ecografía clínica

Ecocardiografía clínica avanzada visión del internista

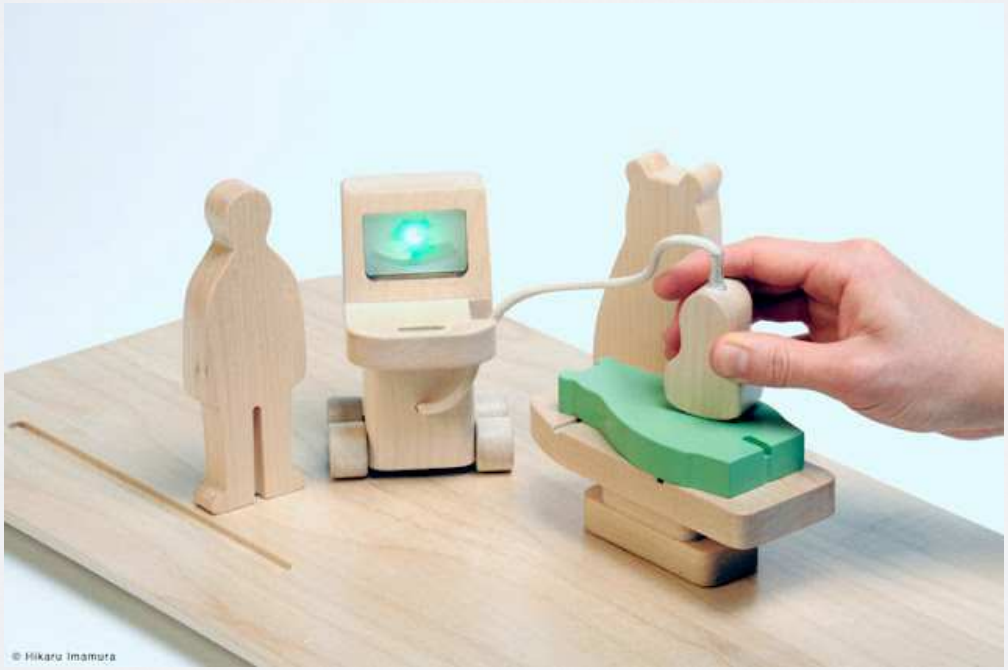
Juan Torres Macho

INTRODUCCIÓN

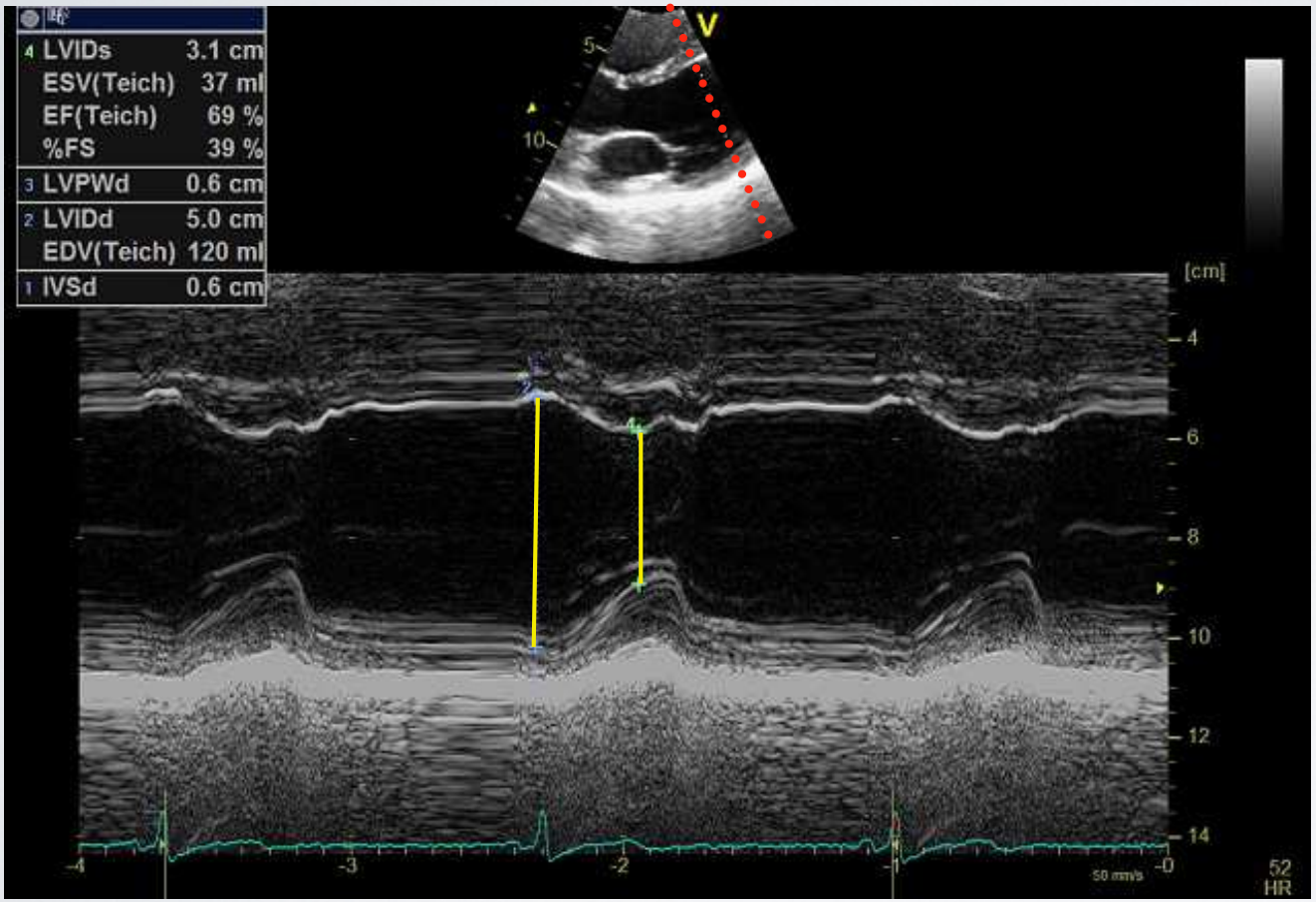
- Aspectos útiles más allá del “top five”
- Curva de aprendizaje no excesivamente larga con alta fiabilidad (sea asequible para cualquier Internista)
- Evidencia previa en la literatura

PREMISA INICIAL

- PARA SER UN BUEN "ECOGRAFISTA CLÍNICO" ES IMPRESCINDIBLE REALIZAR UNA BUENA HISTORIA CLÍNICA Y UN BUEN DIAGNÓSTICO DIFERENCIAL

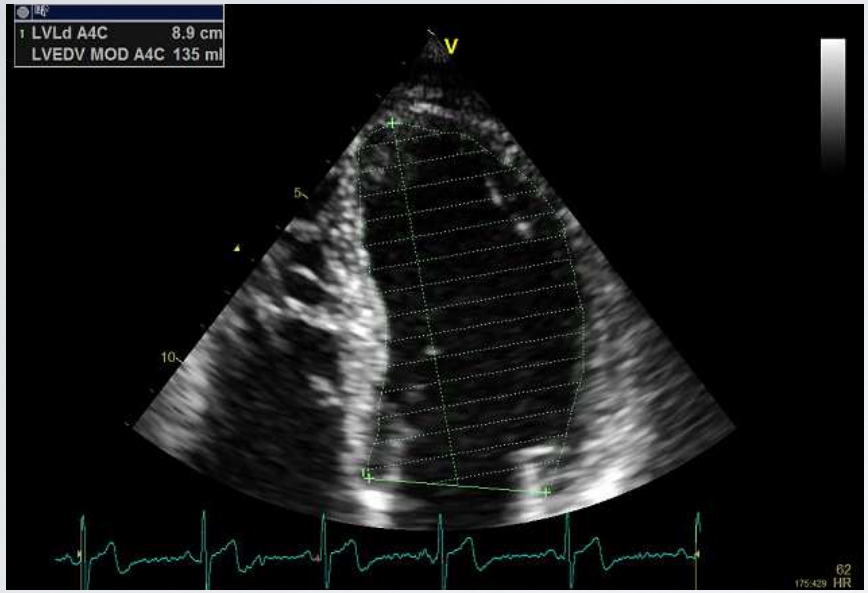


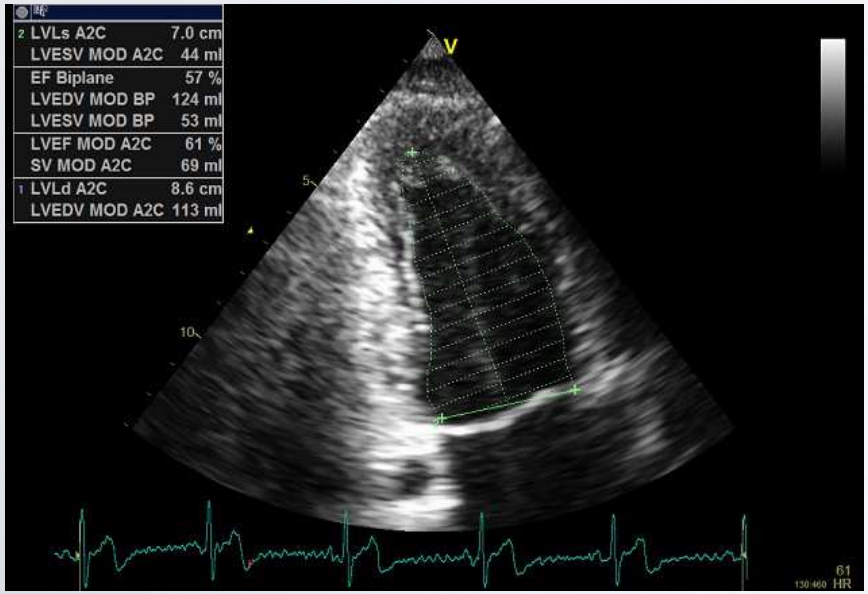
METODO TEICHOLZ



- Contractilidad homogénea
- Util para otras mediciones

METODO SIMPSON



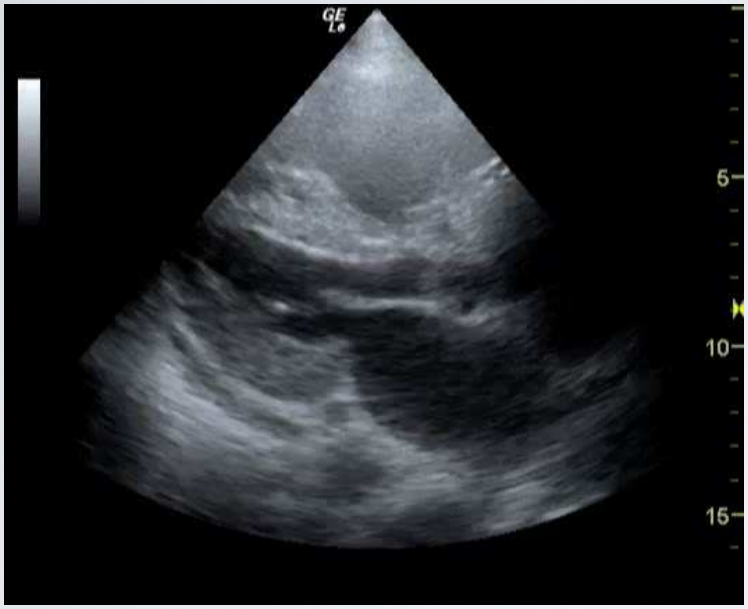


- Laborioso
- Obtención planos 4C y 2 C
- Buena visualización endocardio

FUNCION VENTRICULAR

- Casos dudosos (FA, BCRI)
- En clínica en general necesitamos respuesta dicotómica
- No evidencia en la literatura

