

Siêu âm trong đánh giá bệnh cơ tim do thiếu máu cơ tim

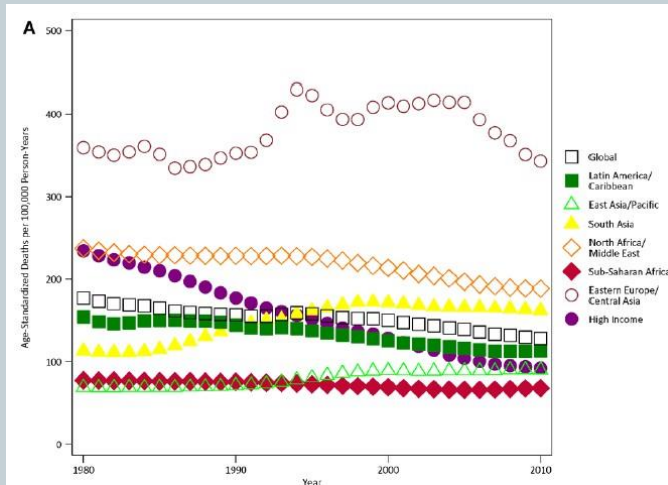


GS. TS. Đỗ Doãn Lợi
PCT Hội Tim mạch VN

The Full Spectrum of IHD

IHD Mortality Rate in 21 World Regions (2010)

males



females

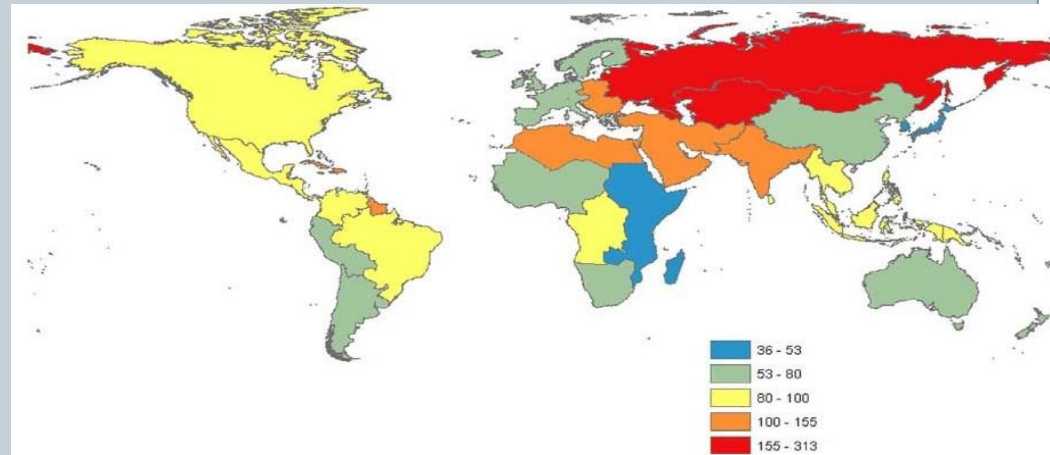
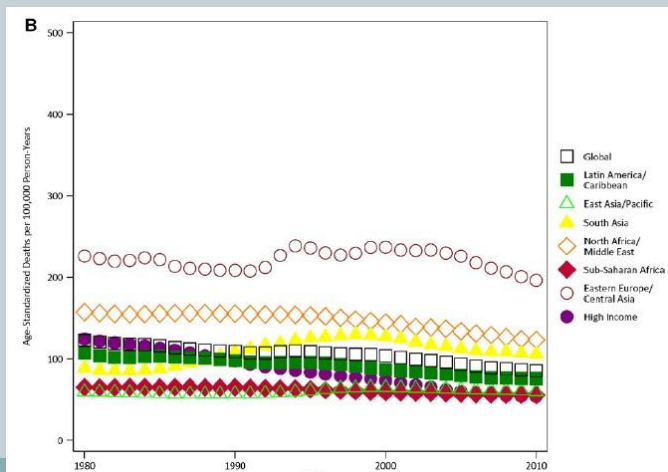


Figure 1. Map of age-standardized ischemic heart disease mortality rate per 100 000 persons in 21 world regions, 2010, the Global Burden of Disease 2010 Study.

The Full Spectrum of IHD

Need to Improve Outcome and Reduce Costs

Aging of the Population

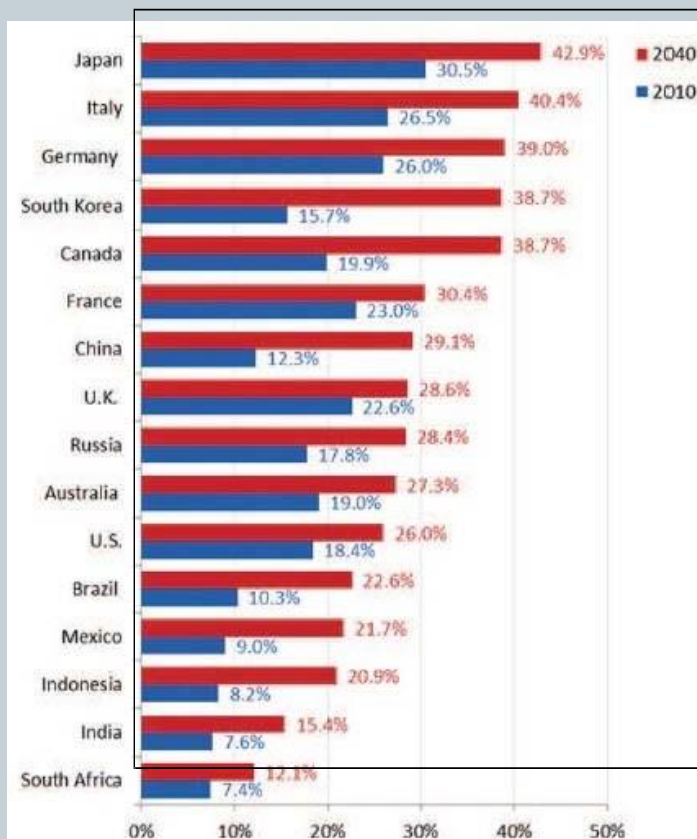
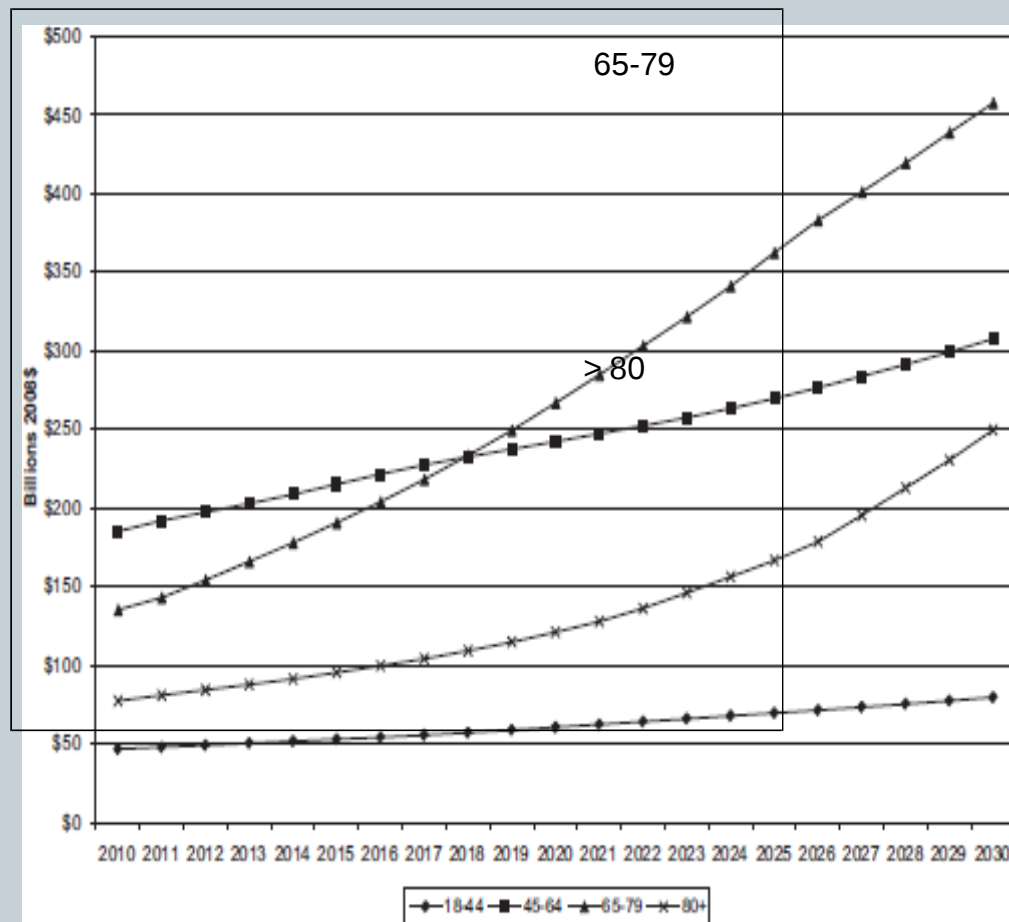


Figure 6

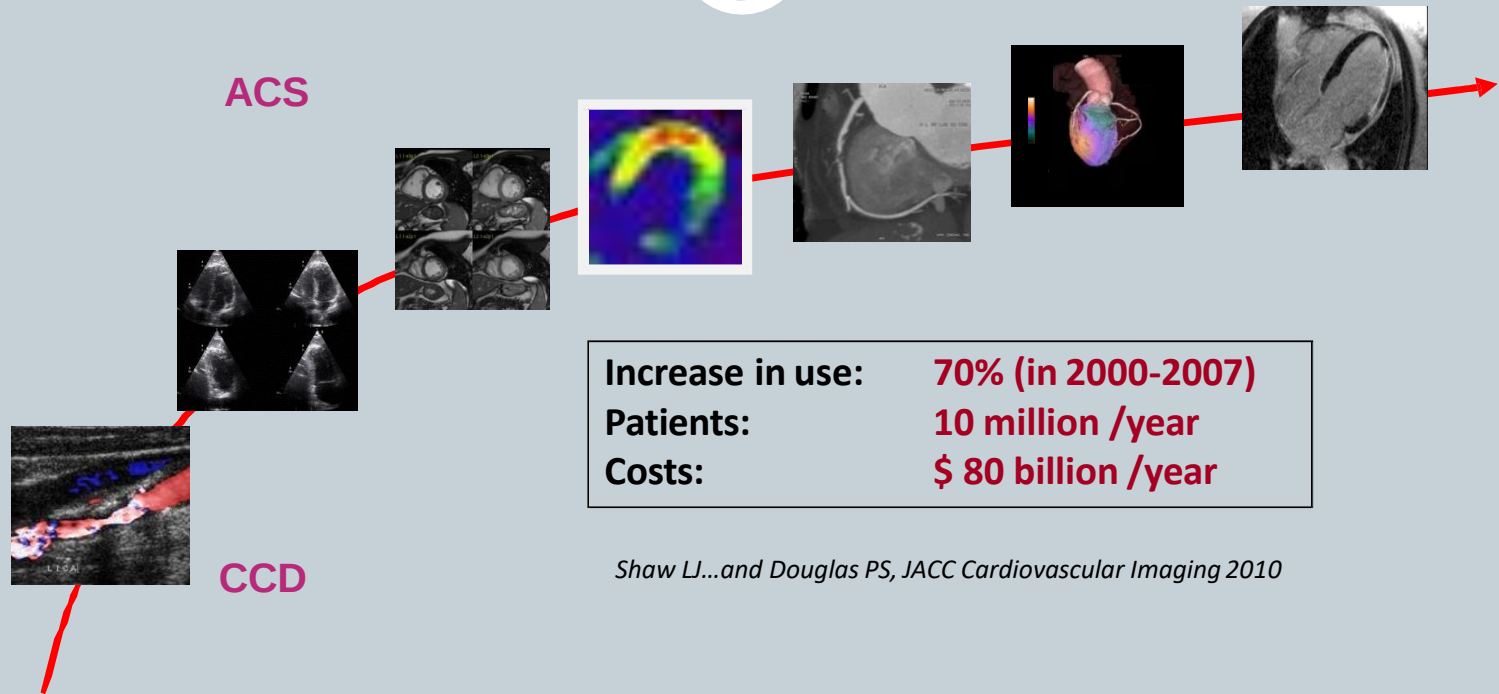
Elderly (Age 60 Years and Older),
as Percent of Population In 2010 and 2040

Projected Costs of IHD by Age



Cardiovascular Imaging

Need for "**WISE and PERSONALIZED**" use in clinical practice



Shaw LJ...and Douglas PS, JACC Cardiovascular Imaging 2010

ACC/AHA 2016



- *Siêu âm là thăm dò chẩn đoán hữu ích nhất để đánh giá bệnh nhân có suy tim bởi vì có khả năng đánh giá không xâm nhập chức năng thất cũng như nguyên nhân của bệnh lý cấu trúc tim*
- Bệnh cơ tim – biểu hiện lâm sàng của tổn thương cơ tim do nhiều nguyên nhân.

