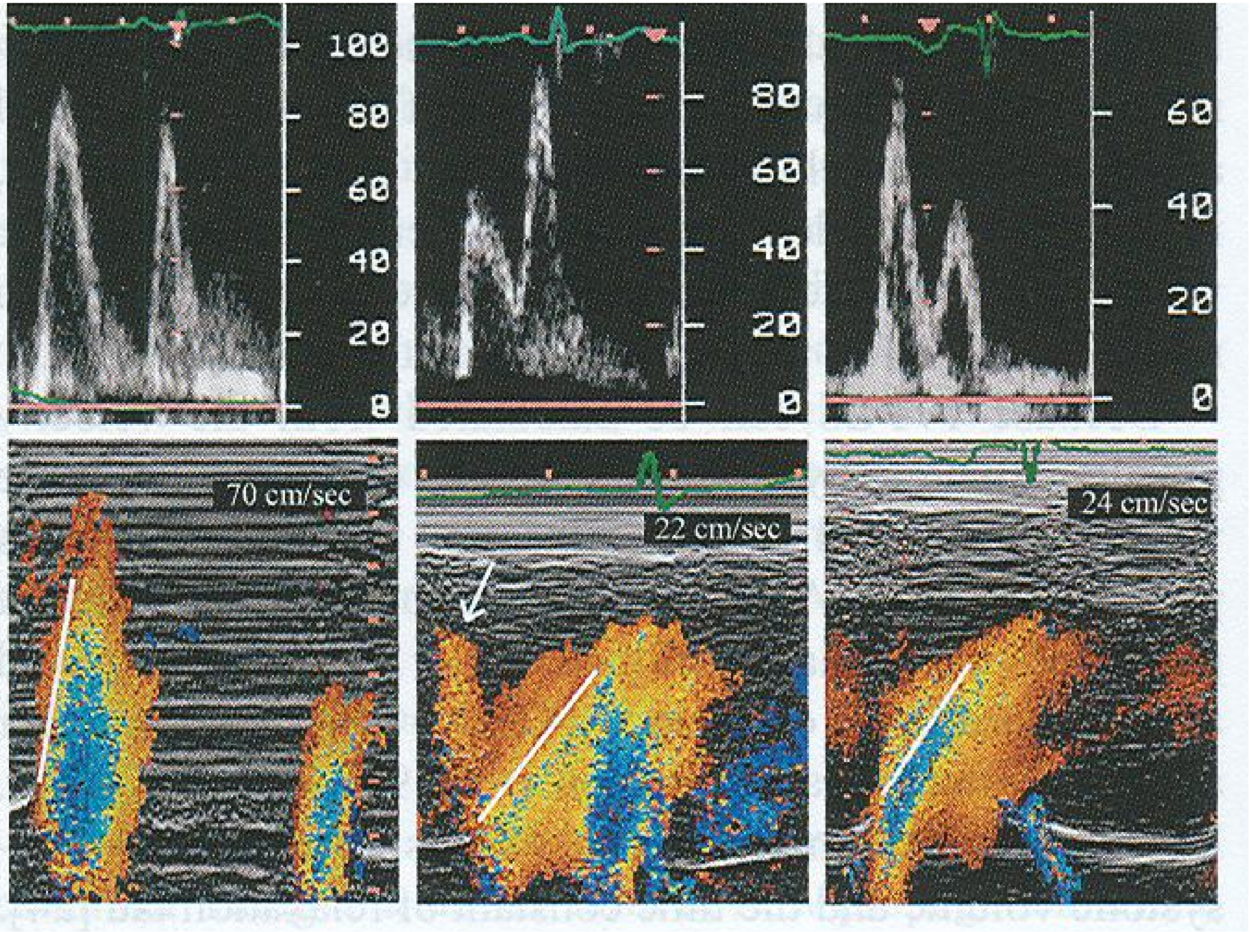
P_v obtained from slope of first colour aliasing

E/P_v > 2.6 predicts LAP > 15 mm Hg

Ref: Garcia MJ et al 1997.JACC;29(2):448

Colour M Mode of the mitral inflow as a guide to LAP





Normal impaired relaxation pseudonormal

De Boeck B..EJHF 2005

Methods of measuring left atrial pressure

Left chamber size

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IAS
movement

QuickTime® and aCinepak decompressorare needed to see this picture.