MASA VENTRICULAR



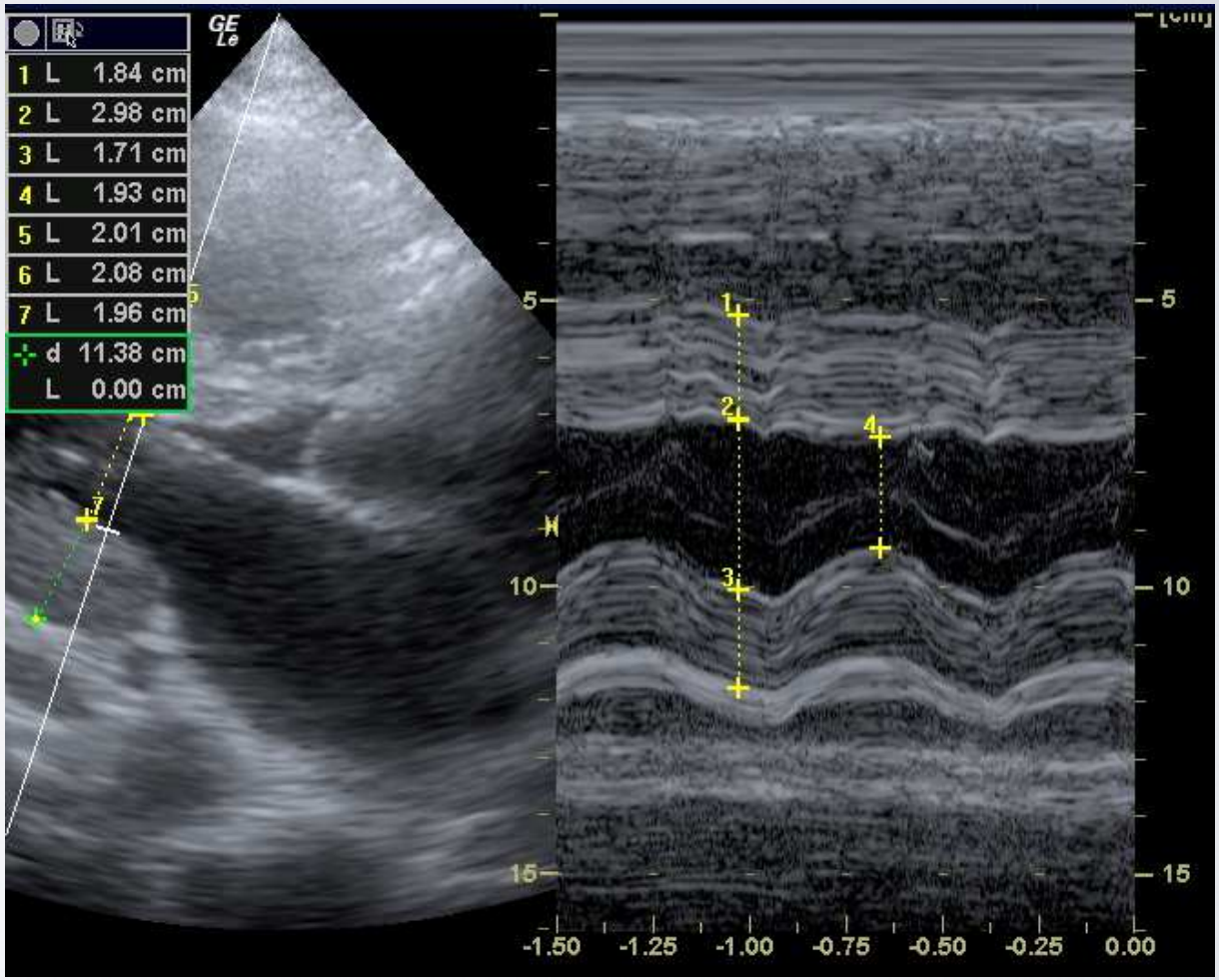
CALCULATION

Input

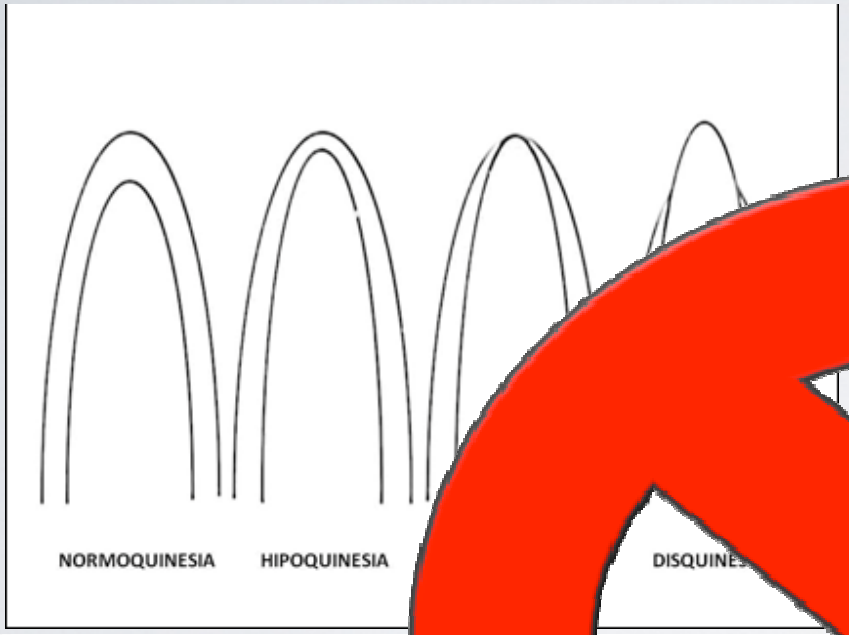
LVEDD	29,8	mm	Height	152	cm
IVSd	18,4	mm	Weight	58	kg
PWd	17,1	mm	Gender	○ Male	
				◉ Female	

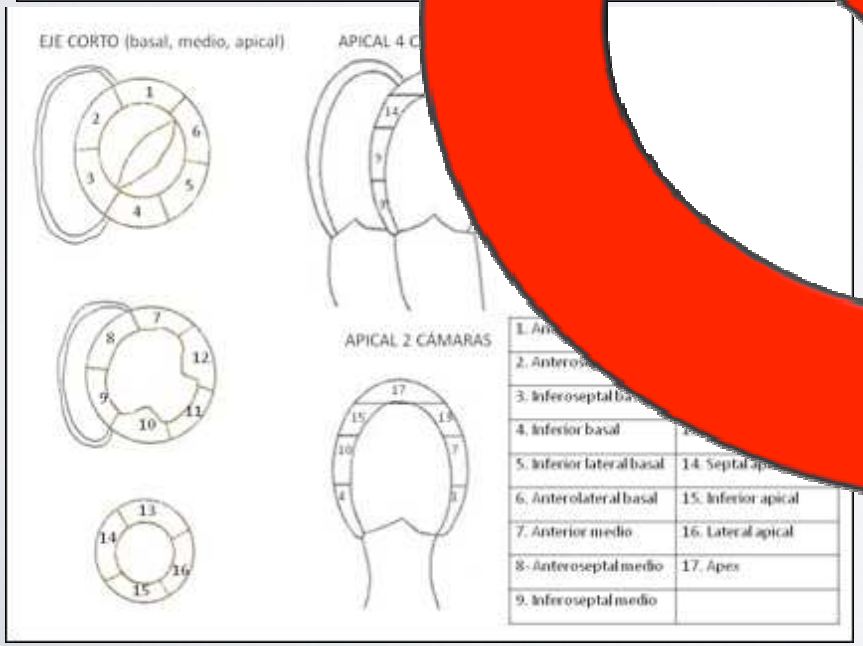
Result

LV Mass	198	g
LV Mass Index	127	g/m^2
	Severely abnormal	
RWT	1.17	
	Concentric hypertrophy	



CONTRACTILIDAD





dolor torácico

en urgenci

• E lidad

ador

CHEST Consensus Statement

American College of Chest Physicians/ La Société de Réanimation de Langue Française Statement on Competence in Critical Care Ultrasonography*

Paul H. Mayo, MD; Yannick Beaulieu, MD; Peter Doelken, MD; David Feller-Kopman, MD; Christopher Harrod, MS; Adolfo Kaplan, MD; John Oropello, MD; Antoine Vieillard-Baron, MD; Olivier Axler, MD; Daniel Lichtenstein, MD; Eric Maury, MD; Michel Slama, MD; and Philippe Vignon, MD

Chest 2009;135;1050-1060

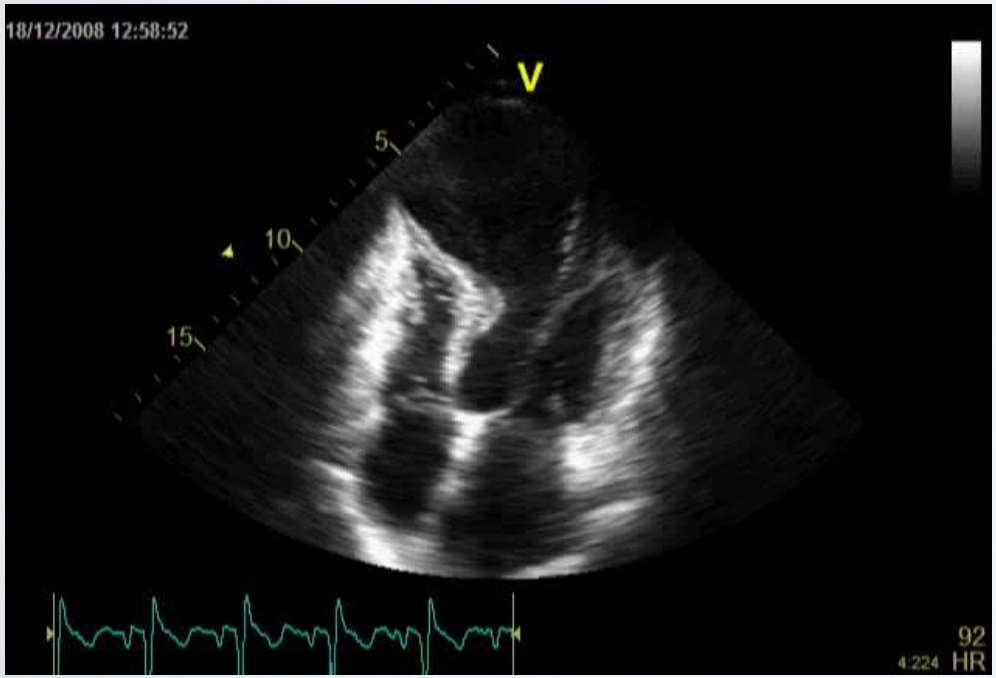
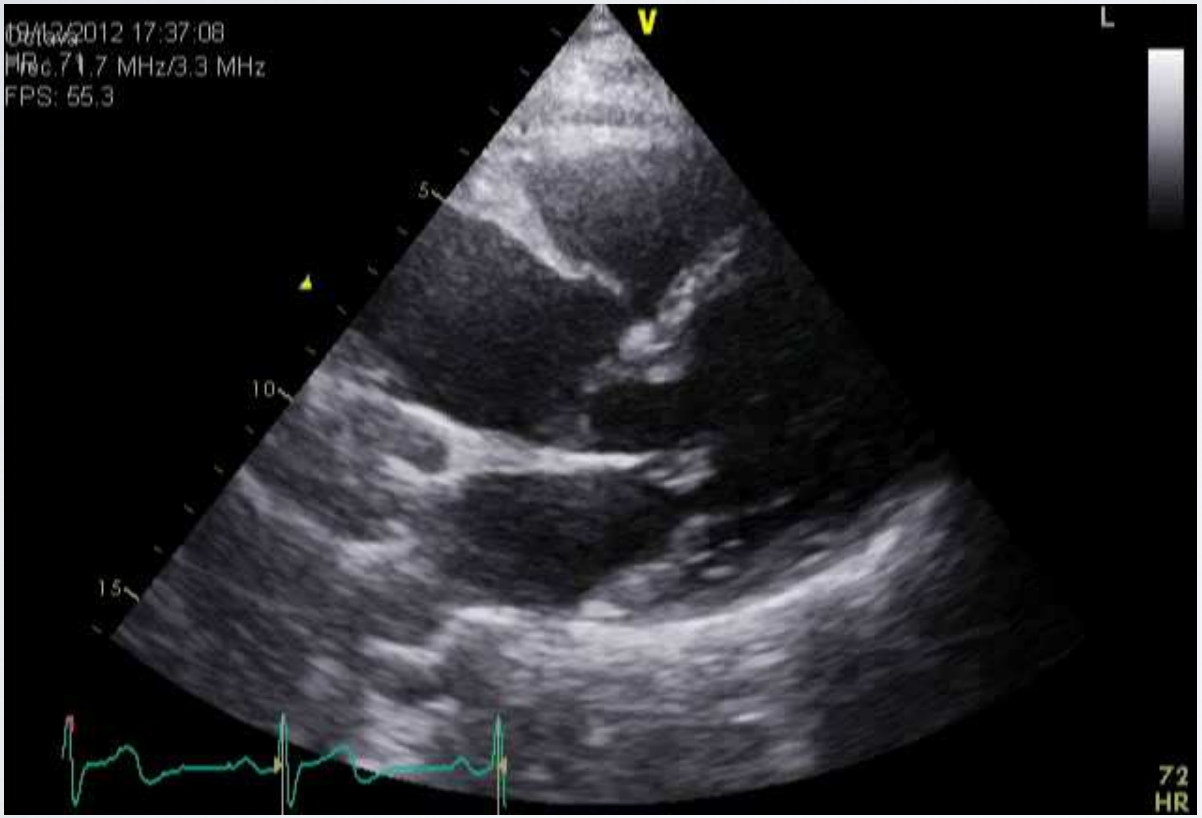