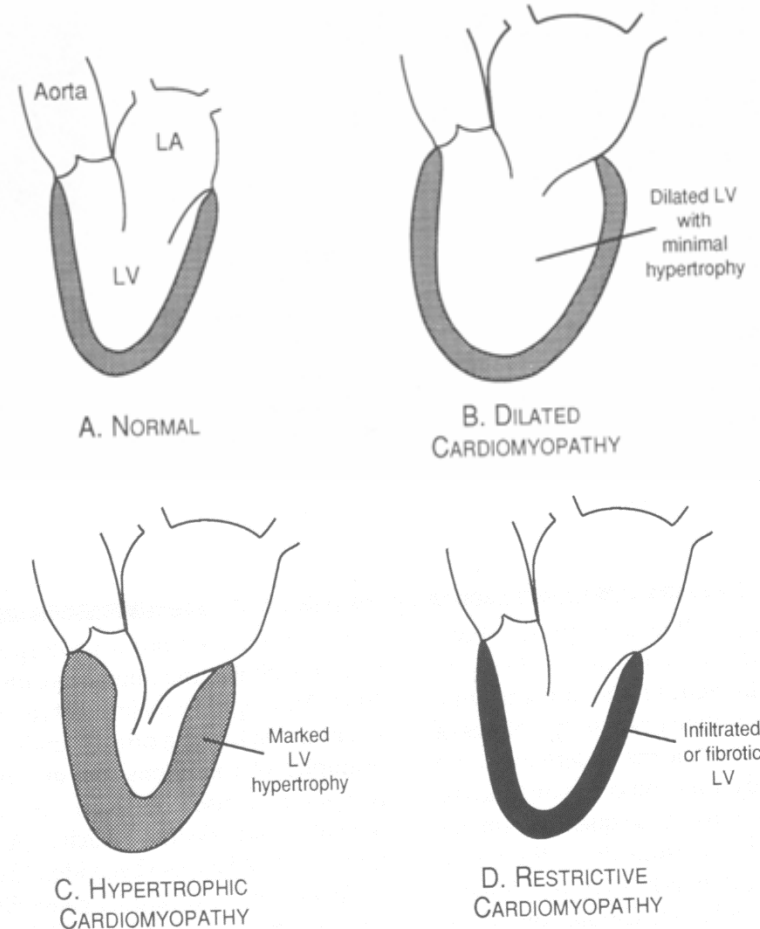
Cardiomyopathy



WHO Classification

anatomy & physiology of the LV

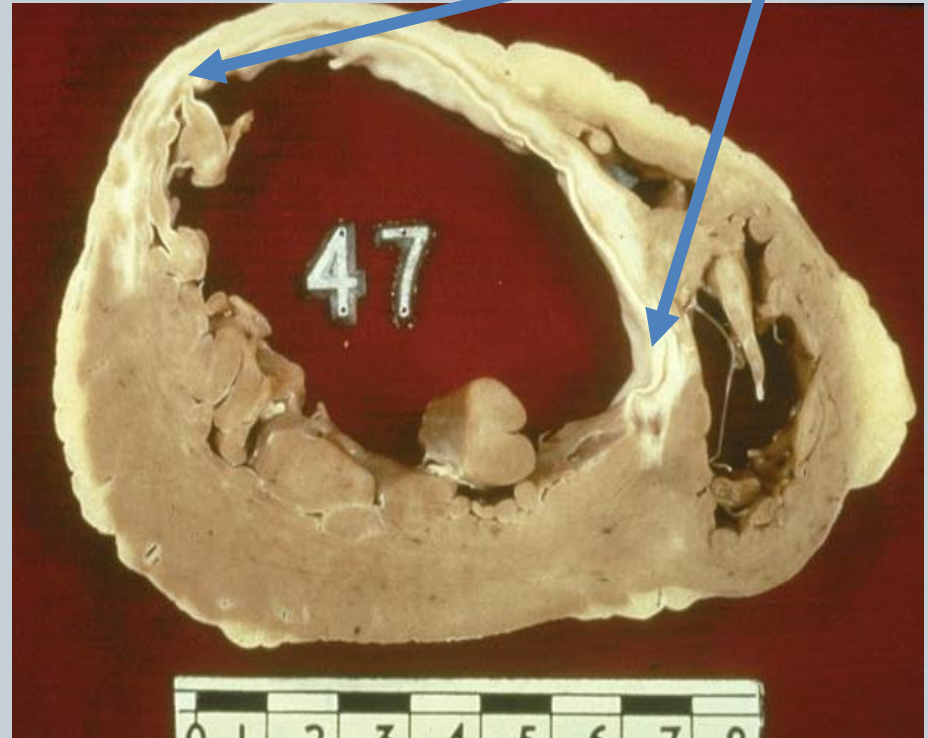
1. Dilated
 - Enlarged
 - Systolic dysfunction
2. Hypertrophic
 - Thickened
 - Diastolic dysfunction
3. Restrictive
 - Diastolic dysfunction
4. Arrhythmogenic RV dysplasia
 - Fibrofatty replacement
5. Unclassified
 - Fibroelastosis
 - LV noncompaction



CM: Specific Etiologies

- Ischemic
- Valvular
- Hypertensive
- Inflammatory
- Metabolic
- Inherited
- Toxic reactions
- Peripartum

Ischemic: thinned, scarred tissue



Siêu âm trong BCT



3 vấn đề chính cần nắm rõ:

- EF có bình thường hay giảm?
(Lưu ý phương pháp tính EF theo tình huống bệnh lý).
 - Kích thước, cấu trúc thất trái ?
 - Bất thường cấu trúc khác
 - van tim
 - màng tim
 - thất phải
- có thể ứng với biểu hiện lâm sàng của suy tim?

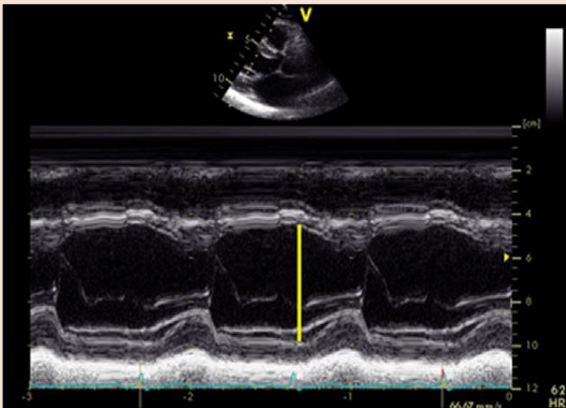
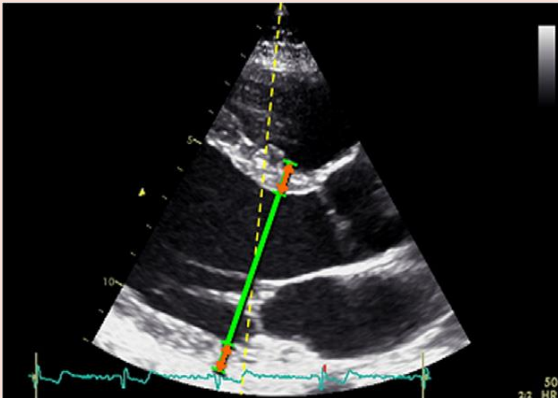
Vai trò của siêu âm & Doppler



- Đo kích thước tim (chiều dày, đường kính), hình dạng thất.
- Chức năng tâm thu: thất trái và phải
- Chức năng tâm trương
- Đánh giá huyết động: áp lực nhĩ trái, áp lực làm đầy thất trái, áp lực động mạch phổi tâm thu, áp lực TM trung tâm, thể tích tổng máu.
- Chẩn đoán bệnh lý cấu trúc của tim: vận động vùng, van tim, màng tim...

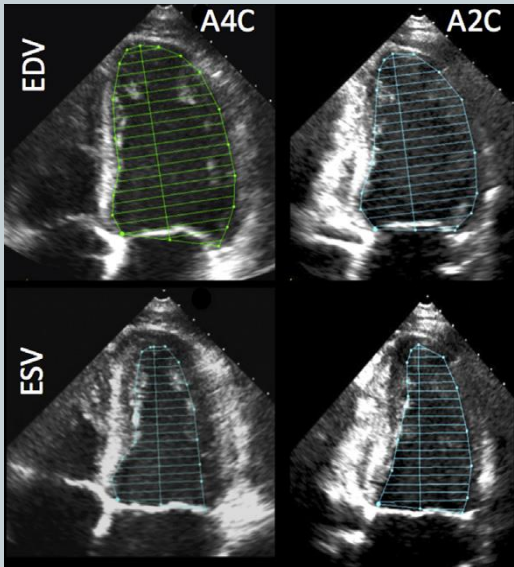
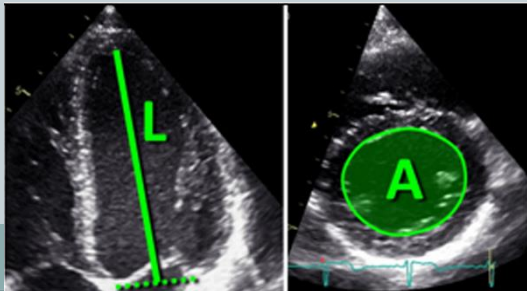
ASE/EACI recommendations 2015

Table 1 Recommendations for the echocardiographic assessment of LV size and function

Parameter and method	Technique	Advantages	Limitations
Internal linear dimensions. Linear internal measurements of the LV should be acquired in the parasternal long-axis view carefully obtained perpendicular to the LV long axis, and measured at the level of the mitral valve leaflet tips. Electronic calipers should be positioned on the interface between myocardial wall and cavity and the interface between wall and pericardium (<i>orange arrows</i>).	M-mode tracing 	• Reproducible • High temporal resolution • Wealth of published data	• Beam orientation frequently off axis • Single dimension, i.e., representative only in normally shaped ventricles
	2D-guided linear measurements 	• Facilitates orientation perpendicular to the ventricular long axis	• Lower frame rates than M-mode • Single dimension, i.e., representative only in normally shaped ventricles