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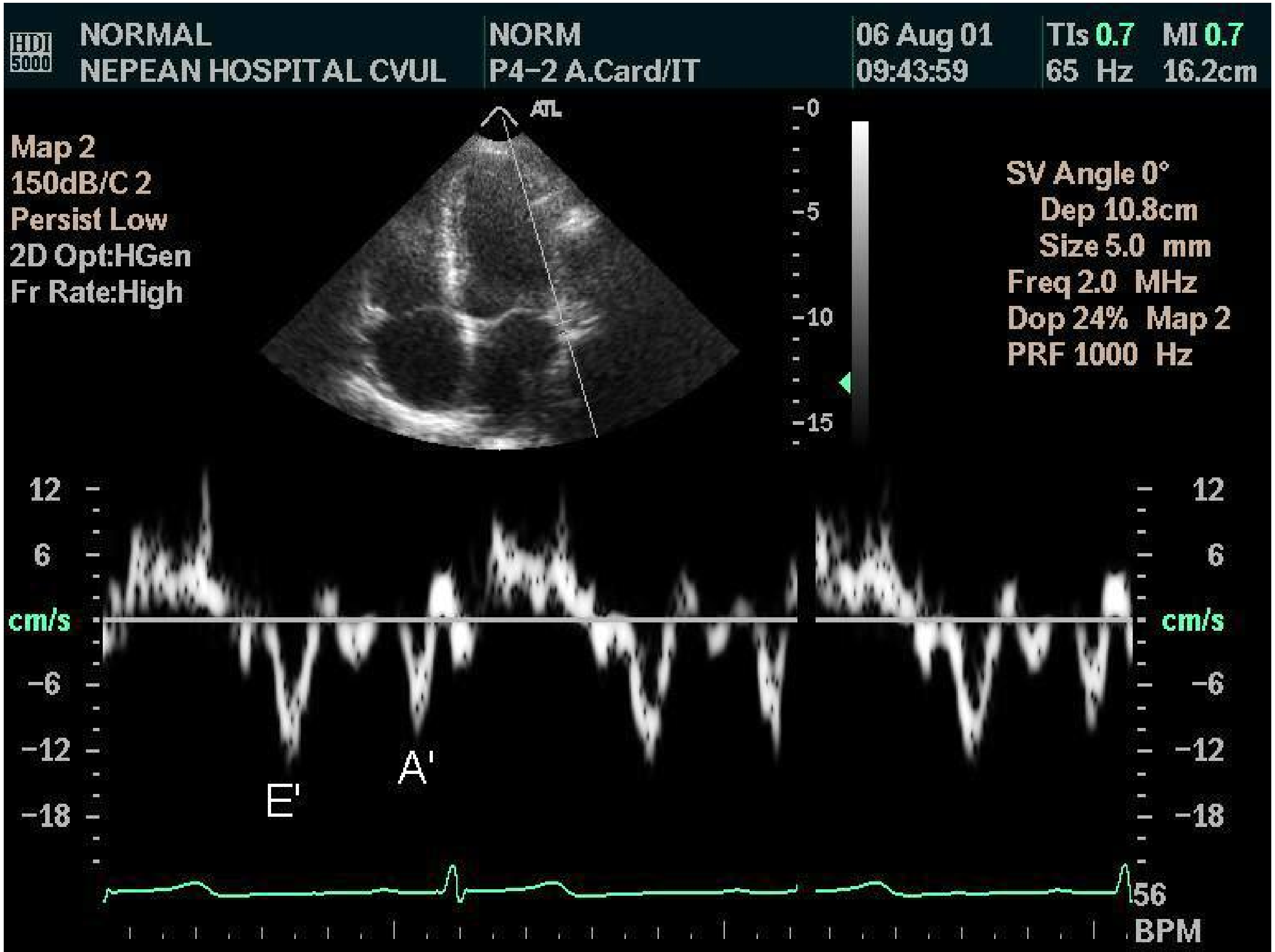
Tissue Doppler Imaging of the mitral annulus as a guide to LAP