Table 7—*Competence in Basic CCE: Required Cognitive Skills in Recognition of Clinical Syndromes*

Clinical Syndromes	Echocardiographic Findings
Severe hypovolemia	Small, hyperdynamic ventricles Small IVC with wide respiratory variations
LV failure	Global LV systolic dysfunction Heterogeneous contractility pattern suggestive of myocardial ischemia LV cavity dilatation suggestive of chronic cardiac disease

DILATACION AORTA



- Diagnóstico diferencial del dolor torácico / Hallazgo casual
- Sensibilidad subóptima

DILATACION AORTA

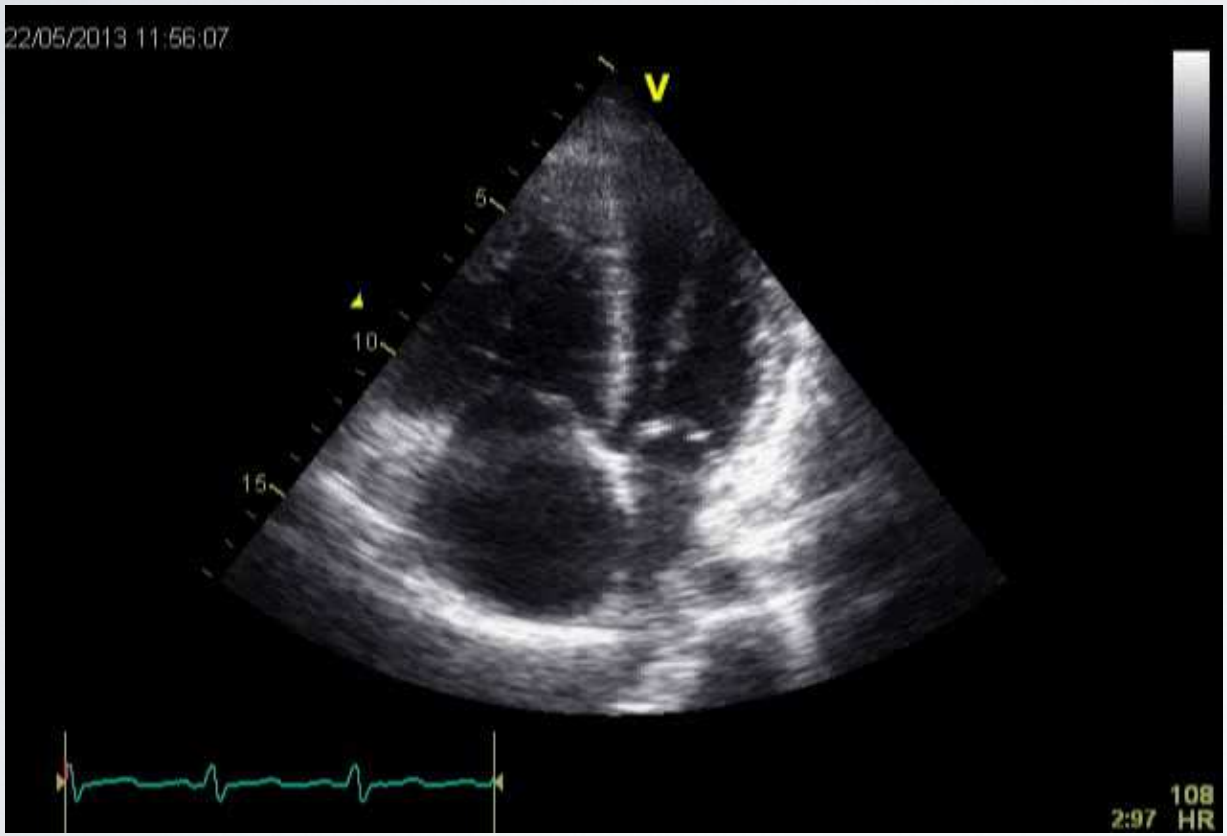
Point-of-care Focused Cardiac Ultrasound for the Assessment of Thoracic Aortic Dimensions, Dilation, and Aneurysmal Disease

R. Andrew Taylor, MD, Isabel Oliva, MD, Reinier Van Tonder, MBChB, John Elefteriades, MD, James Dziura, PhD, and Christopher L. Moore, MD

ACADEMIC EMERGENCY MEDICINE 2012; 19:244–247

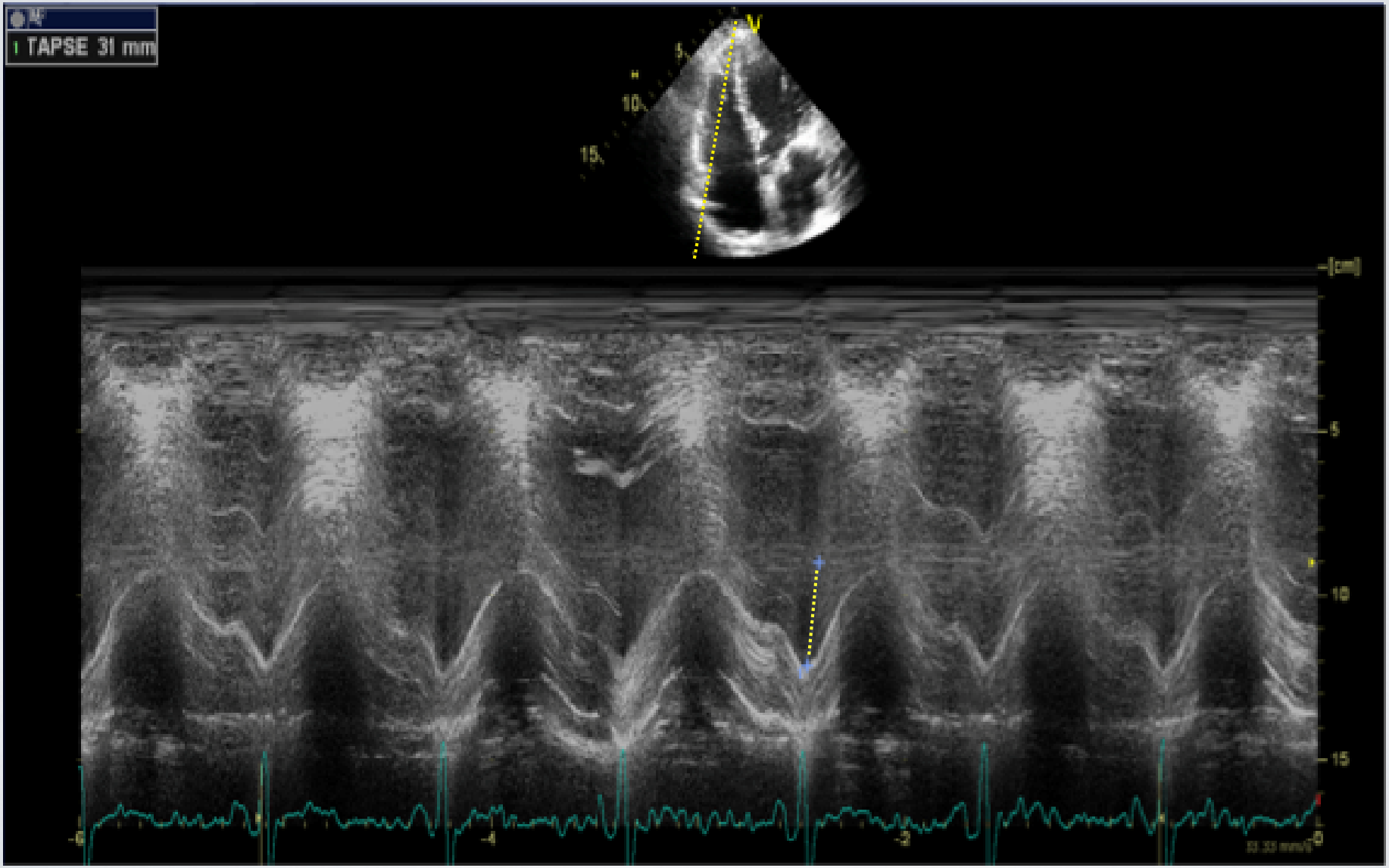
- Médicos de Urgencias
- 82 pacientes con sospecha de patología aórtica aguda
- Compara Ecocardiografía clínica con CT
- Para dilatación igual o mayor 45 mm S = 64%, E = 99% y kappa 0.71

FUNCIÓN VD



- Tratamiento en TEP masivo /DEM
- Diagóstico TEP, disnea, cor pulmonale

FUNCIÓN VD



FUNCIÓN VD

Table 6—*Competence in Basic Critical Care Echocardiography: Required Cognitive Skills in Image Interpretation*

Echocardiographic patterns
Global LV size and systolic function
Homogeneous/heterogeneous LV contraction pattern
Global RV size and systolic function
Assessment for pericardial fluid/tamponade
IVC size and respiratory variation
Basic color Doppler assessment for severe valvular regurgitation

Table 1 Goals of the focused cardiac ultrasound in the symptomatic emergency department patient

Assessment for the presence of pericardial effusion
Assessment of global cardiac systolic function
Identification of marked right ventricular and left ventricular enlargement
Intravascular volume assessment
Guidance of pericardiocentesis
Confirmation of transvenous pacing wire placement

FUNCIÓN VD

Comparison of Effectiveness of Hand-Carried Ultrasound to Bedside Cardiovascular Physical Examination

Sergio L. Kobal, MD[a], Luca Trento, BS[b], Simin Baharami, BS[b], Kirsten Tolstrup, MD[a], Tasneem Z. Naqvi, MD[a], Bojan Cercek, MD, PhD[a], Yoram Neuman, MD[a], James Mirocha, MS[a], Saibal Kar, MD[a], James S. Forrester, MD[a], and Robert J. Siegel, MD[a,*]

Table 2
Students' and cardiologists' (MD) diagnoses of nonvalvular lesions

Finding	Cases	Sensitivity (%)			Specificity (%)		
		Students	MD	p Value	Students	MD	p Value
LV ejection fraction <50%	22	86	45	0.002	82	69	0.302
LV end-diastolic diameter >56 mm	12	67	75	1.000	94	63	<0.001
LV hypertrophy	23	65	43	0.227	71	63	0.581
Pulmonary hypertension	28	39	36	1.000	88	70	0.109
Elevated right atrial pressure	14	50	57	1.000	83	70	0.263
Right ventricular enlargement	16	63	44	0.508	95	82	0.109
Total	115	61	47	0.040	84	68	<0.001