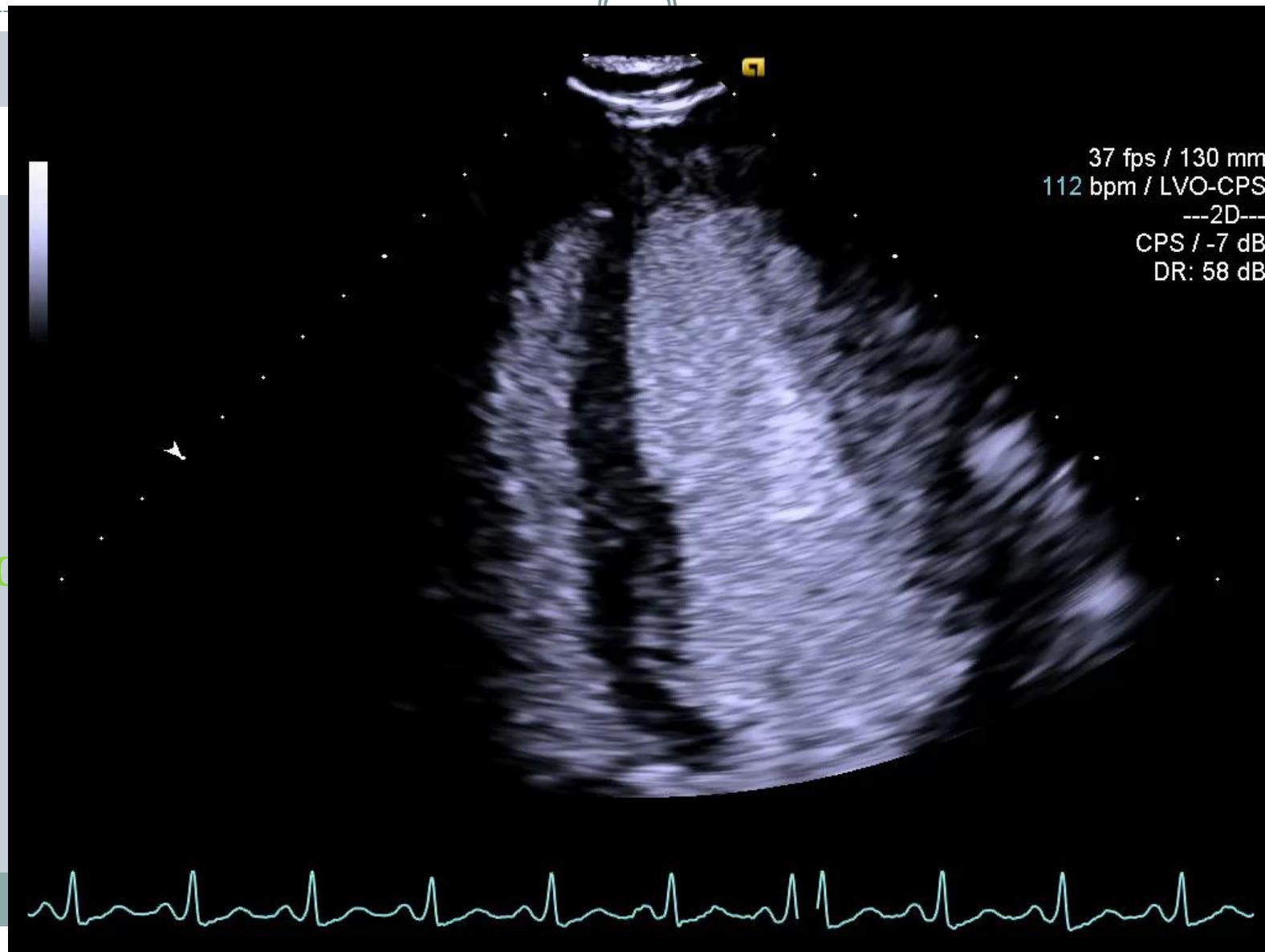
ASE/EACI recommendation 2015

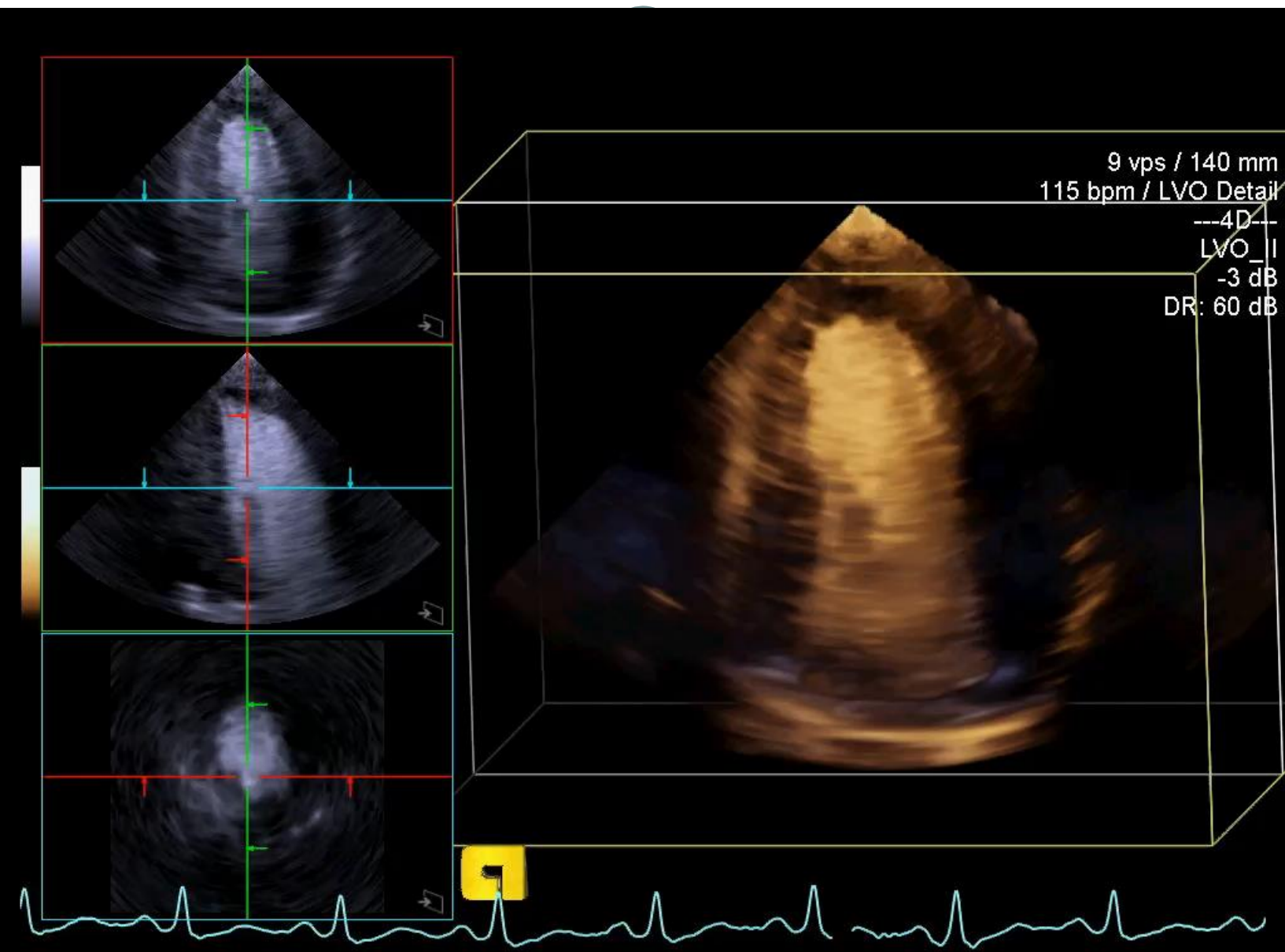
Table 1 Recommendations for the echocardiographic assessment of LV size and function

Parameter and method	Technique	Advantages	Limitations
Volumes. Volume measurements are usually based on tracings of the blood-tissue interface in the apical four- and two-chamber views. At the mitral valve level, the contour is closed by connecting the two opposite sections of the mitral ring with a straight line. LV length is defined as the distance between the middle of this line and the most distant point of the LV contour.	Biplane disk summation 	• Corrects for shape distortions • Less geometrical assumptions compared with linear dimensions	• Apex frequently foreshortened • Endocardial dropout • Blind to shape distortions not visualized in the apical two- and four-chamber planes
	Area-length 	• Partial correction for shape distortion	• Apex frequently foreshortened • Heavily based on geometrical assumptions • Limited published data on normal population

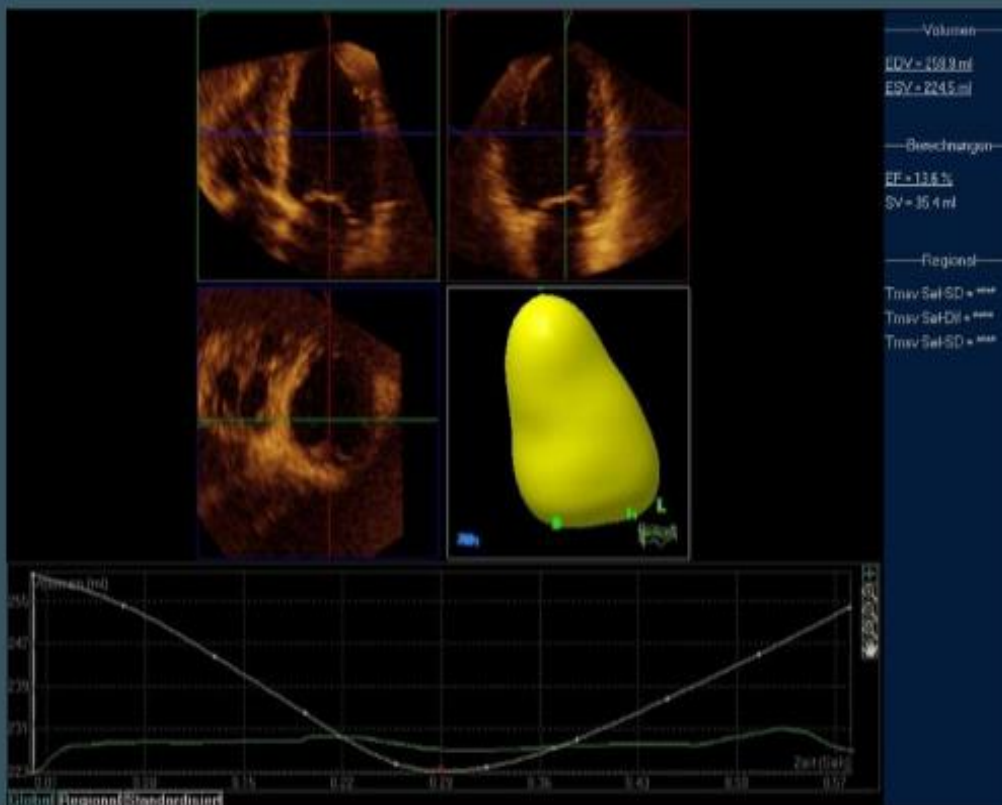


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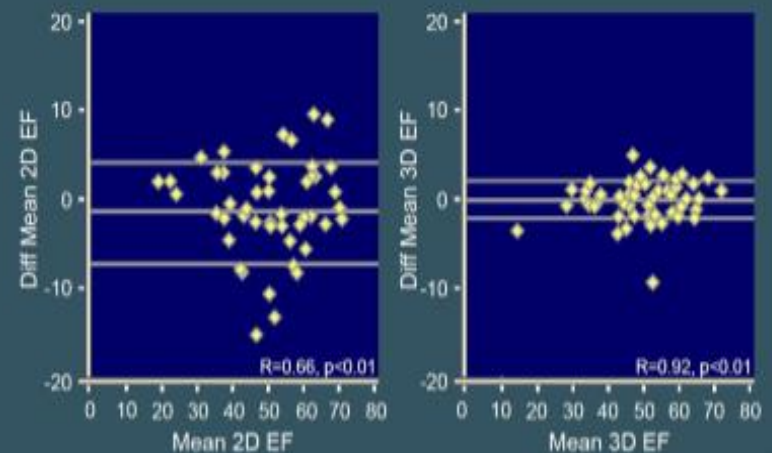




Semiautomated quantification to calculate EF and volumes within a minute



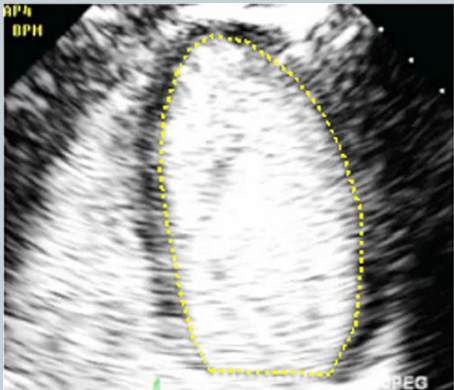
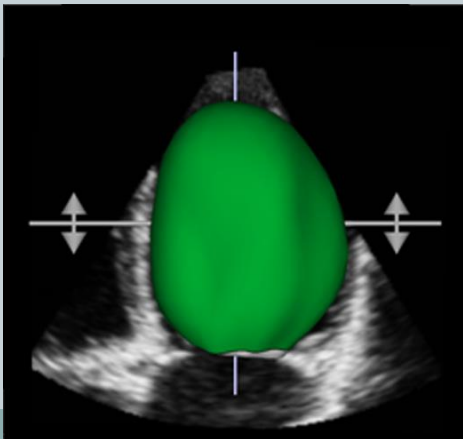
Test-retest reproducibility of 2DE and 3DE



Jenkins et al. JACC 2004

ASE/EACI recommendation 2015

Table 1 (Continued)

Parameter and method	Technique	Advantages	Limitations
	Endocardial border enhancement 	• Helpful in patients with suboptimal acoustic window • Provides volumes that are closer to those measured with cardiac magnetic resonance	• Same limitations as the above non-contrast 2D techniques • Acoustic shadowing in LV basal segments with excess contrast
	3D data sets 	• No geometrical assumption • Unaffected by foreshortening • More accurate and reproducible compared to other imaging modalities	• Lower temporal resolution • Less published data on normal values • Image quality dependent

ASE/EACI recommendation 2015



Table 2 Normal values for 2D echocardiographic parameters of LV size and function according to gender

Parameter	Male		Female	
	Mean $\pm$ SD	2-SD range	Mean $\pm$ SD	2-SD range
LV internal dimension				
Diastolic dimension (mm)	50.2 $\pm$ 4.1	42.0–58.4	45.0 $\pm$ 3.6	37.8–52.2
Systolic dimension (mm)	32.4 $\pm$ 3.7	25.0–39.8	28.2 $\pm$ 3.3	21.6–34.8
LV volumes (biplane)				
LV EDV (mL)	106 $\pm$ 22	62–150	76 $\pm$ 15	46–106
LV ESV (mL)	41 $\pm$ 10	21–61	28 $\pm$ 7	14–42
LV volumes normalized by BSA				
LV EDV (mL/m ²)	54 $\pm$ 10	34–74	45 $\pm$ 8	29–61
LV ESV (mL/m ²)	21 $\pm$ 5	11–31	16 $\pm$ 4	8–24
LV EF (biplane)	62 $\pm$ 5	52–72	64 $\pm$ 5	54–74

BSA, body surface area; EDV, end-diastolic volume; EF, ejection fraction; ESV, end-systolic volume; LV, left ventricular; SD, standard deviation.