Tissue Doppler Imaging of the mitral annulus as a guide to LAP

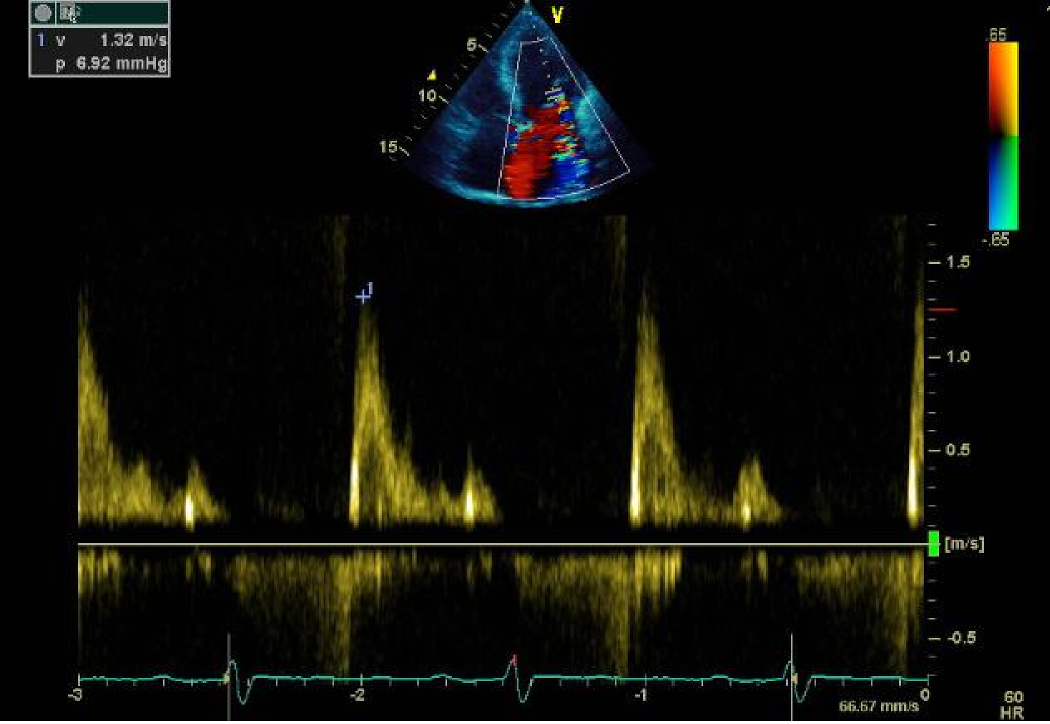
DTI of lateral or medial annulus

Published work mainly on TTE

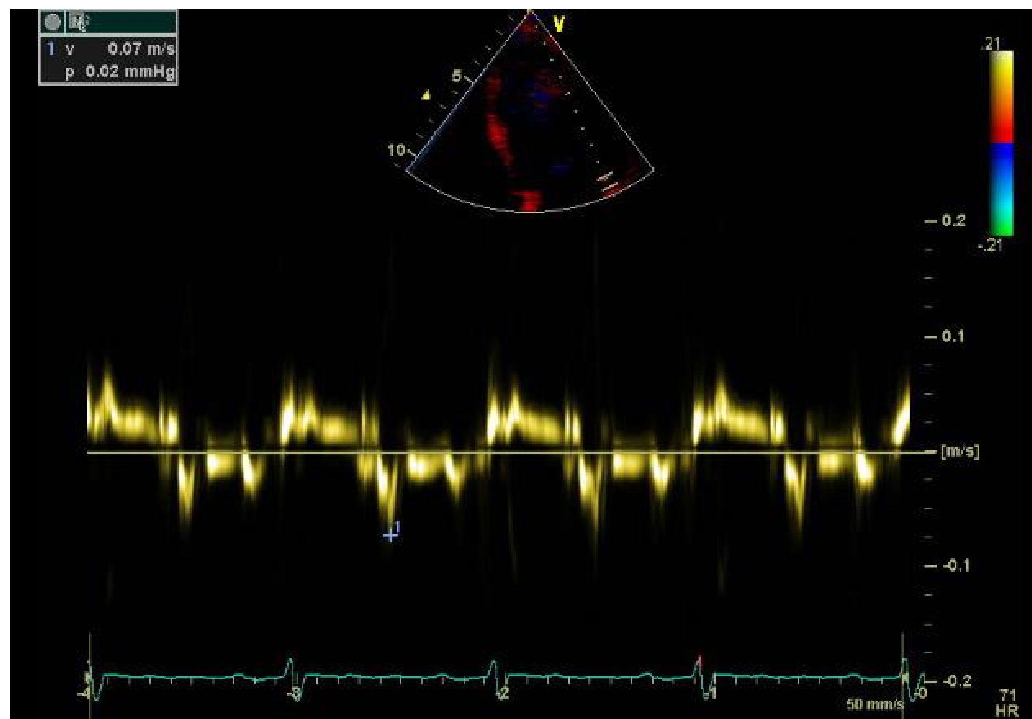
$E/E^1 < 8$ mean LAP normal

$E/E^1 > 15$ mean LAP > 12 mm Hg