(Am J Cardiol 2005;96:1002–1006)

FUNCIÓN VD

Pocket-size hand-held cardiac ultrasound as an adjunct to clinical examination in the hands of medical students and junior doctors

Vasileios F. Panoulas[1,2]*, Anna-Lena Daigeler[1], Anura S.N. Malaweera[1], Amrit S. Lota[1], Dinnish Baskaran[1], Syed Rahman[1], and Petros Nihoyannopoulos[1,2]

Table 2 Trainee sensitivity, specificity, PPV and NPV for various echocardiographic parameters (student's PHHE vs. cardiologist's PHHE—reference standard)

	Moderate-to-severe LV systolic dysfunction	Moderate-to-severe RV systolic dysfunction	Moderate-to-severe valvular regurgitation	Moderate-to-severe valvular stenosis	Moderate-to-severe LVH	Moderate-to-large pericardial effusion
Sensitivity	74.1	66.7	70.0	85.7	66.7	100
Specificity	93.9	100	98.0	100	100	100
PPV	90.9	100	93.3	100	100	100
NPV	81.6	96.4	89.0	99.2	98.3	100

European Heart Journal – Cardiovascular Imaging (2013) **14**, 323–330

FUNCIÓN VD

Original Contribution

Initial accuracy of bedside ultrasound performed by emergency physicians for multiple indications after a short training period

Juan Torres-Macho PhD*, Juan M. Antón-Santos MD, Isabel García-Gutierrez MD, María de Castro-García MD, Sergio Gámez-Díez MD, Pilar García de la Torre MD, Gonzalo Latorre-Barcenilla MD, Yolanda Majo-Carbajo MD, Juan C. Reparaz-González MD, Gonzalo García de Casasola PhD
Working Group of Clinical Ultrasound, Spanish Society of Internal Medicine

American Journal of Emergency Medicine (2012) **30**, 1943–1949

Table 1 Diagnostic accuracy of EP-performed ultrasonography

	n	S (%)	Sp (%)	PPV (%)	NPV (%)	%
Cholecystitis	78	96 (90-100)	79 (68-91)	73 (59-87)	97 (92-100)	85.5
Hydronephrosis	80	92 (84-100)	78 (61-95)	91 (82-98)	82 (66-98)	87.5
DVT	76	92 (82-100)	98 (94-100)	96 (88-100)	96 (90-100)	96
Echocardiogram	41	87 (69-100)	88 (76-100)	81 (62-100)	92 (81-100)	87.8
LV dysfunction		67 (29-100)	100	100	85 (65-100)	88.2
RV dysfunction		100	71 (38-100)	67 (29-100)	100	81.8
P effusion		100	88 (65-100)	83 (54-100)	100	92.3

FUNCIÓN VD

Right Ventricular Dilatation on Bedside Echocardiography Performed by Emergency Physicians Aids in the Diagnosis of Pulmonary Embolism

Scott Dresden, MD; Patricia Mitchell, RN; Layla Rahimi, BA; Megan Leo, MD, RDMS; Julia Rubin-Smith, MPH; Salma Bibi, MPH; Laura White, PhD; Breanne Langlois, MPH; Alison Sullivan, MD; Kristin Carmody, MD, RDMS

[Ann Emerg Med. 2013;■:1-9.]

Results: Thirty of 146 patients had a pulmonary embolism. Right ventricular dilatation on echocardiography had a sensitivity of 50% (95% confidence interval [CI] 32% to 68%), a specificity of 98% (95% CI 95% to 100%), a positive predictive value of 88% (95% CI 66% to 100%), and a negative predictive value of 88% (95% CI 83% to 94%). Positive and negative likelihood ratios were determined to be 29 (95% CI 6.1% to 64%) and 0.51 (95% CI 0.4% to 0.7%), respectively. Ten of 11 patients with right ventricular hypokinesis had a pulmonary embolism. All 6 patients with McConnell's sign and all 8 patients with paradoxical septal motion had a diagnosis of pulmonary embolism. There was a 96% observed agreement between coinvestigators and principal investigator interpretation of images obtained and recorded.

FUNCIÓN VD

POINT-OF-CARE FOCUSED CARDIAC ULTRASOUND FOR PREDICTION OF PULMONARY EMBOLISM ADVERSE OUTCOMES

R. Andrew Taylor, MD, Jennifer Davis, MD, Rachel Liu, MD, Vishal Gupta, MD, James Dziura, PHD, and Christopher L. Moore, MD

The Journal of Emergency Medicine, Vol. 45, No. 3, pp. 392–399, 2013

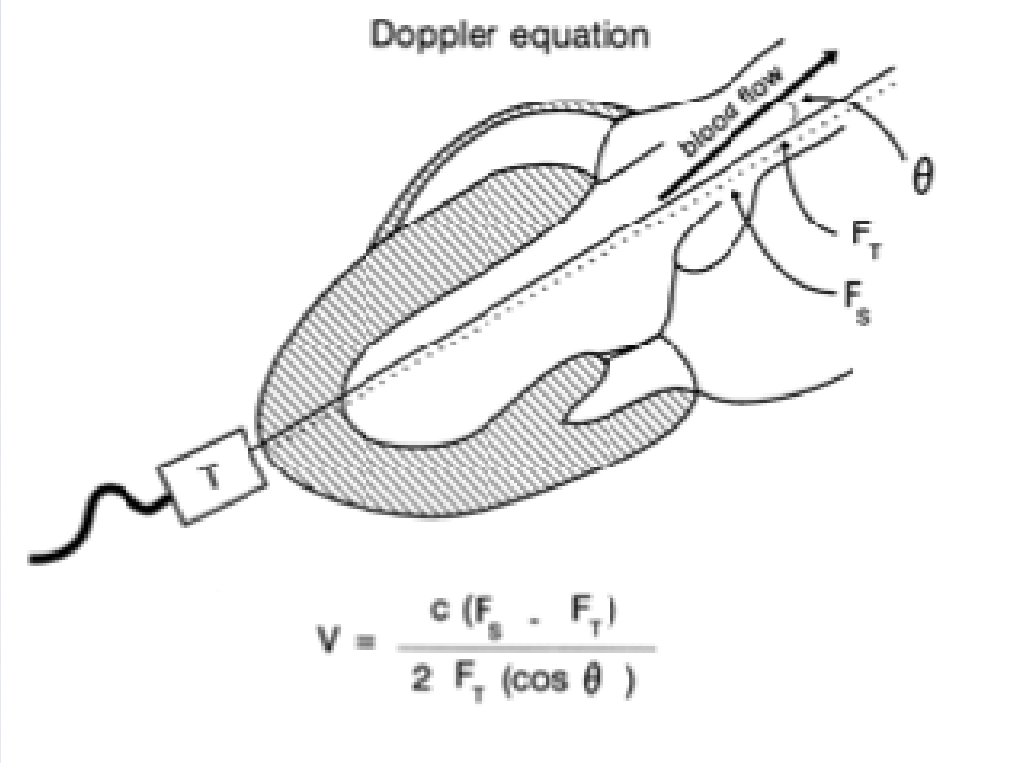
Table 4. Results of Multivariate Logistic Regression Analysis

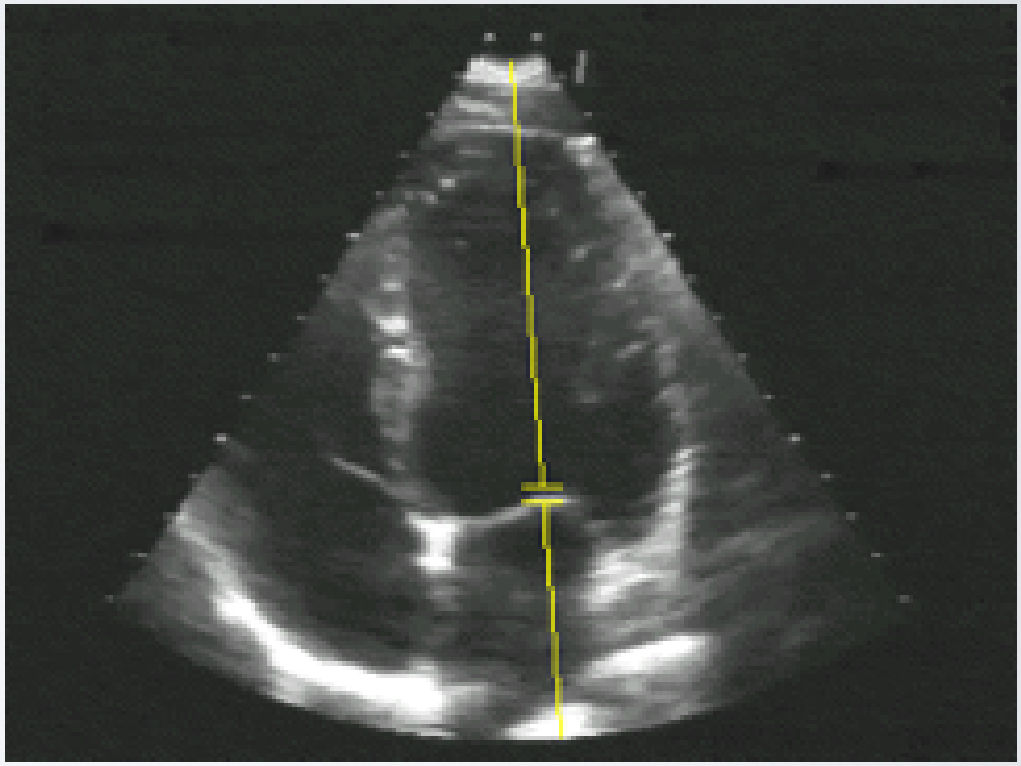
Variable	Odds Ratio	(95% CI)	*p* Value
Daniels score > 8	1.9	(0.32–9.4)	0.47
Geneva score (high risk)	1.83	(0.47–7.05)	0.37
Hypotension (SBP < 90 mm Hg)	1.74	(0.45–7.11)	0.42
RV strain	9.2	(3.2–29)	<0.0001
Thromboembolic disease	1.2	(0.32–5.37)	0.78
Cardiopulmonary disease	3.4	(1.2–11)	0.02
HR > 110 beats/min	1.1	(0.35–3.1)	0.91
AMS	3.1	(0.59–16)	0.18
Hypoxia (O_2 < 90)	1.1	0.34–3.14)	0.91

FUNCIÓN VD

¿ Es posible realizar una estratificación pronóstica inmediata mediante ecografía clínica (Evaluación VD + TVP) ?