Kỹ thuật mới và nhược điểm chính

- Siêu âm 3D: tính V và EF

- Doppler mô (TDI), biến dạng mô (strain) và vận tốc biến dạng (strain rate)

-Đánh dấu mô (speckle tracking)

- Chi phí cao (3D): đầu dò, phần mềm

- Lệ thuộc góc (TDI)

- Cần phần mềm đọc offline (với strain và speckle tracking)

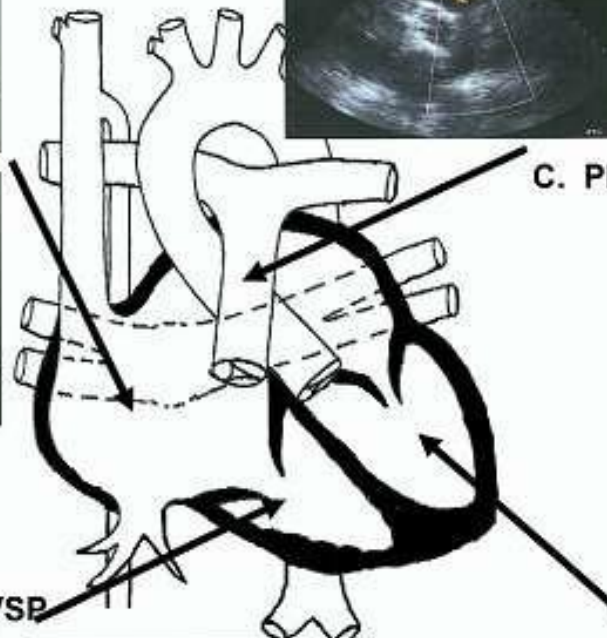
Siêu âm với vai trò cung cấp thông số thông tim



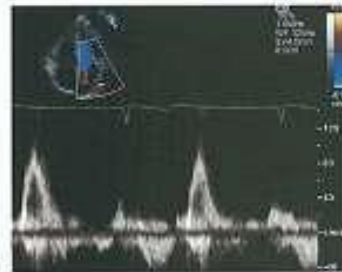
A. IVCCI-RAP



B. TR Vel.--RVSP

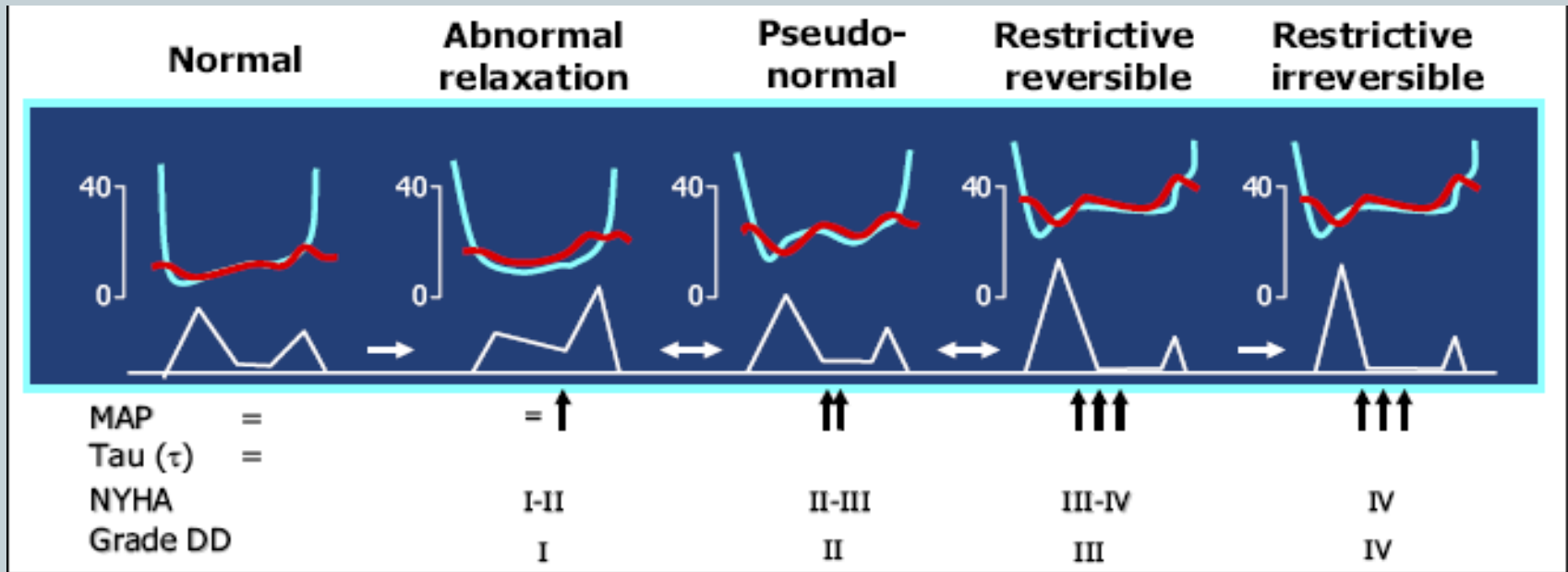


C. PR Vel.--PAPm, PAPd



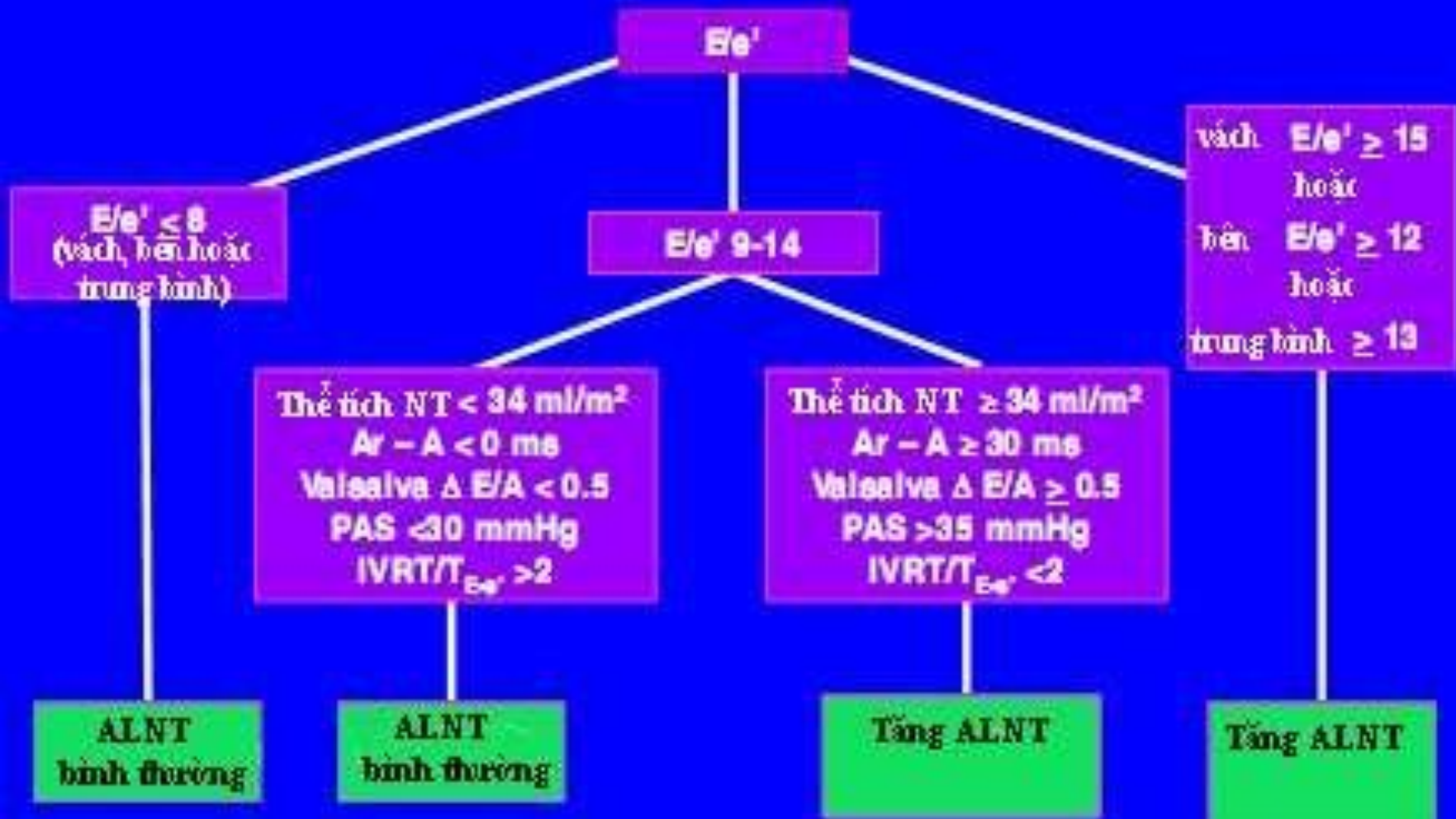
D. E/E'--PCWP

Mối liên hệ độ suy tim tâm trương và NYHA



ƯỚC LƯỢNG ÁP LỰC LÀM ĐẦY MÁU KHI EF BÌNH THƯỜNG

EAE/ASE 2009



ƯỚC LƯỢNG ÁP LỰC LÀM ĐẦY THẤT Ở NGƯỜI CÓ EF GIẢM

EAE/ASE 2009



**Table 4—Correlation of Transmitral Flow Variables
and Vp and E/Vp With LVEDP**

Transmitral Flow	All Patients	EF < 50%	EF > 50%
E, m/s	0.45	0.50*	0.45
A, m/s	− 0.29	− 0.48	− 0.15
E/A ratio	0.49	0.62*	0.40
Deceleration time, ms	− 0.31	− 0.4	− 0.22
IVRT, ms	− 0.19	− 0.29	− 0.14
Mitral A-wave duration, ms	− 0.19	− 0.52*	− 0.13
Vp, m/s	− 0.19	− 0.47	0.18
E/Vp	0.54*	0.77*	0.41
Systolic reversal wave, m/s	0.11	0.01	0.18
Diastolic reversal wave, m/s	0.39	0.35	0.40
Systolic/diastolic reversal wave	− 0.17	− 0.15	− 0.24
Atrial reversal wave, m/s	0.11	0.20	0.08
Pulmonary A-wave duration, ms	0.57*	0.32	0.61*
Mitral − pulmonary A-wave duration, ms	− 0.43*	− 0.14	− 0.51*
Lateral E', m/s	− 0.35	− 0.38	− 0.28
Lateral A', m/s	0.27	− 0.37	0.12
Lateral E/E'	0.68*	0.80*	0.58*
Septal E', m/s	− 0.22	− 0.22	− 0.11
Septal A', m/s	− 0.30	− 0.50*	− 0.09
Septal E/E'	0.52*	0.72*	0.29

*p < 0.01.

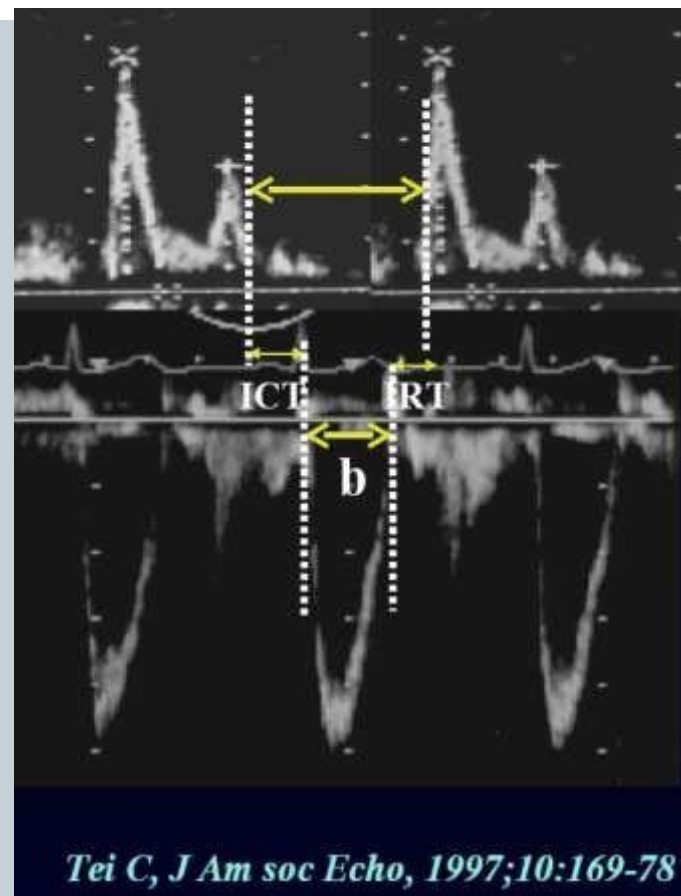
Phù phổi cấp



- Tỷ lệ E/E' và E/V_p được chứng minh có mối tương quan tốt với áp lực mao mạch phổi.
- Ít ra chúng cũng giúp phân biệt áp lực mao mạch phổi cao hay thấp và từ đó phân biệt phù phổi huyết động hay tổn thương từ đó định hướng điều trị.