Ref: Ommen SR et al 2000. Circulation 102:1788



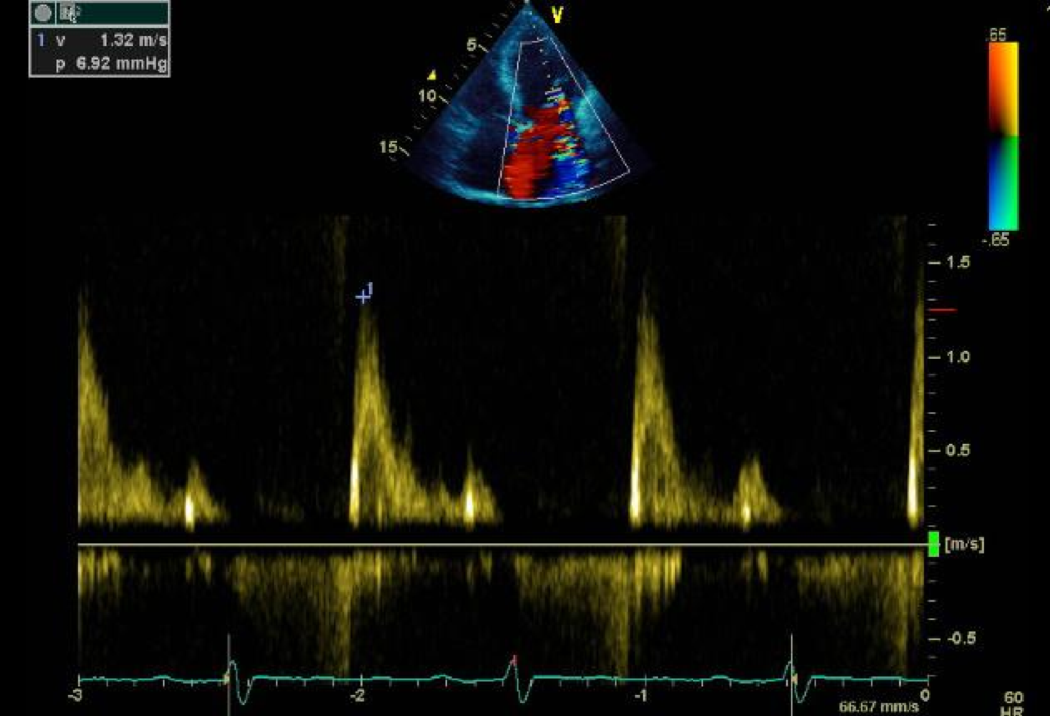
lateral annulus



$$E / E^1 = 1.32/0.07$$

$$= 18.9$$

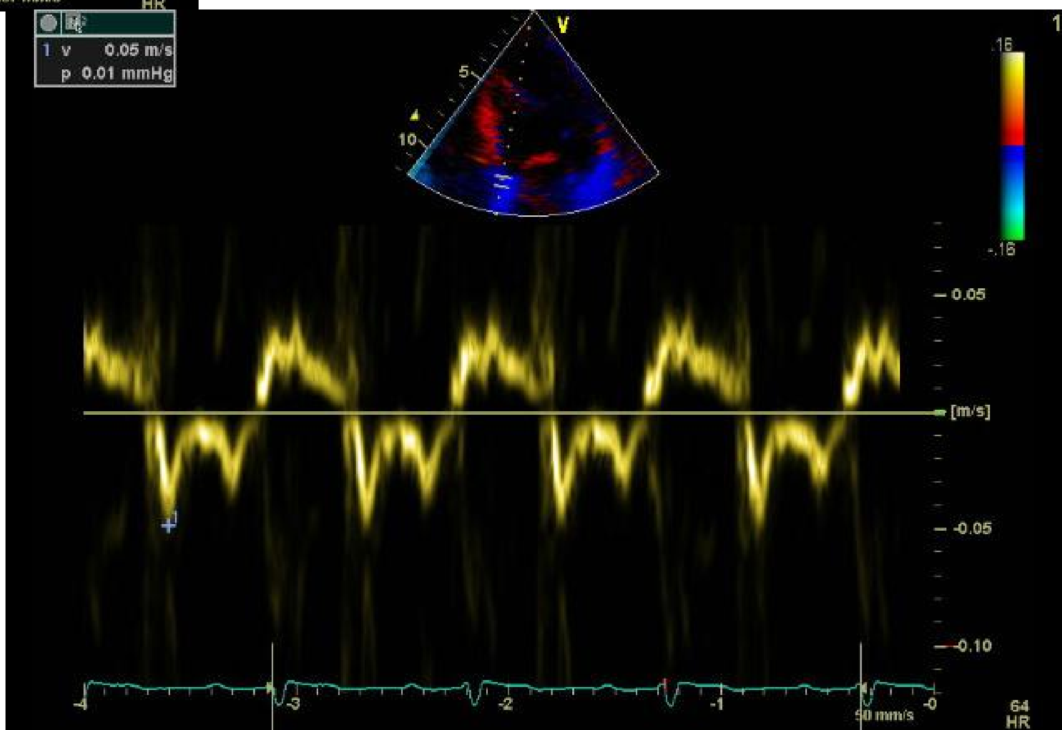
ie LAP is > 12 mmHg



consider the presence of

Segmental wall defects