DOPPLER COLOR CONTINUO Y PULSADO





DOPPLER COLOR CONTINUO Y PULSADO

- **PULSADO**

Emite pulso y tras un intervalo de tiempo recoge ecos

Analiza un punto específico (volúmen de muestra)

Limitado flujos de alta velocidad

- **CONTINUO**

Emite y registra de forma continua

Analiza toda la línea de exploración

No limitado flujos de alta velocidad

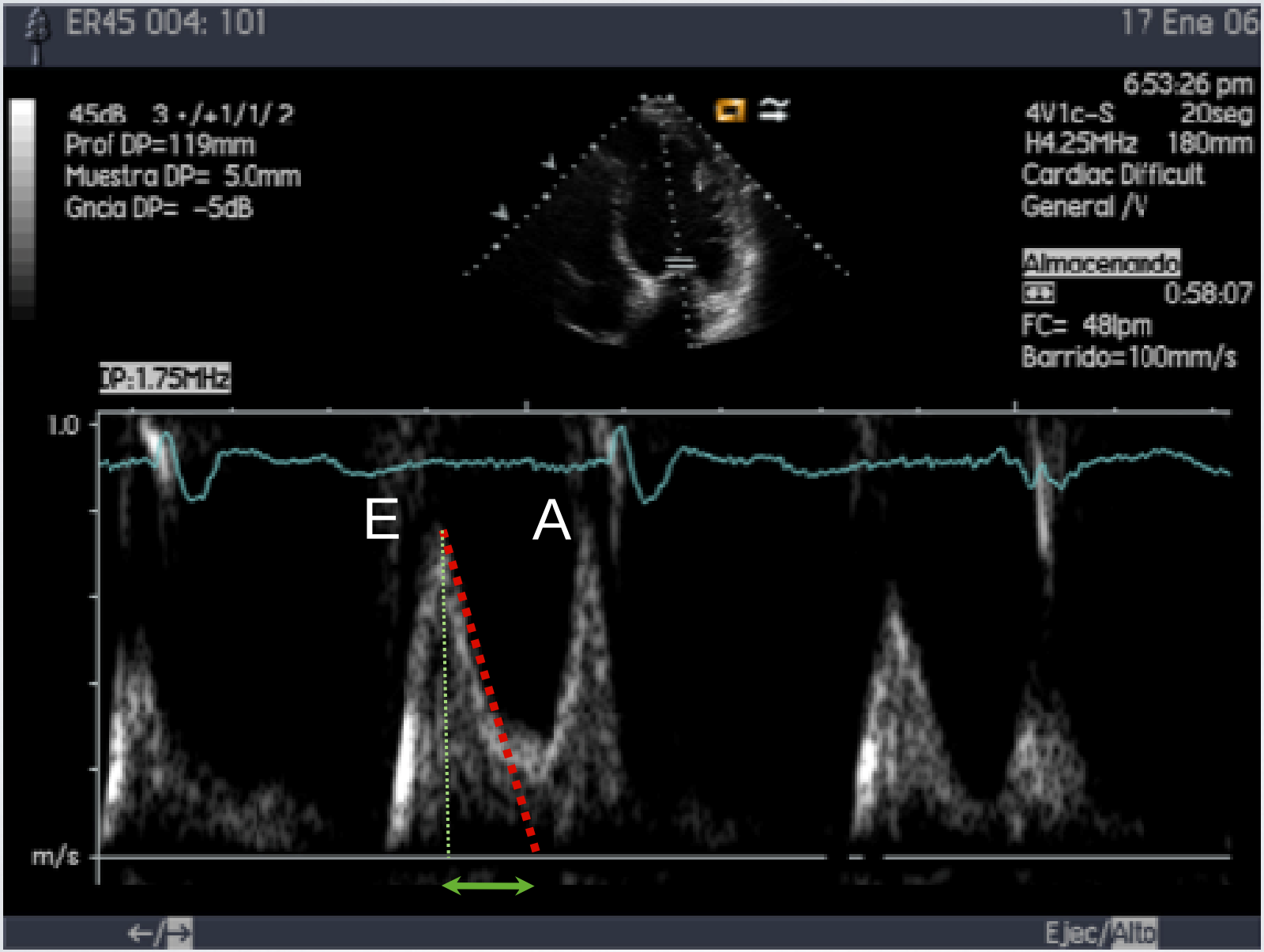
- **COLOR**

Mismos principios que Doppler pulsado

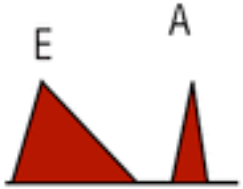
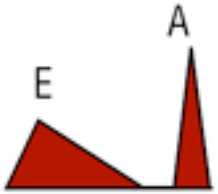
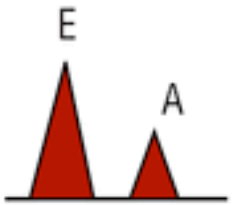
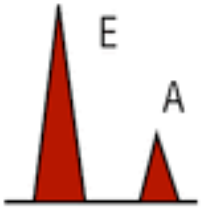
Interroga una matriz de puntos

Código de colores, rojo se acerca, azul se aleja y amarillo o verde aliasing

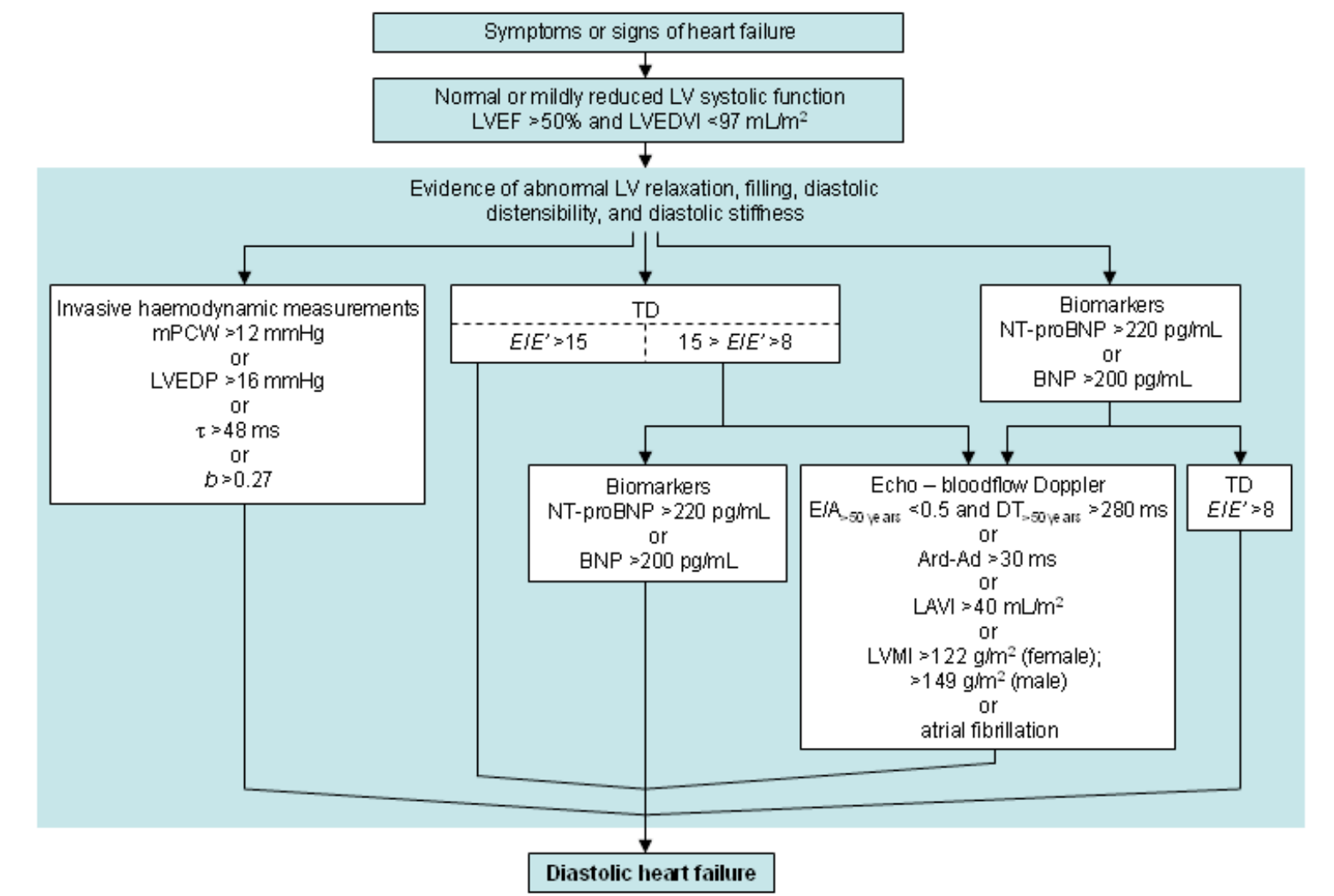
función diastólica



función diastólica

	Normal joven	Normal anciano	Alteración de la relajación	Seudonormal	Restrictivo
					
E/A	> 1	< 1	< 1	1-1,5	> 2
TDE	160-240	160-240	> 240	160-200	< 140-160
TRIS	70-90	70-90	> 90	< 90	< 70

función diastólica



BNP = B-natriuretic peptide; E/A = ratio of early (E) to late (A) mitral valve flow velocity; HFNEF = heart failure with normal ejection fraction; LAVI = left atrial volume index; LV = left ventricular; LVEF = left ventricular ejection fraction; LVDEVI = left ventricular end-diastolic volume index; LVEDP = left ventricular end-diastolic pressure; LVMI = left ventricular mass index; mPCW = mean pulmonary capillary wedge pressure; TD = tissue Doppler

Adapted from Paulus WJ, et al. Eur Heart J. 2007;28:2539-2550

función diastólica

Limited bedside echocardiography by emergency physicians for diagnosis of diastolic heart failure

Erol Erden Ünlüer,[1] Serdar Bayata,[2] Nursen Postaci,[2] Murat Yeşil,[2] Özcan Yavaşi,[1] Pınar Hanife Kara,[1] Nergis Vandenberk,[1] Serhat Akay[1]

Emerg Med J 2012;**29**:280–283.

Table 1 True positive, true negative, false positive and false negative values and sensitivity, specificity, positive and negative predictive values of BECH based on the cardiologists' echocardiography

		Cardiologists' echocardiography for diastolic dysfunction		
		Positive	**Negative**	
Emergency physicians' BECH for diastolic dysfunction	Positive	48	3	→PPV 0.80
	Negative	6	12	→NPV 0.33
		↓Sensitivity 0.89	↓Specificity 0.80	Accuracy 0.87

BECH, bedside echocardiography; NPV, negative predictive value; PPV, positive predictive value.

psAp

PSAP = 4 x (velocidad pico IT)2 + PAD

VALVULOPATIAS

- **OBJETIVO**:Descartar valvulopatía al menos moderada-severa (SCREENING) **VS** Detección de valvulopatía severa

- Utilidad en soplos, insuficiencia cardiaca, disnea sin claro origen, síncope...etc

- Crucial en insuficiencias valvulares agudas

VALVULOPATIAS

Gran parte de los contenidos que vamos a presentar no están demostrados en la literatura y existe gran controversia