Chỉ số Tei đánh giá chức năng thất toàn bộ

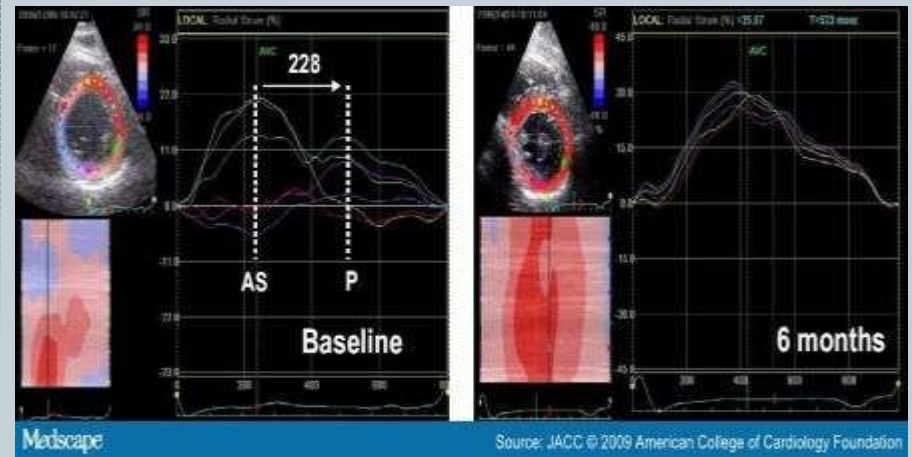
- Hơn EF trong tiên lượng tử vong và mức độ nặng của bệnh nếu $>0,77$.
- Ưu điểm là có thể đo ngay cả khi hình ảnh siêu âm xấu.
- Không lệ thuộc tần số tim, không cần giả định hình dạng thất khi tính.
- Có thể đo trên Doppler qui ước và mô.
- Nhược điểm: giá trị bình thường thay đổi theo tuổi.



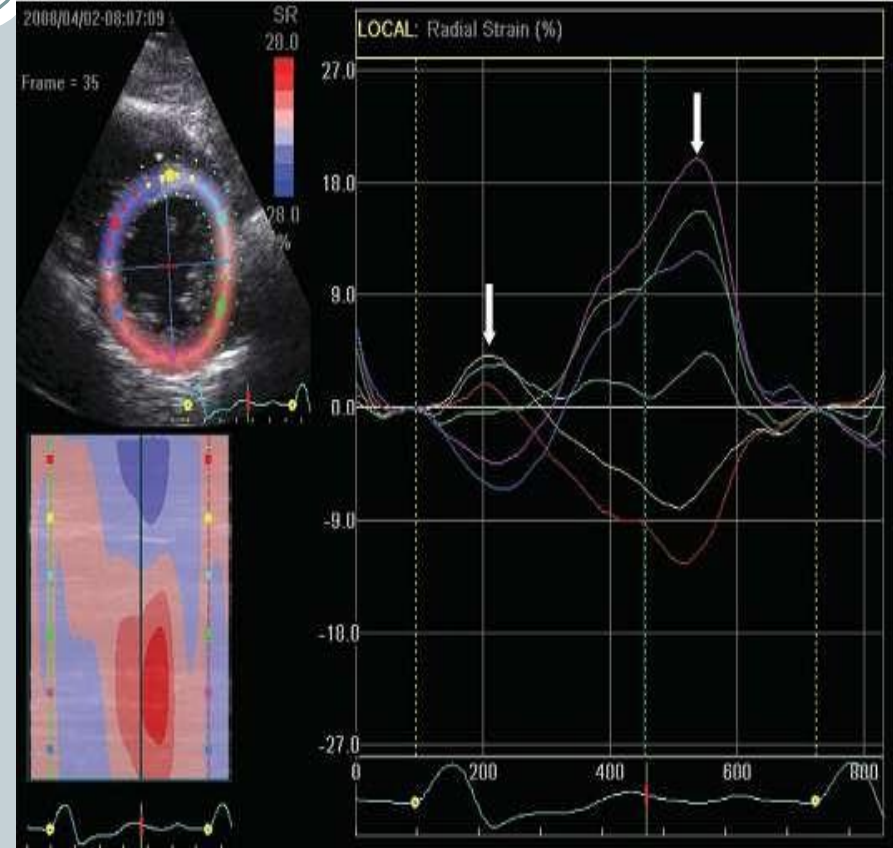
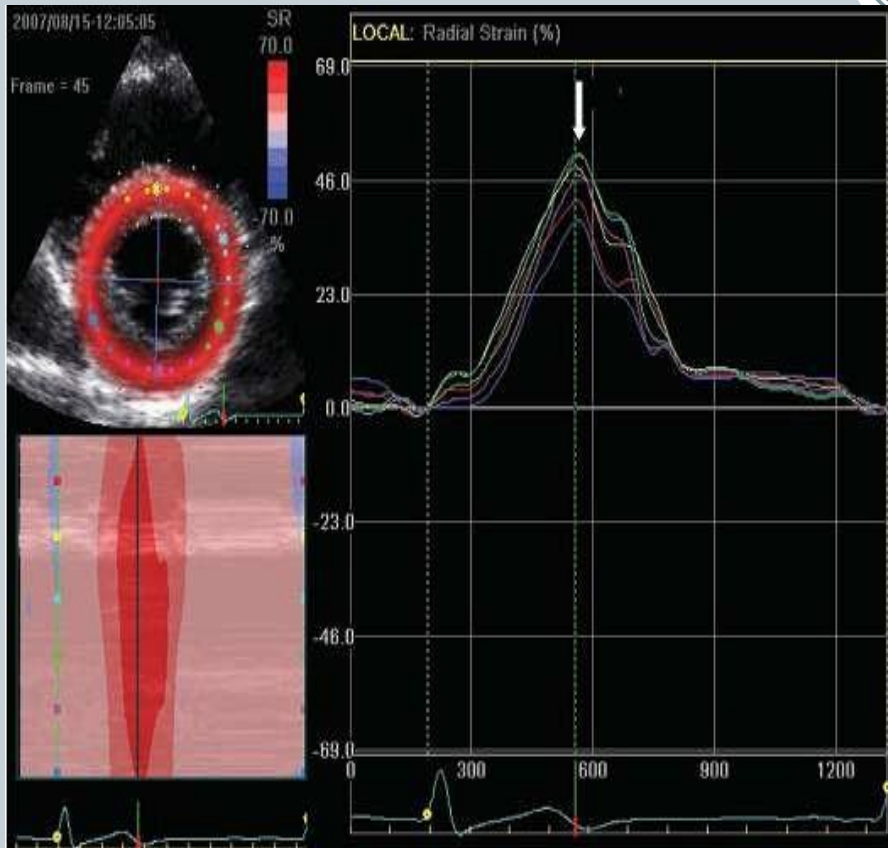
CRT



- Mất đồng vận có thể giữa 2 thất hoặc trong cùng thất.
- Chọn dựa trên: $EF < 35\%$, QRS giãn, nhịp xoang, suy tim vừa – nặng (NYHA 3-4).
- Có nhiều thông số siêu âm đánh giá mất đồng vận: M-mode, TDI, SR.



speckle-tracking radial strain



- Kỹ thuật speckle tracking đánh giá chức năng thất trái theo 3 trục: dọc, nan hoa, xoay

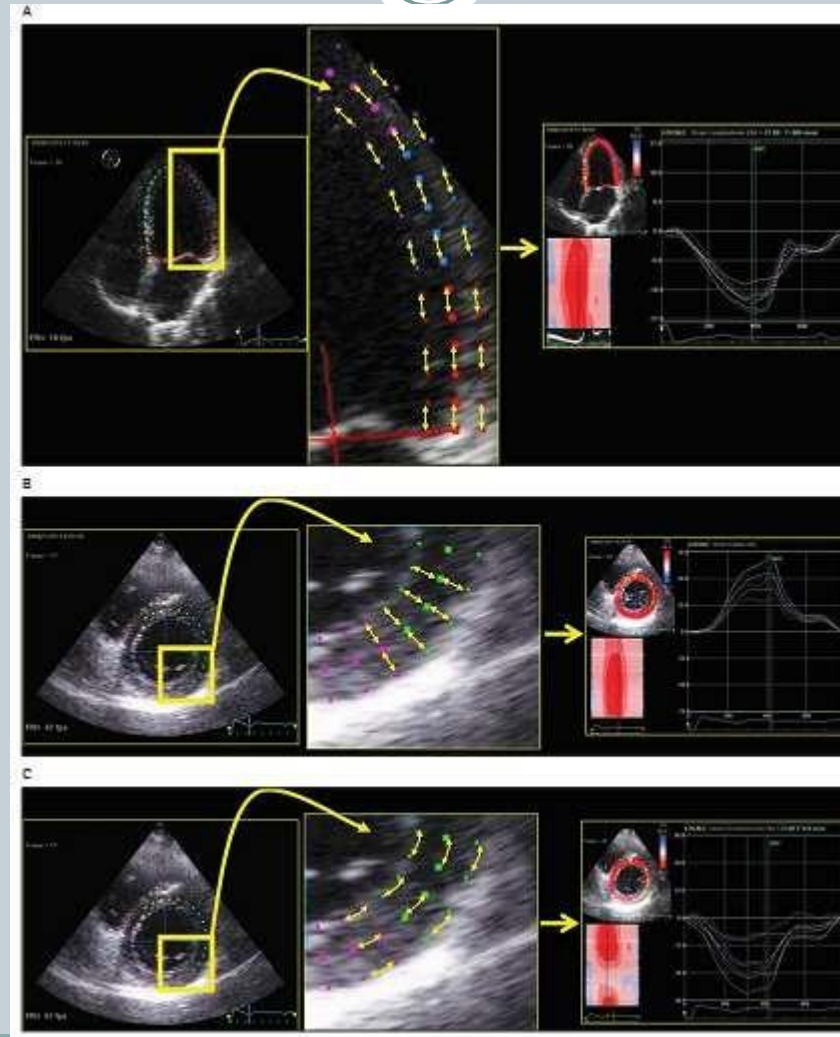
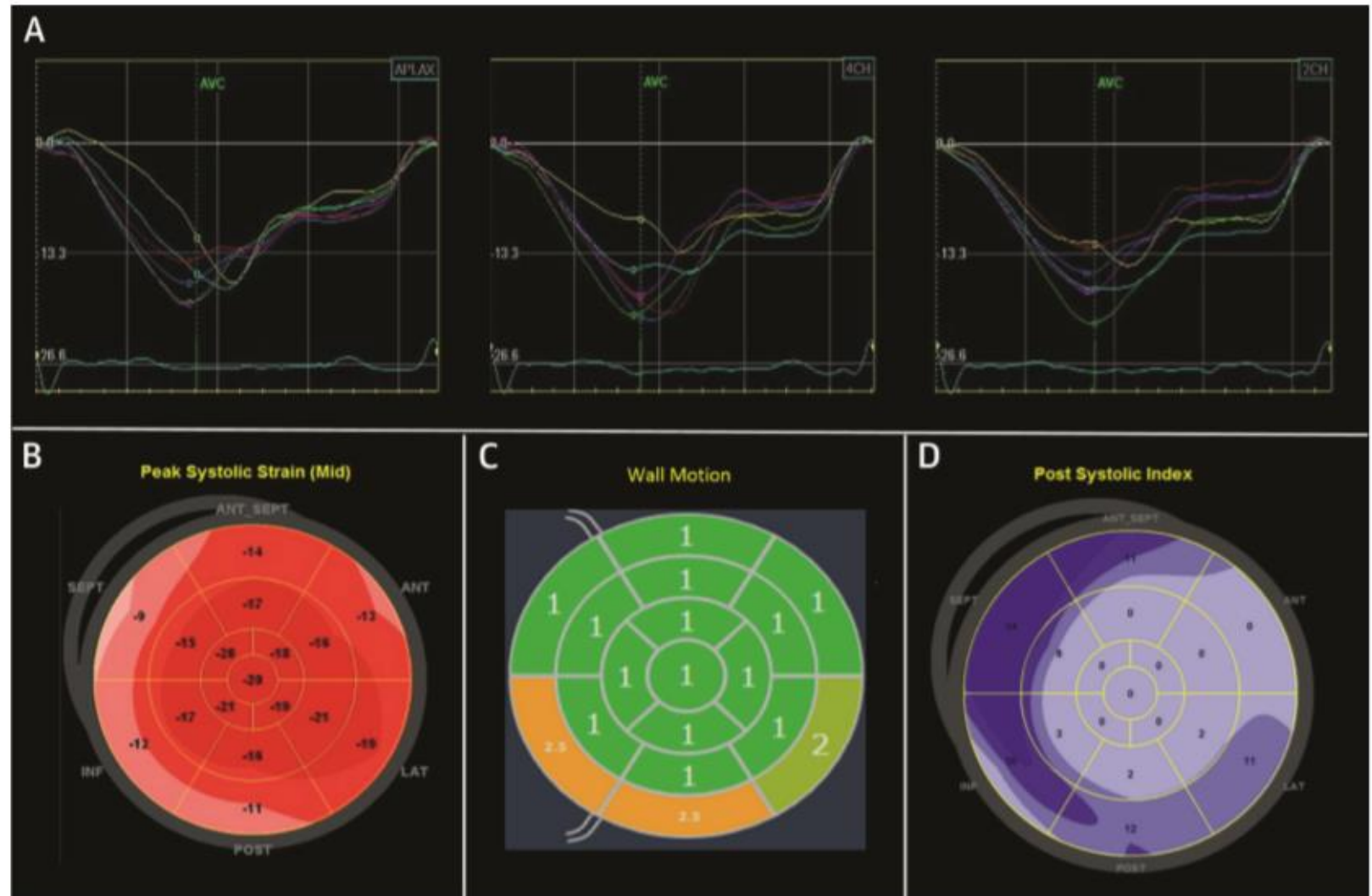
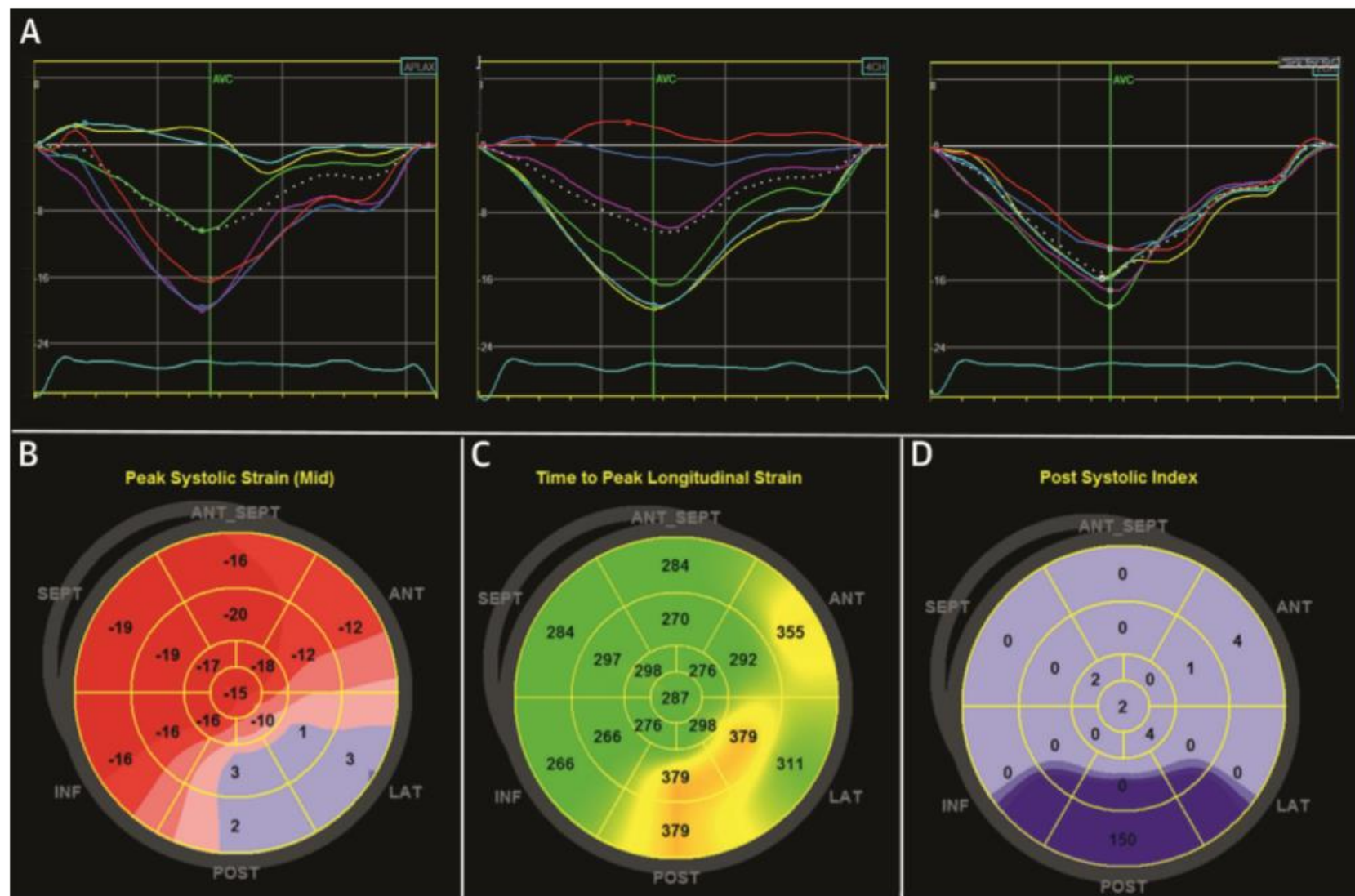