medial annulus



$E / E^1 = 1.32/0.05$

$= 26$

ie LAP is > 12 mmHg

Methods of measuring left atrial pressure

Mitral inflow Doppler

Left chamber size

& MR velocity

TDI mitral annulus

IAS movement

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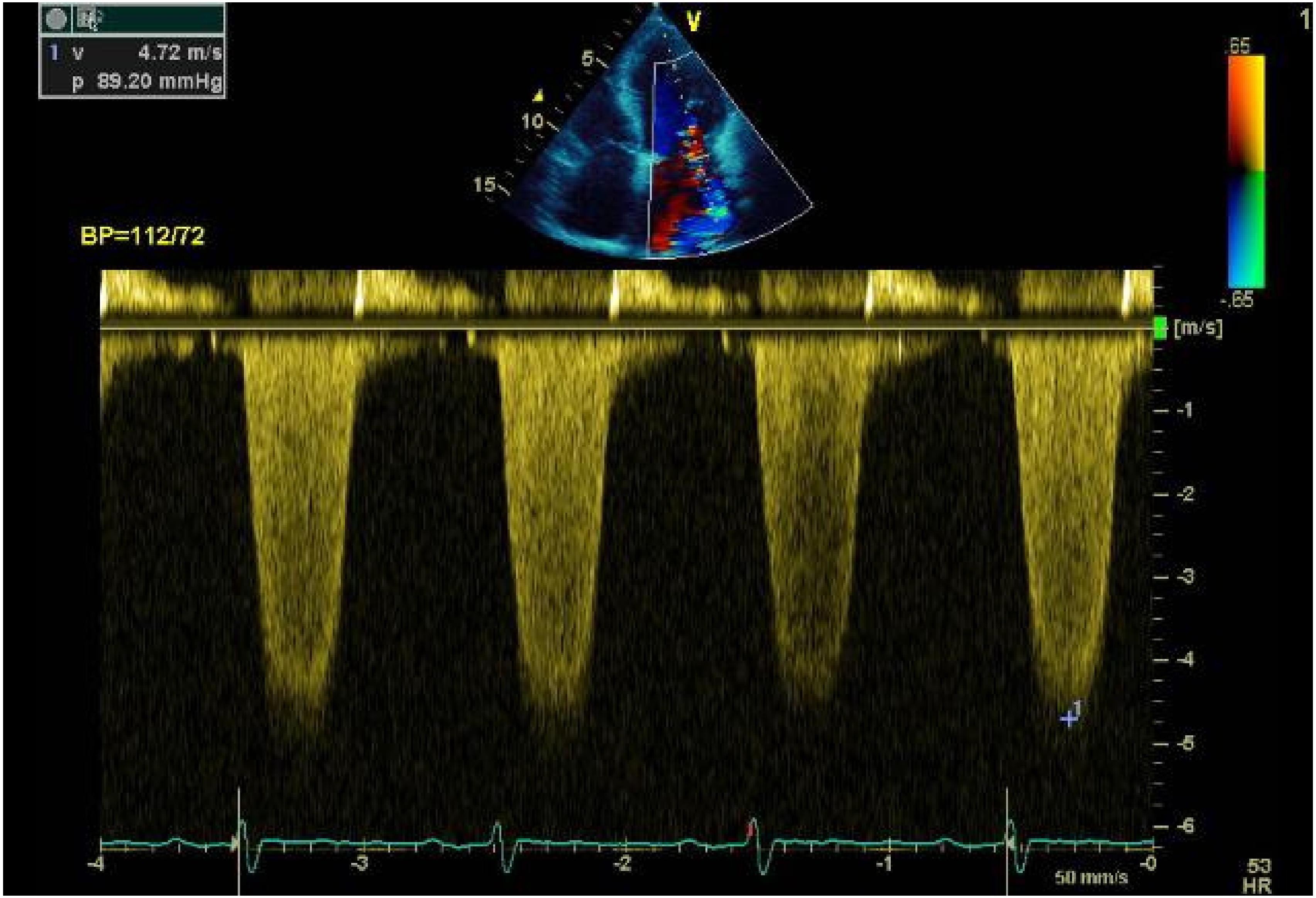
Using mitral regurgitant velocities to measure LAP

LAP = systolic BP — MR peak pressure

- need mitral regurgitant signal
- sBP in shock may not reflect LV systolic pressure
- inaccurate in aortic stenosis/HOCM
- <u>often very useful</u>