Ante la más mínima duda

Consulte con el cardiólogo de su Hospital

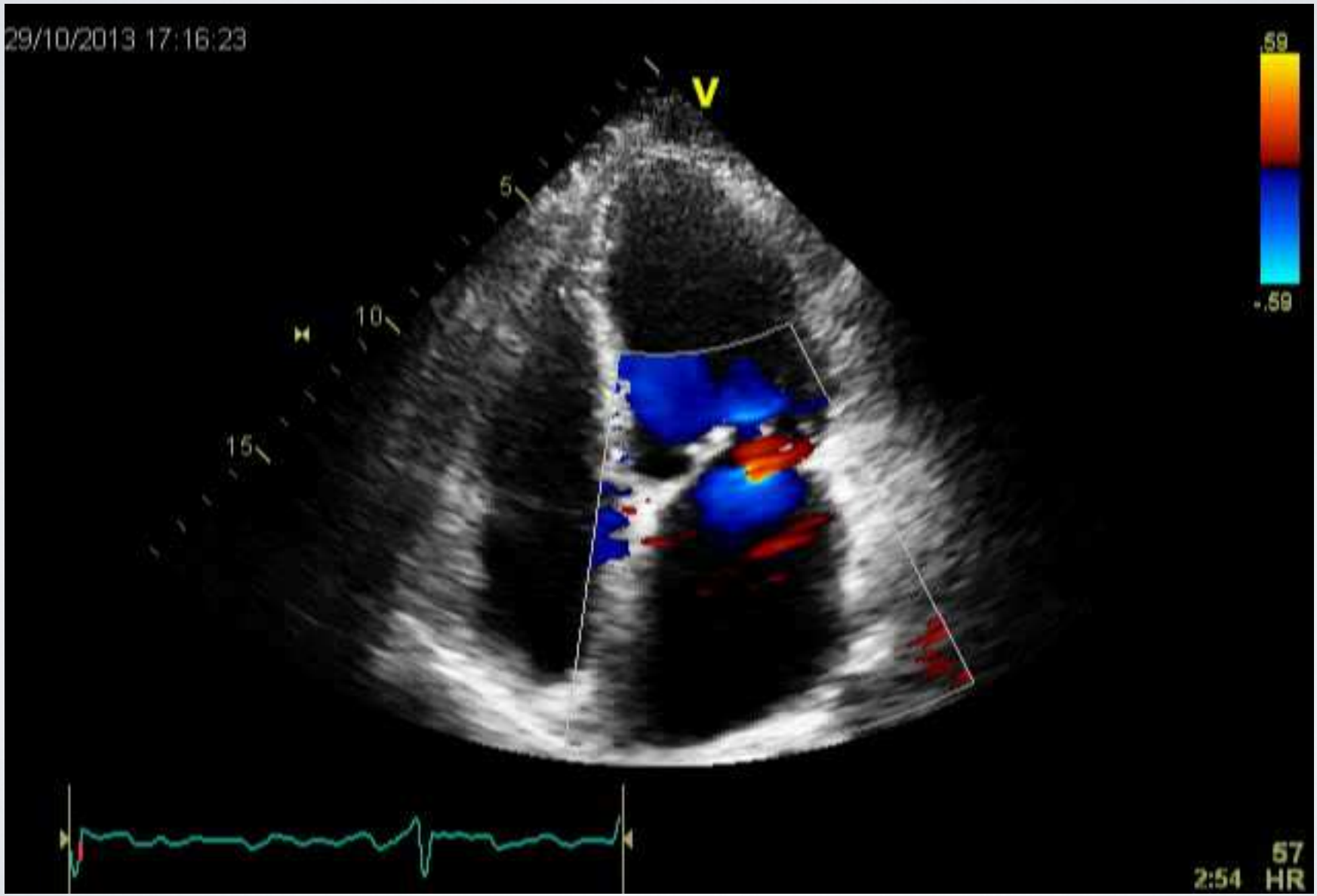
INSUFICIENCIA MITRAL

Table 1 Qualitative and quantitative parameters useful in grading mitral regurgitation severity

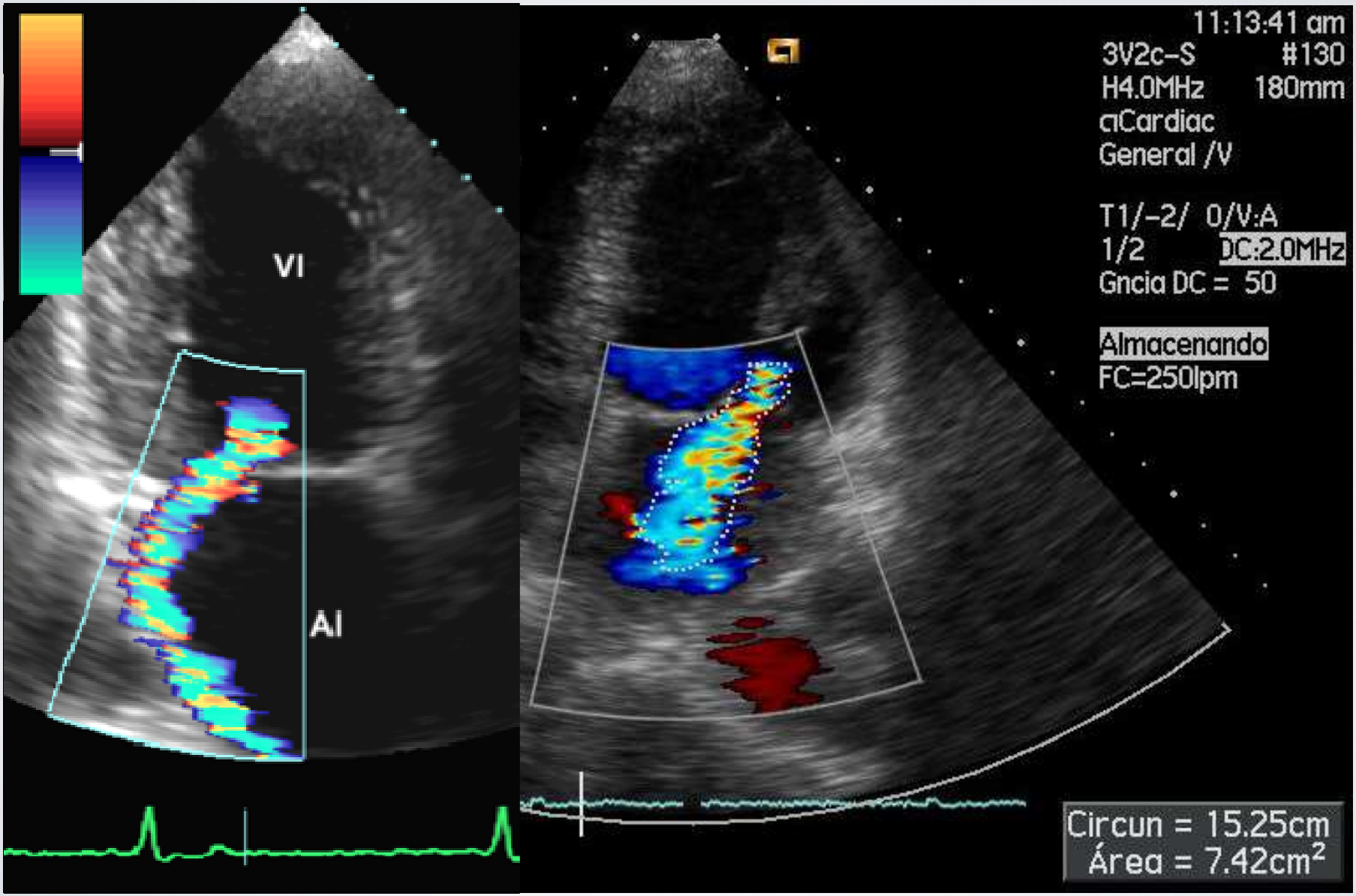
	Mild	Moderate	Severe
Structural parameters			
LA size	Normal*	Normal or dilated	Usually dilated**
LV size	Normal*	Normal or dilated	Usually dilated**
Mitral leaflets or support apparatus	Normal or abnormal	Normal or abnormal	Abnormal/ Flail leaflet/ Ruptured papillary muscle
Doppler parameters			
Color flow jet area[ζ]	Small, central jet (usually < 4 cm^2 or < 20% of LA area)	Variable	Large central jet (usually > 10 cm^2 or > 40% of LA area) or variable size wall-impinging jet swirling in LA
Mitral [illegible] –P	A wave dominant[Φ]	Variable	E wave dominant[Φ] (E usually 1.2 m/s)
[illegible]	Incomplete or faint	Dense	Dense
Jet contour –CW	Parabolic	Usually parabolic	Early peaking–triangular
Pulmonary vein flow	Systolic dominance[§]	Systolic blunting[§]	Systolic flow reversal†
Quantitative parameters[Ψ]			
[illegible]	< 0.3	0.3-0.69	≥ 0.7
[illegible] (ml/be	< 30	30-44 45-59	≥ 60
RF (	< 30	30-39 40-49	≥ 50
EROA (	< 0.20	0.20-0.29 0.30-0.39	≥ 0.40

J Am [illegible] cardiogr 2003;16:777-802.