FIGURE 3 Case Example of Strain in Clinical Practice: Right Coronary Artery Infarct



Segmental strain traces recorded from apical 3-, 4-, and 2-chamber views, respectively (**A**); bull's eye plot displaying midwall peak systolic strain (**B**); regional wall motion plot (**C**); and post-systolic index (percentage of post-systolic increment over systolic strain) (**D**) in a patient with a right coronary artery infarct. Reduced regional strain values (**A**, **B**) and segmental post-systolic shortening (**D**) correspond to the regional wall motion plot (**C**). Note that the strain plots are rotated 60° clockwise compared with the regional wall motion plot.

FIGURE 4 Case Example of Strain in Clinical Practice: Left Circumflex Artery Infarct



Segmental strain traces recorded from apical 3-, 4-, and 2-chamber views, respectively (**A**); bull's eye plots displaying midwall peak systolic strain (**B**); time to peak longitudinal strain (**C**); and post-systolic index (percentage of post-systolic increment over systolic strain) (**D**) in a patient with a left circumflex infarct. Affected segments demonstrate reduced regional strain values (**A, B**), delayed time to peak strain (**C**), and segmental post-systolic shortening (**D**).

Ưu nhược điểm của 2D STE



- Không lệ thuộc góc
- Tính được các thông số vận tốc, biến dạng mô theo nhiều hướng.
- Nhược: phải có chất lượng hình đẹp, phải có phần mềm chạy offline và phần mềm của hãng này không chạy chung dữ liệu của máy hãng khác.

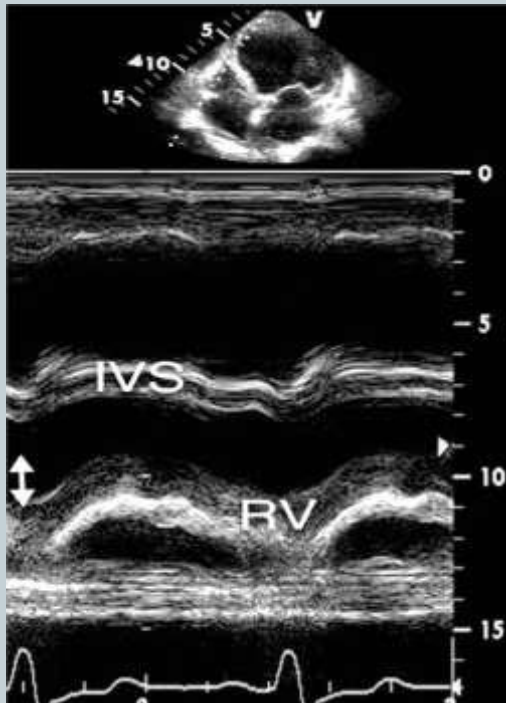
Đánh giá hình thái chức năng thất phải



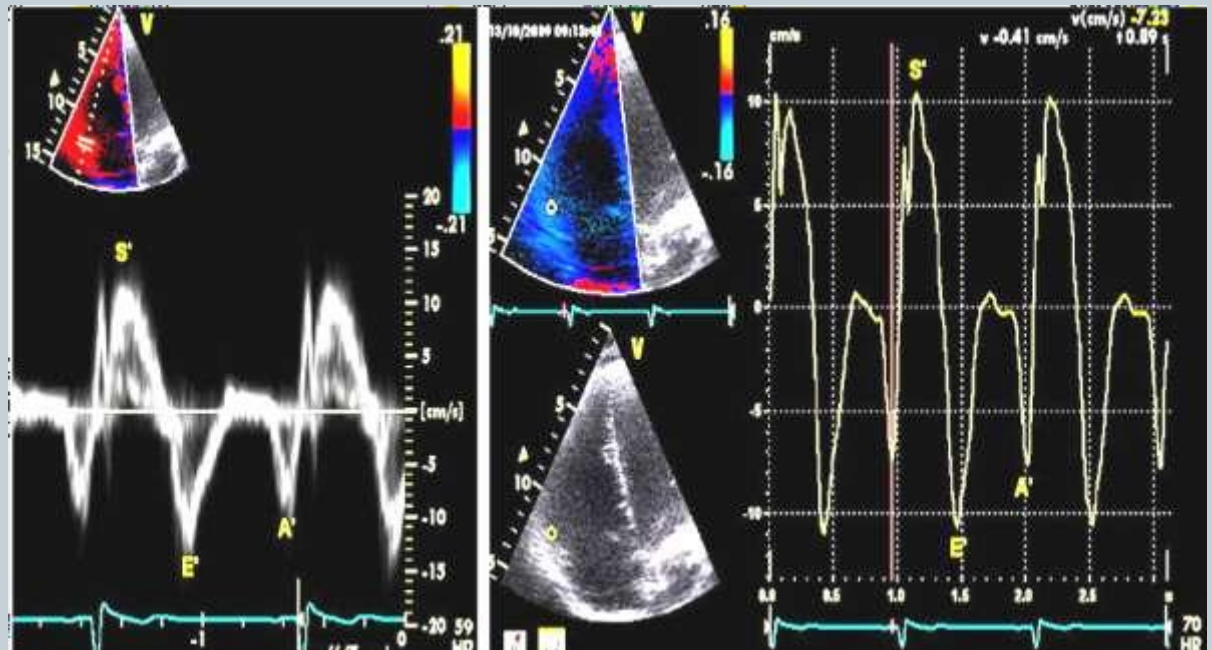
- Đo đường kính và chiều dày cơ thất phải
- Đo áp lực động mạch phổi từ dòng chảy hở van ba lá và hở phổi
- Trong tắc động mạch phổi, hội chứng đột quỵ hô hấp cấp có thể thấy vách liên thất đẩy sang trái. Nếu có thêm giãn thất phải có thể gây giảm huyết áp và cung lượng tim.
- Khuyến cáo ASE/EAE 2010 đánh giá chức năng tâm thu và tâm trương thất phải chủ yếu dựa vào TAPSE, Doppler mô.

TAPSE & TDI đánh giá chức năng thất phải

Đo Sa trên Doppler mô



Đo TAPSE



Chronic ischemic cardiomyopathy



- + Chronic LV dysfunction due to sequelae of diffuse coronary artery disease
- + There is typically RWMA- mostly akinesia or dyskinesia
- + No RWMA: It is not possible to separate an ischemic from non ischemic dilated cardiomyopathy

Clues to the former include patient age, presence of cardiac risk factors, clinical history of previous ischemic events and as mentioned earlier present

Myocardial Ischaemia Assessment

Indications for SE in CAS



1. Assessment of undifferentiated chest pain
2. Assessment of exertional dyspnea
3. Ischaemia localization and assessment of functional significance of coronary artery stenosis
4. Risk stratification and prognosis in patients with established diagnosis of CAS
5. Evaluation of symptoms after revascularisation
6. Myocardial viability assessment
7. Preoperative risk assessment

Myocardial Ischaemia Assessment

Stress Modalities



1. Exercise SE

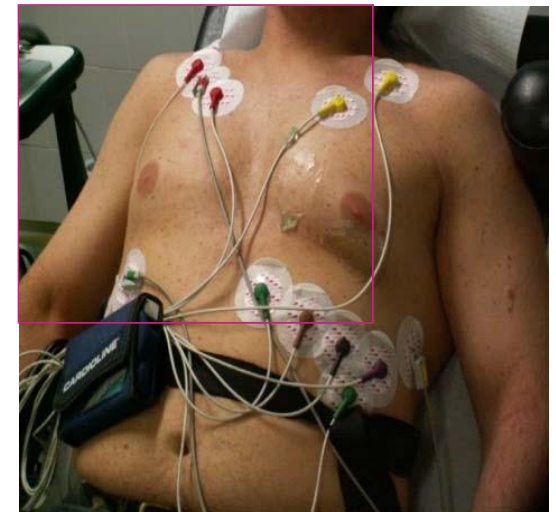
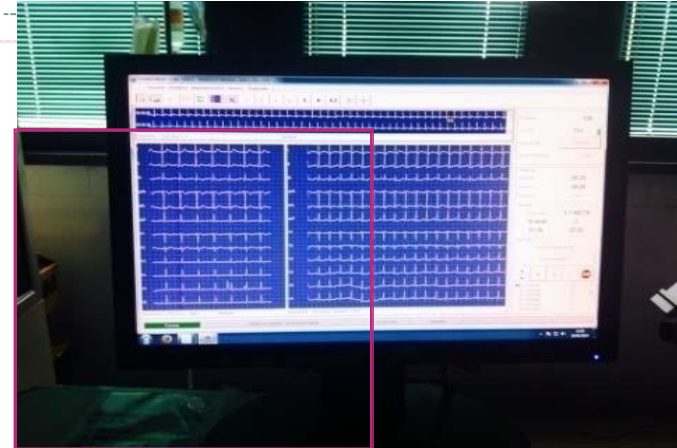
- + Bicycle:
 - Upright
 - Semi-recumbent
 - Recumbent
- + Treadmill