Ref: Garcia MJ et al 1997 JACC;29(2):448



ie LAP = 112 - 89 = 23 mm HG

Formula for Estimating PCWP by Using downslope of the MR CW signal

Uzun M..Echo2004.21;673

t_1 = time between MR downslope 4 m/sec to end of signal

t_2 = time MR downslope 3 m/s to end of MR signal

$$PAWP = 24.196\ t_1/t_2 - 17.761$$

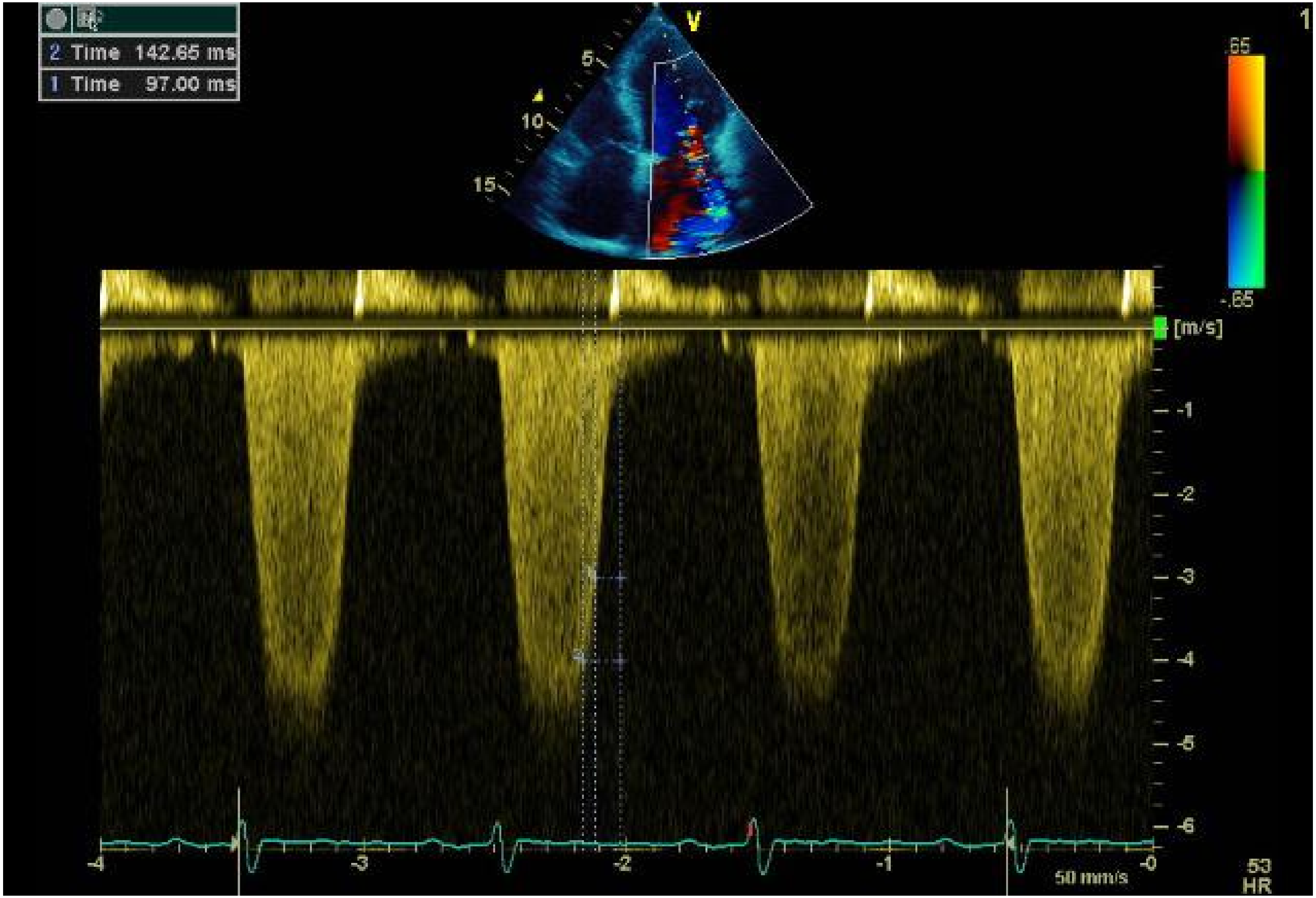
ie $t_1/t_2 > 1.44$ then PCWP > 16 mm Hg

1.30 - 1.44PCWP N or increased

Study: n=80 MR++/+++

PAC comparison

satisfactory CW MR signal in 63/80 ie 78%



t_1/t_2 = 1.47 ie LAP (PCWP) > 16 mm Hg

LAP by echoDoppler

Parameter	Description	Preload Estimate	
Mitral inflow	E/A > 2	PCWP ≥ 20 μμ Ηγ	Σενσιτιϖιτψ 43% Σπεχιφιχιτψ 99%
Μιτραλ ινφλοω Ε ωαϖε	ΔΤ ≤ 120μσεχ	ΠΧΩΠ>20	Σενσιτιϖιτψ 100% Σπεχιφιχιτψ 99%
Πυλμοναρψ ϖενουσ φλοω	Σψστολιχ Φραχτιον<0.4	ΠΧΩΠ>18 ρ=0.78	
Μιτραλ ινφλοω + πυλμοναρψ ϖενουσ φλοω	Α ρεϖερσαλ>Α δυρατιον	ΛςΕΔΠ>15	Σενσιτιϖιτψ 85% Σπεχιφιχιτψ 79%
Μιτραλ ινφλοω + Μιτραλ αννυλυσ ΔΤΙ	E/E_1 > 15	ΛςΕΔΠ> 15	
Μιτραλ ινφλοω ΧΜΜΔ οφ μιτραλ ινφλοω	Ε/ςπ > 2.6	ΠΧΩΠ>15	ΠΠς 0.89 ΝΠς 0.86
ΙΑΣ μοϖεμεντ	Φξεδ χυρϖατυρε (Λ→[illegible]	[illegible]	
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The End
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