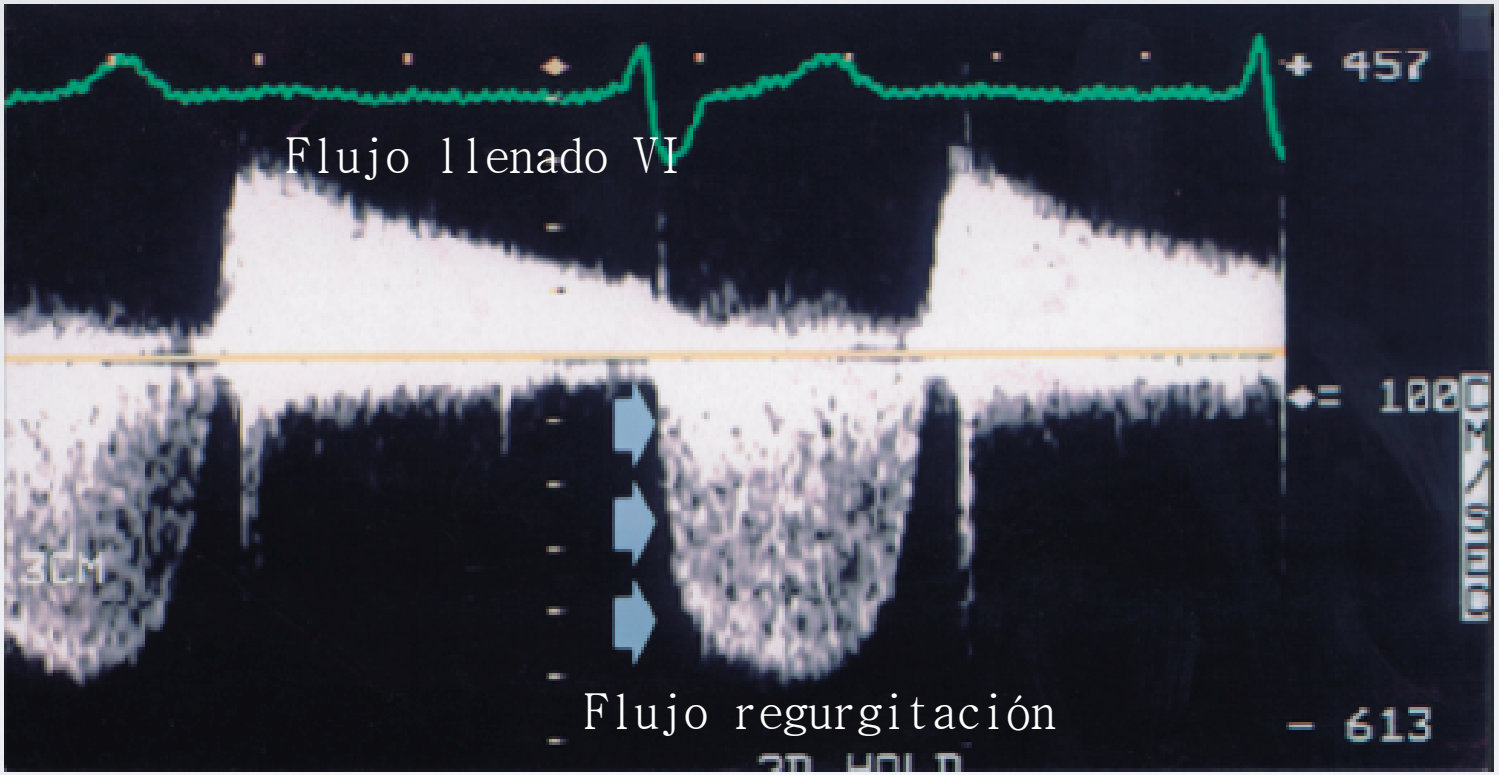
INSUFICIENCIA MITRAL



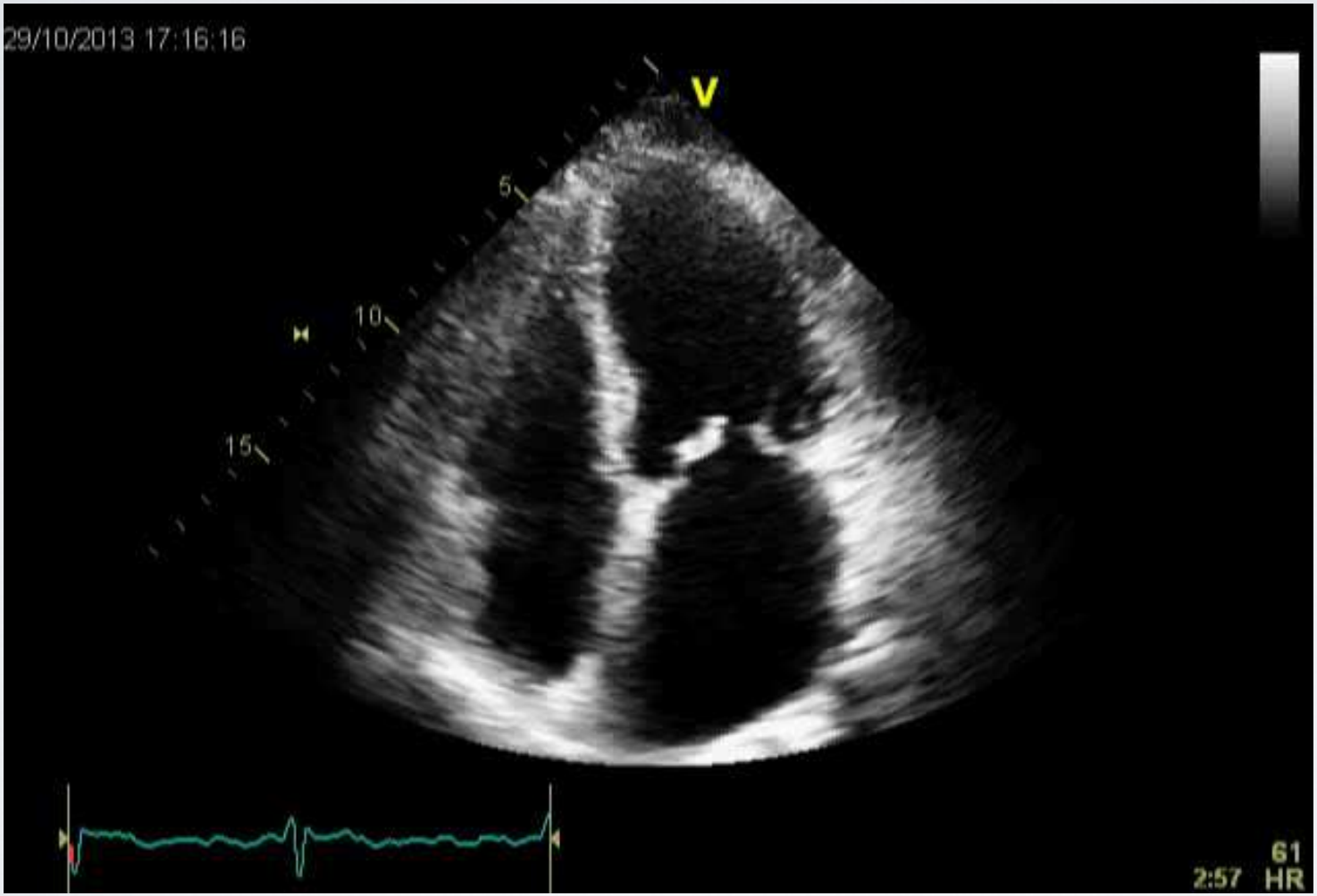
INSUFICIENCIA MITRAL



INSUFICIENCIA MITRAL



estenosis mitral



estenosis mitral

Table 8 Approaches to evaluation of mitral stenosis

Measurement	Units	Formula / Method	Concept	Advantages	Disadvantages
Valve area - planimetry by 2D echo	cm^2	tracing mitral orifice using 2D echo	direct measurement of anatomic MVA	- accuracy - independence from other factors	- experience required - not always feasible (poor acoustic window, severe valve calcification)
- pressure half-time	cm^2	$220 / T_{1/2}$	rate of decrease of transmitral flow is inversely proportional to MVA	easy to obtain	dependence on other factors (AR, LA compliance, LV diastolic function…)
- continuity equation	cm^2	$MVA = (CSA_{LVOT})(VTI_{Aortic}) / VTI_{Mitral}$	volume flows through mitral and aortic orifices are equal	independence from flow conditions	- multiple measurements (sources of errors) - not valid if significant AR or MR
- PISA	cm^2	$MVA = \pi(r^2)(V_{aliasing}) /$ peak $V_{Mitral} \cdot \alpha/180°$	MVA assessed by dividing mitral volume flow by the maximum velocity of diastolic mitral flow	independence from flow conditions	technically difficult
Mean gradient	mm Hg	$\Delta P = \Sigma 4v^2 / N$	pressure gradient calculated from velocity using the Bernoulli equation	easy to obtain	dependent on heart rate and flow conditions
Systolic pulmonary artery pressure	mm Hg	$sPAP = 4v^2_{Tricuspid}$ + RA pressure	addition of RA pressure and maximum gradient between RV and RA	patients with MS	- arbitrary estimation of RA pressure - no estimation of pulmonary vascular resistance
Mean gradient and systolic pulmonary artery pressure at exercise	mm Hg	$\Delta P = \Sigma 4v^2 / N$ $sPAP = 4v^2_{Tricuspid}$ + RA pressure	assessment of gradient and sPAP for increasing workload	incremental value in assessment of tolerance	- experience required - lack of validation for decision-making
Valve resistance	$dyne \cdot sec^{-1} \cdot cm^{-5}$	$Mvres = P_{Mitral} / (CSA_{LVOT})(VTI_{Aortic}) / DFT)$	resistance to flow caused by MS	initially suggested to be less flow-dependent, but not confirmed	no prognostic value no clear threshold for severity no additional value vs. valve area

Level of recommendations: (1) appropriate in all patients (yellow); (2) reasonable when additional information is needed in selected patients (green); and (3) not recommended (blue).

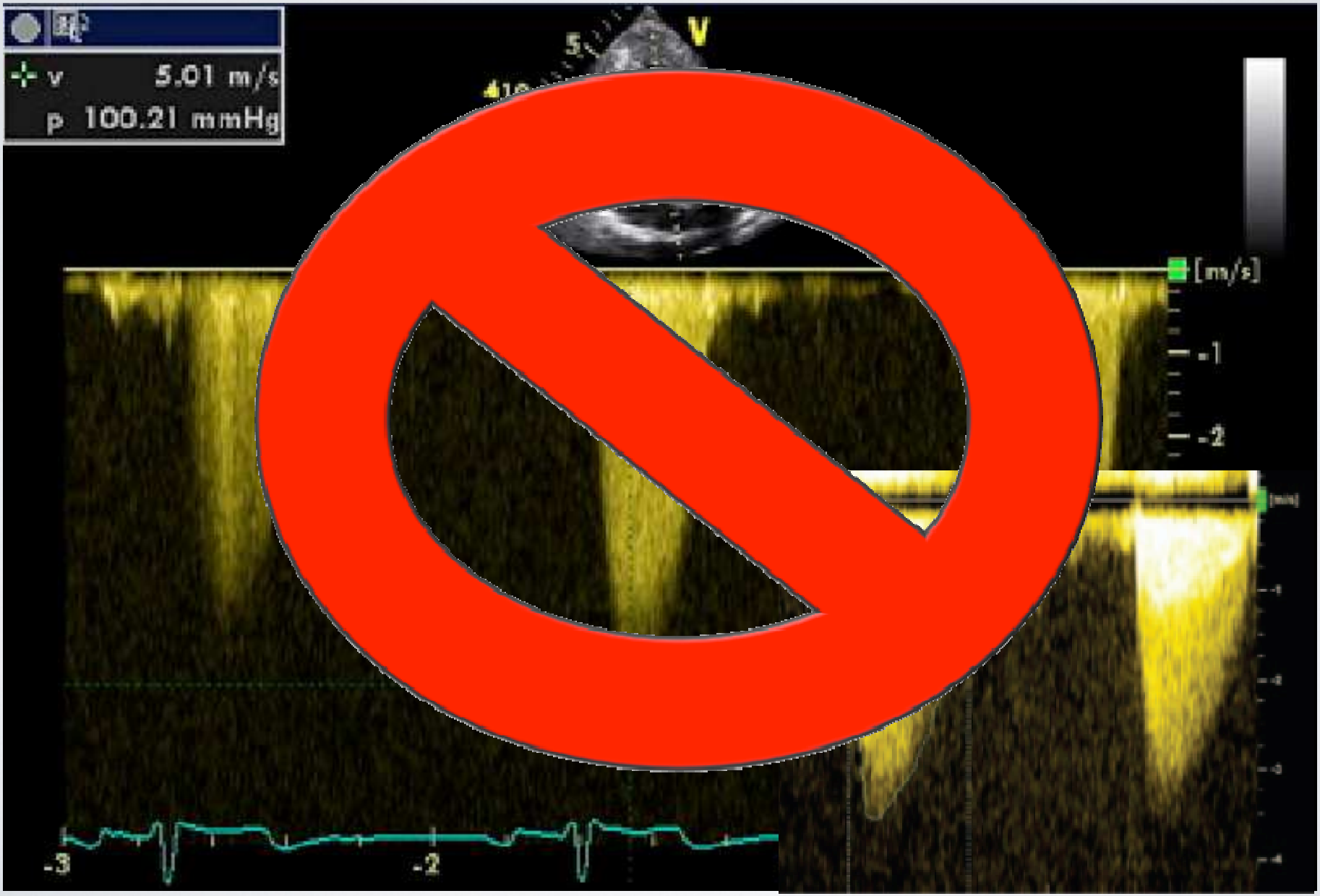
Journal of the American Society of Echocardiography
Volume 22 Number 1

ESTENOSIS MITRAL

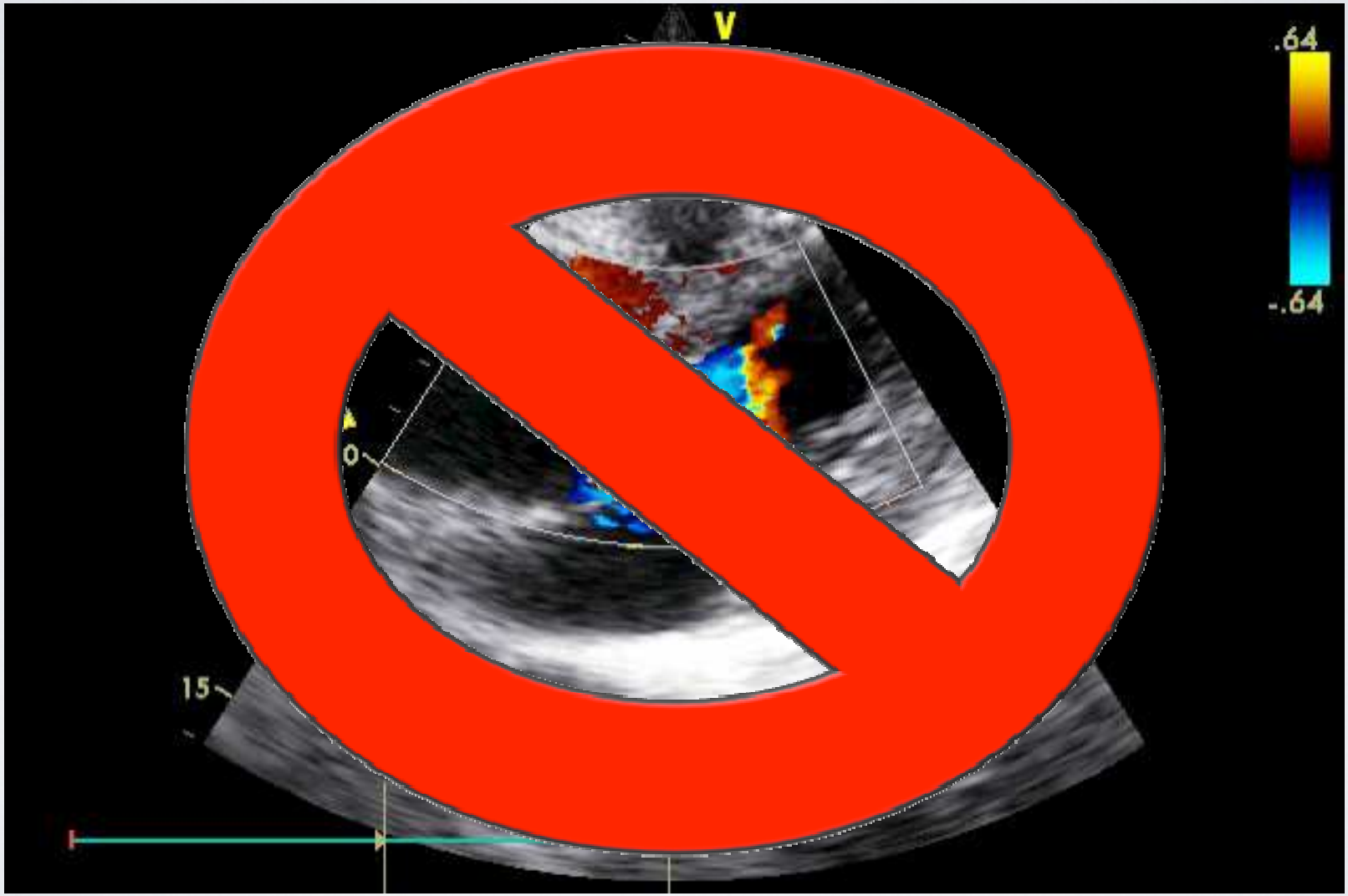
CALCULO DEL GRADIENTE MEDIO

Grado de estenosis	Área valvular mitral (cm2)	Gradiente medio mitral (mmHg)	Presión sistólica de arteria pulmonar
Normal	4 – 6	Despreciable	< 30
Estenosis ligera	> 1.5	< 5	< 30
Estenosis moderada	1.0 – 1-5	5 – 10	30 - 50
Estenosis severa	< 1.0	➢10	> 50