2. Pharmacologic SE:

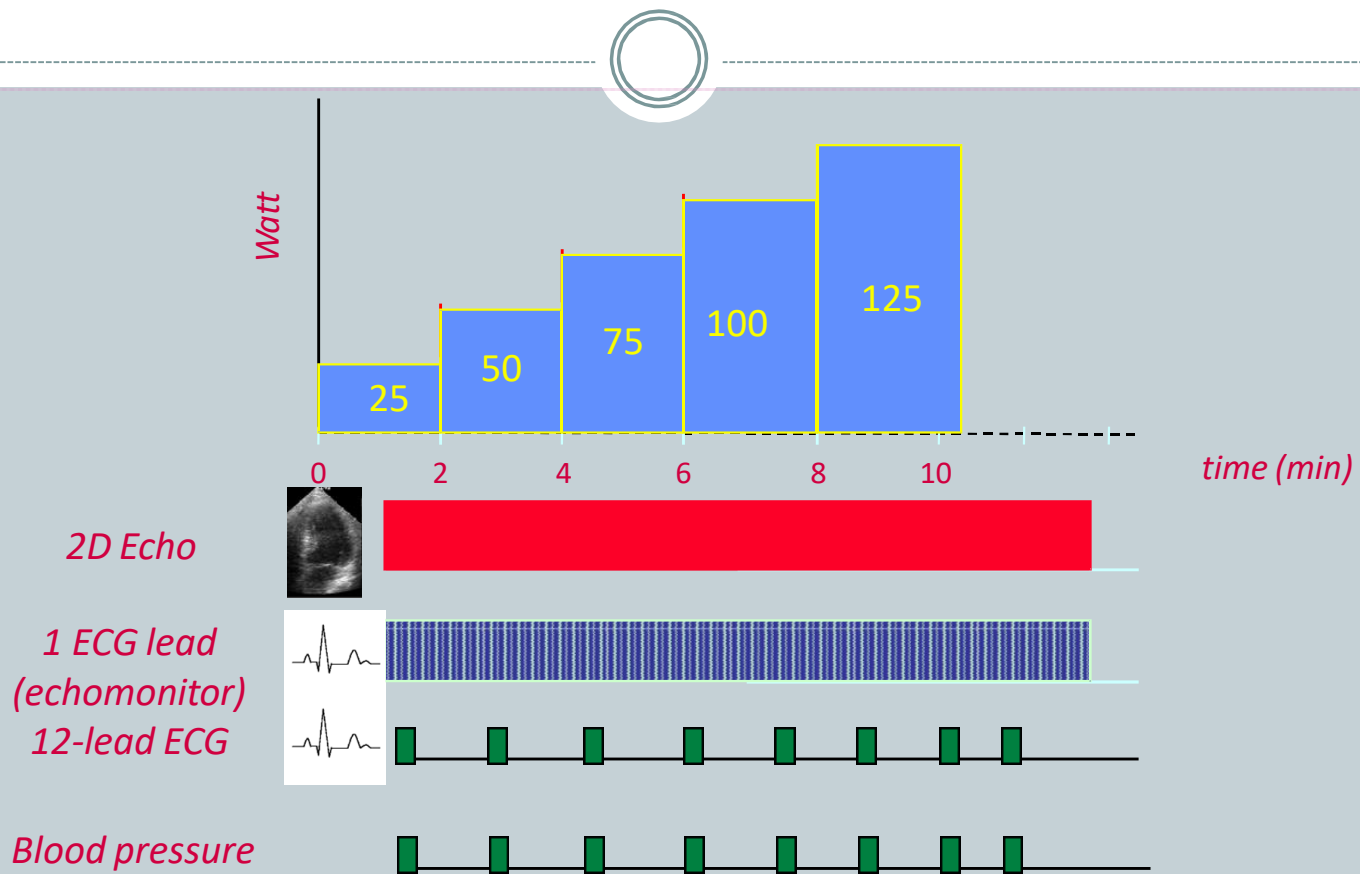
- + Dobutamine
- + Vasodilators
 - Adenosine
 - Dipyridamole

3. Pacing

Stress Echo Lab (Exercise)

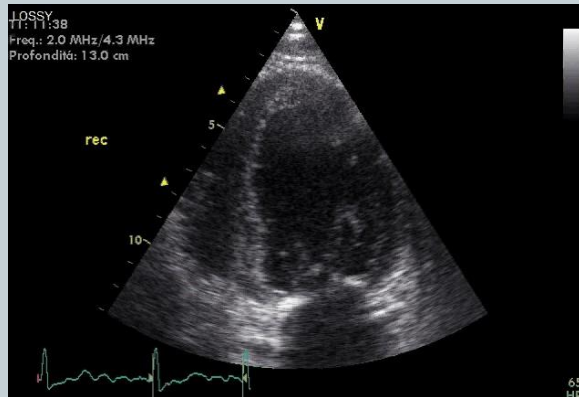


Stress Echo (Exercise)

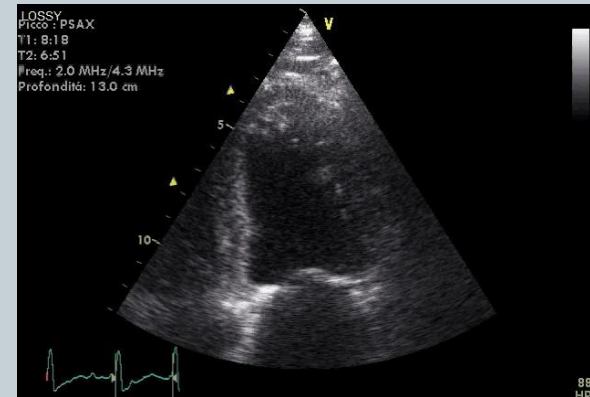


Exercise Stress Echo

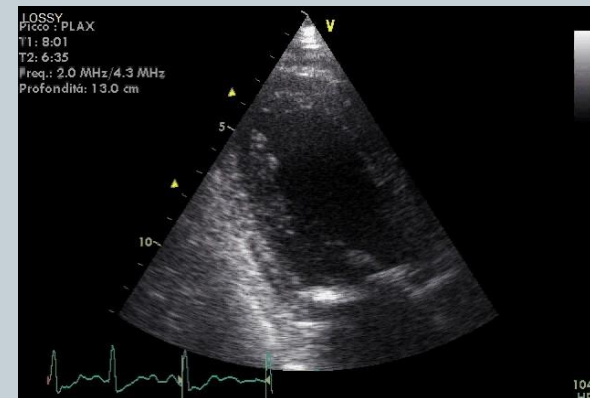
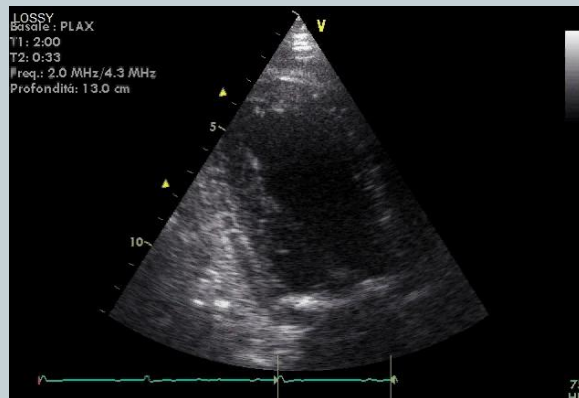
Positive WM (3 segments)



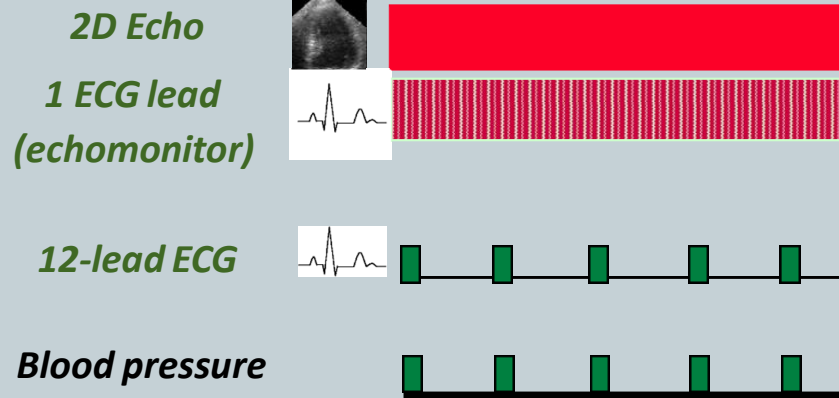
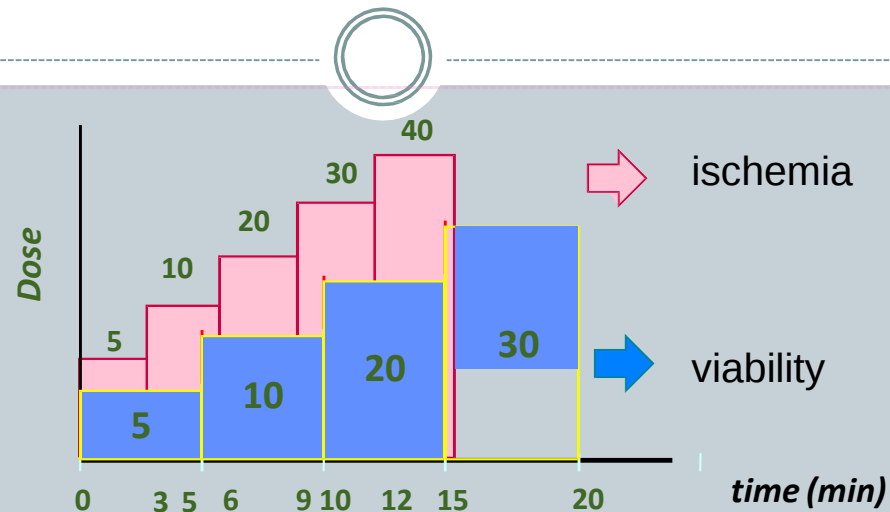
rest



peak



Stress Echo (Dobutamine)



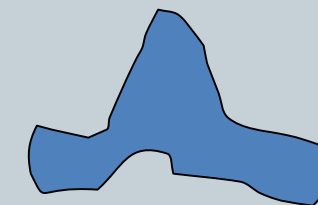
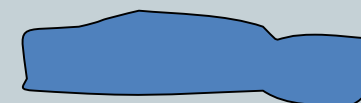
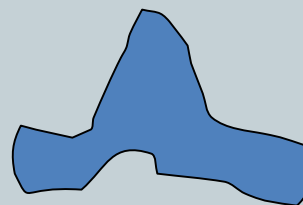
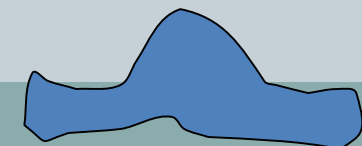
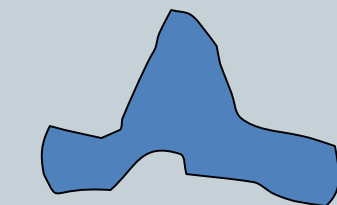
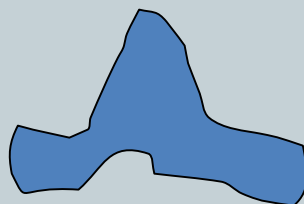
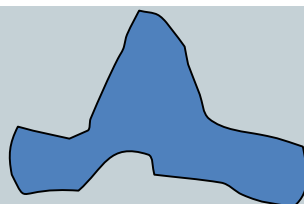
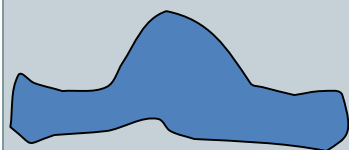
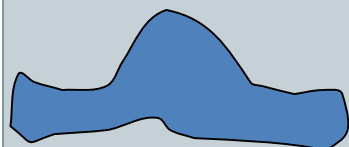
Siêu âm Tim stress

Nghỉ

Stress nhẹ

Stress

nhiều



Bình
thường

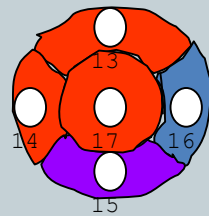
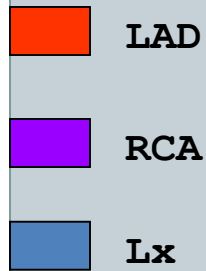
Thiếu máu
(Ischemia)

Hoại tử
(Infarction)

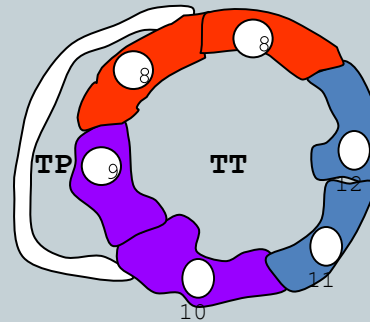
Đờ cơ tim
(stunning)

Đông miên
(Hibernation)

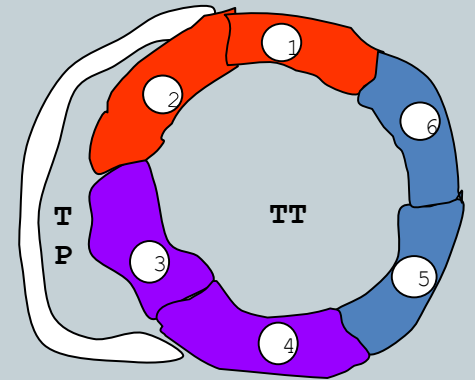
Sơ đồ phân vùng tưới máu cơ tim



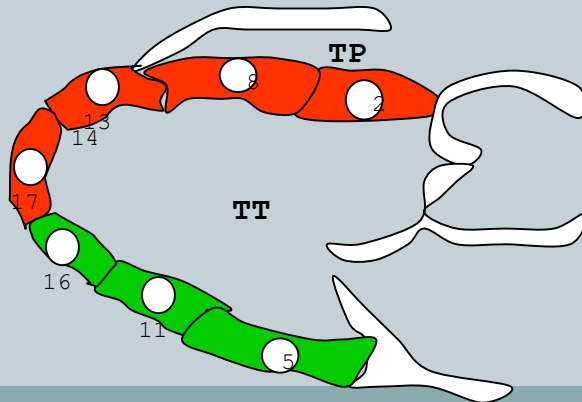
Trông ng³n m³m



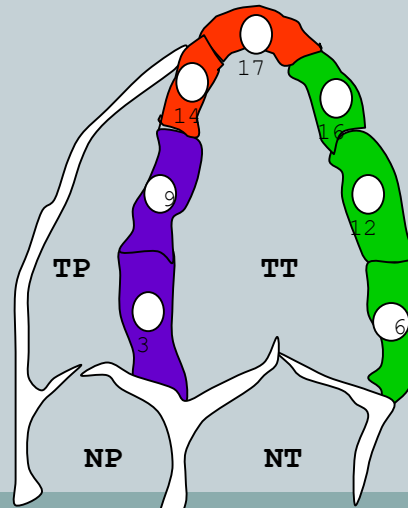
Trông ng³n gi÷a



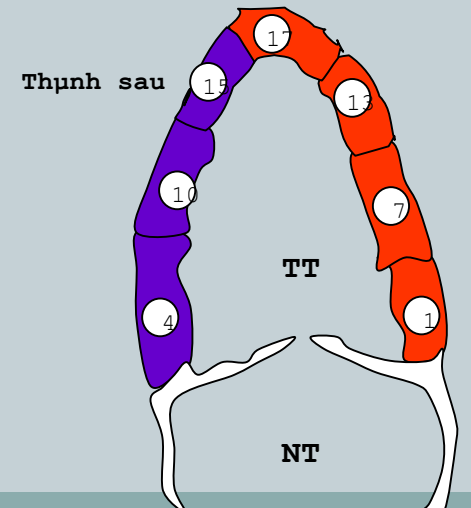
Trông ng³n ®.y
tim



Trông d³i c³nh
øc



Bên buồng t³m m³m



Hai buồng t³m m³m

UTILITY IN ASSESSING VIABILITY IN IHD



Myocardial stunning:

‘Stuns but does not kill’

- + Produced by acute ischemic insults of short duration with no infarction with normal resting coronary flow.
- + Spontaneously recovers within few hours to weeks.
- + Subsets:
 - Reperfusion following AMI
 - Exercise induced severe ischemia
 - Unstable coronary syndromes
 - After revascularization therapy

UTILITY IN ASSESSING VIABILITY IN IHD



Hibernating myocardium:

- + Critically stenosed coronary artery leading to chronic depression of myocardial function
- + Myocardial segments are dysfunctional but alive
- + There is a complete or partial functional recovery after revascularization
- + Delay in revascularisation leads to irreversible damage

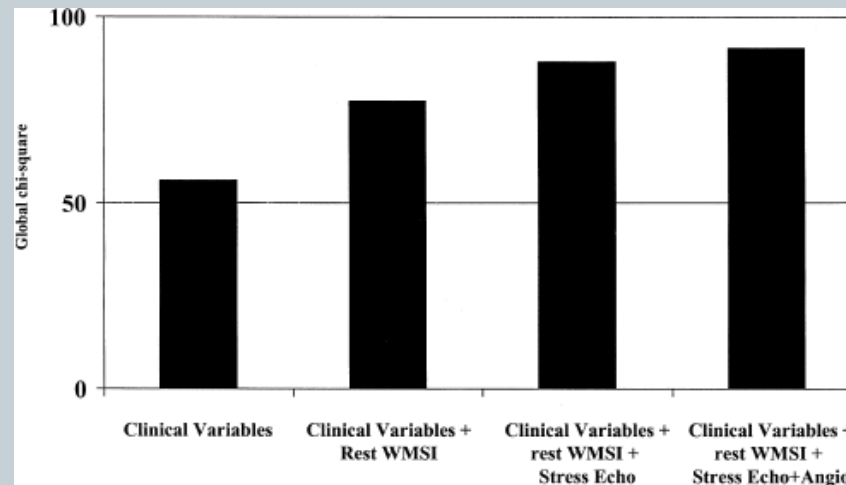
Pharmacological Stress Echo → Ischemia

Additional Prognostic Value over Clinical and Functional Variables



Stress Echo Results Predict Mortality: A Large-Scale Multicenter Prospective International Study

Rosa Sicari, MD, PhD, Emilio Pisanisi, MD, Lucia Venneri, MD, Patrizia Landi, BSc,
Lauro Cortigiani, MD, Eugenio Picano, MD, PhD, on behalf of the Echo Persantine International
Cooperative (EPIC) and Echo Dobutamine International Cooperative (EDIC) Study Groups
Pisa, Italy



Sicari R et al. JACC 2003

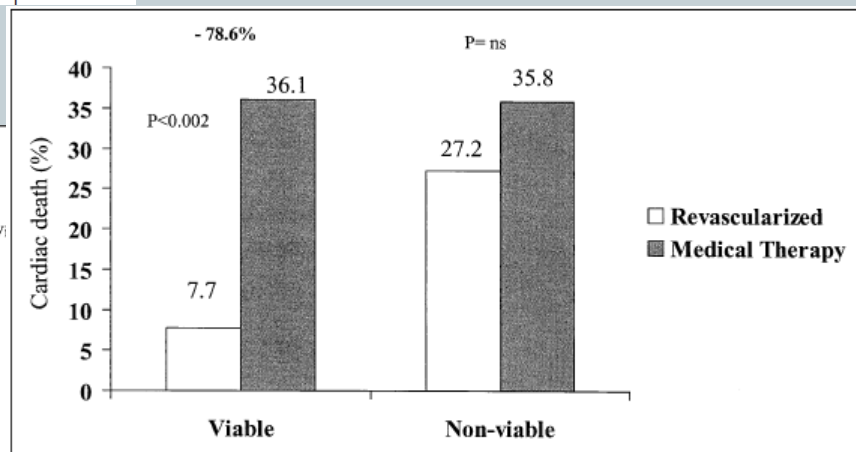
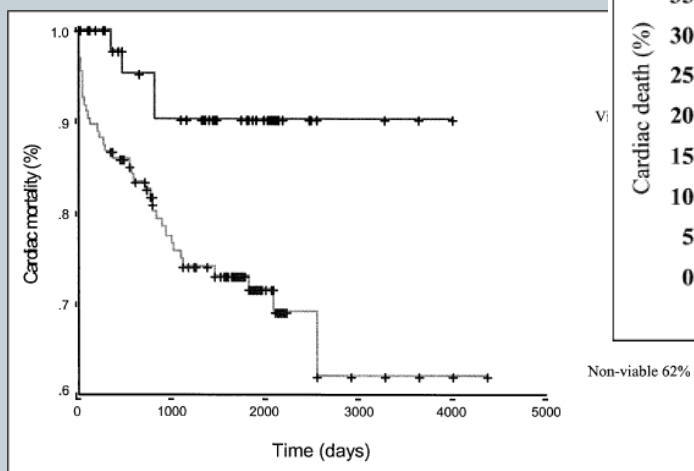
Speaker

Pharmacological Stress Echo → Viability

Additional Prognostic Value over Clinical and Functional Variables

Prognostic Value of Myocardial Viability Recognized by Low-Dose *Dobutamine* Echocardiography in Chronic Ischemic Left Ventricular Dysfunction

Rosa Sicari, MD, PhD, Eugenio Picano, MD, Lauro Cortigiani, MD, Adrian C. Borges, MD, Albert Varga, MD, Caterina Palagi, MD, Riccardo Bigi, MD, Roberta Rossini, MD, and Emilio Pisanisi, MD, on behalf of the VIDA (Viability Identification with Dobutamine Administration) Study Group



Sicari R et al. Am J Cardiol 2003

Speaker

3D stress echo + Contrast

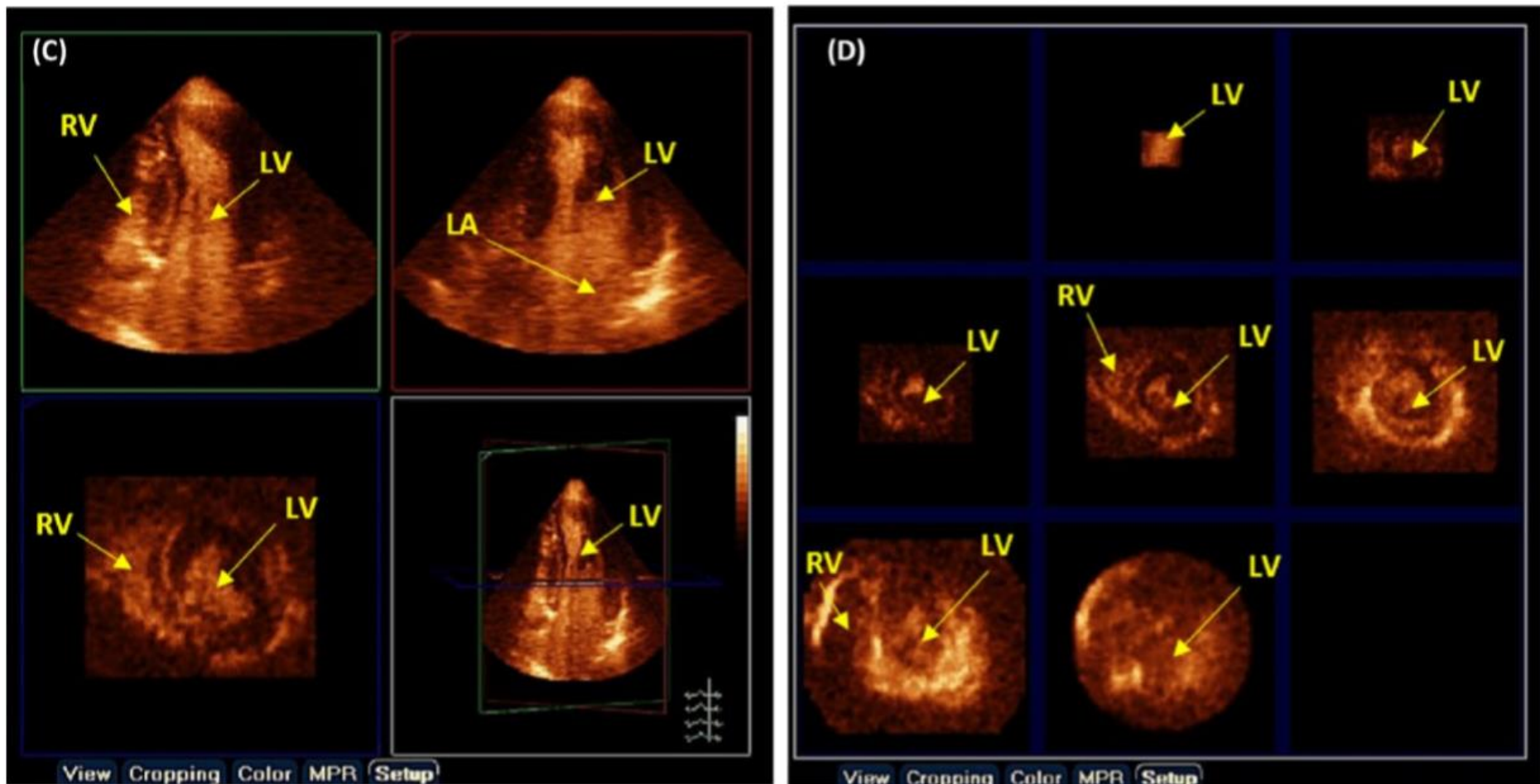


FIGURE 1 RT3D data set showing contrast-enhanced orthogonal views of LV (multi-planar view) and short-axis slices of LV (multi-slice view) at baseline (A and B) and at peak stress (C and D). LA = left atrium; LV = left ventricle; RV = right ventricle

POST ACUTE MI RISK STRATIFICATION/ PROGNOSIS



Predictors of adverse prognosis as assessed by echo

- + Degree of wall motion abnormality and systolic function
- + Infarct extension
- + Infarct expansion and degree of LV dilatation
- + More than mild valvular regurgitation
- + Right ventricular function
- + LA volume index more than 40ml square
- + Diastolic dysfunction variables
 - Especially pseudonormal or
 - Restrictive mitral inflow pattern

=> elevated left ventricular pressure

Kết luận



- Siêu âm Doppler có thể giúp xác định nhanh chóng nguyên nhân suy tim
- Có thể sử dụng kỹ thuật này để đánh giá tốt chức năng tâm thu và tâm trương của các thất.
- SÂ giúp đánh giá huyết động
- SÂ giúp định hướng điều trị
- SÂ tim giúp tiên lượng

Nhưng: rất cần sự phối hợp LS, ĐTĐ, các thể thức SÂ và có thể cả các phương pháp thăm dò khác