ESTENOSIS AORTICA



INSUFICIENCIA AORTICA



VALVULOPATIAS

Tabla 2
Preguntas a realizar con un estudio portátil

Fracción de eyección (cualitativa)
Grosor miocárdico
Tamaño de la aurícula izquierda
Derrame pericárdico

Table 6—*Competence in Basic Critical Care Echocardiography: Required Cognitive Skills in Image Interpretation*

Focused Cardiac Ultrasound: Recommendations from the American Society of Echocardiography

Kirk T. Spencer, MD, FASE, Bruce J. Kimura, MD, Claudia E. Korcarz, DVM, RDCS, FASE, Patricia A. Pellikka, MD, FASE, Peter S. Rahko, MD, FASE, and Robert J. Siegel, MD, FASE, *Chicago, Illinois; San Diego and Los Angeles, California; Madison, Wisconsin; Rochester, Minnesota*

(J Am Soc Echocardiogr 2013;26:567-81.)

VALVULOPATIAS

Presence of valvular abnormalities (regurgitant or stenotic) and their grade (mild, moderate/severe). The severity of regurgitant lesions was based on 2D findings (atrial or ventricular enlargement, hyperdynamic LV) and qualitative colour-Doppler findings (width of vena contracta and jet area), whereas the severity of stenotic lesions was based on 2D findings of valve mobility, thickness, and calcification alongside chamber changes (hyper-

Table 2 **Trainee sensitivity, specificity, PPV and NPV for various echocardiographic parameters (student's PHHE vs. cardiologist's PHHE—reference standard)**

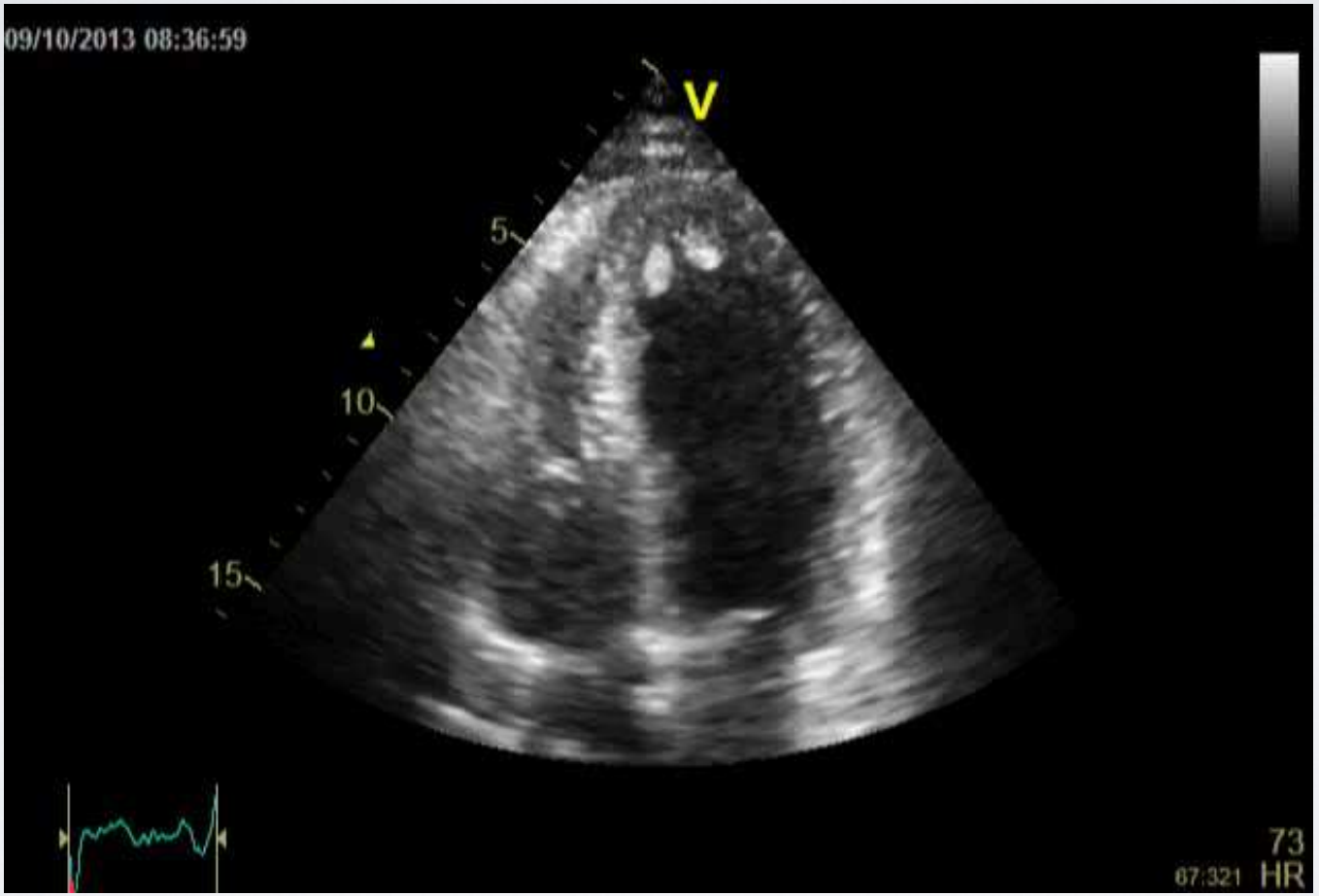
	Moderate-to-severe LV systolic dysfunction	Moderate-to-severe RV systolic dysfunction	Moderate-to-severe valvular regurgitation	Moderate-to-severe valvular stenosis	Moderate-to-severe LVH	Moderate-to-large pericardial effusion
Sensitivity	74.1	66.7	70.0	85.7	66.7	100
Specificity	93.9	100	98.0	100	100	100
PPV	90.9	100	93.3	100	100	100
NPV	81.6	96.4	89.0	99.2	98.3	100

European Heart Journal – Cardiovascular Imaging (2013) **14**, 323–330

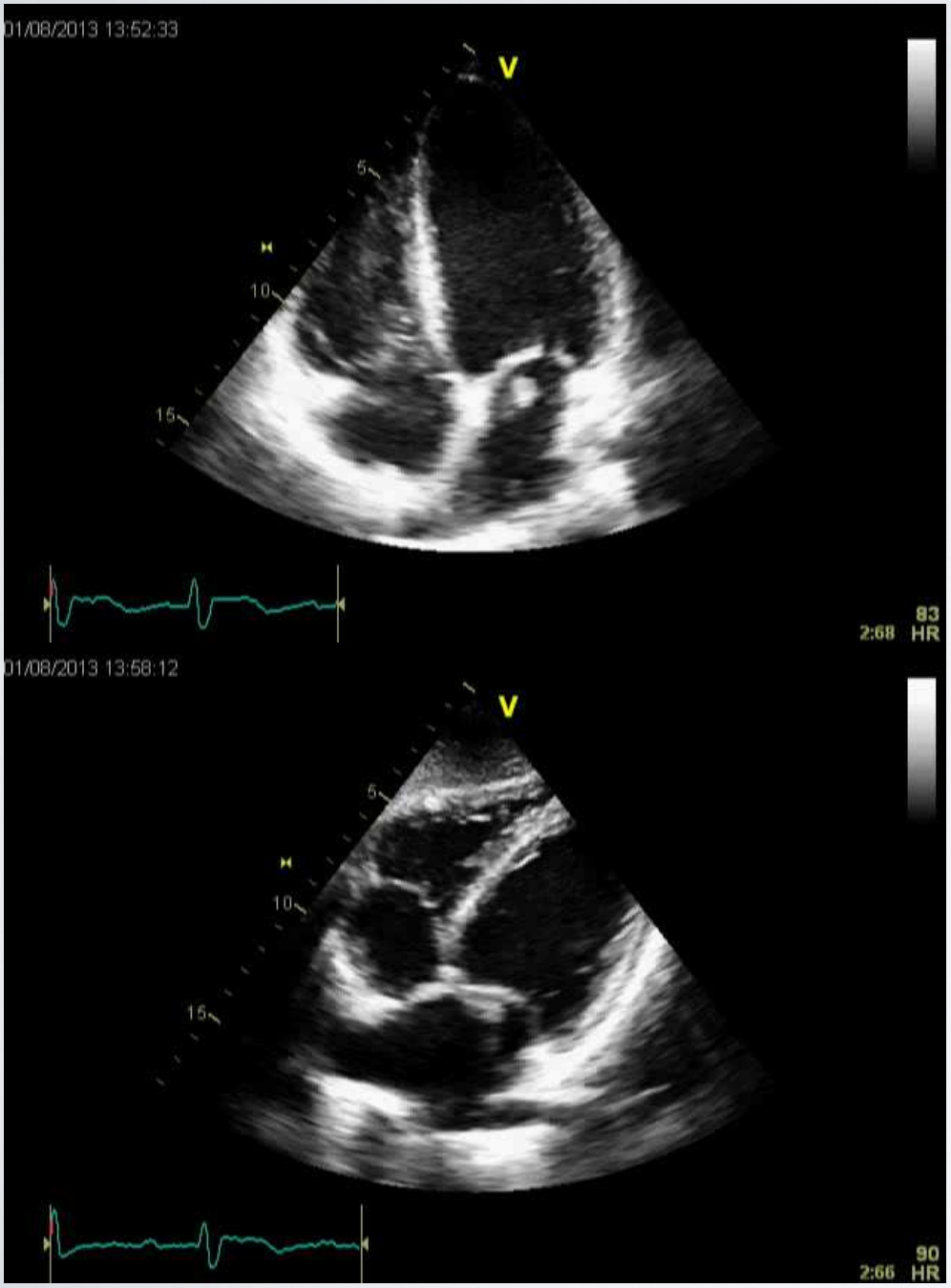
VALVULOPATIAS

- **CONCLUSIONES:**
  - Screening vs Detección precoz
  - Cautela / evaluar escenario clínico
  - Estudios validación

TROMBOS Y MASAS



ENDOCARDITIS



- Sensibilidad ETT del 60-70% (en manos expertas)
- Util acelerar diagnóstico si indicación Qx

CONCLUSIONES

- Se puede llegar más allá del Top five pero ***"lo más importante es ser cauto y saber lo que estamos buscando (historia clínica)"***
- Es necesario establecer un **consenso** a nivel nacional (guías de actuación y formación)
- Estudios de **investigación**
- **Colaboración estrecha** con los Cardiólogos