European Association
of Cardiovascular Imaging
Teaching Course

Imaging the Tricuspid Valve

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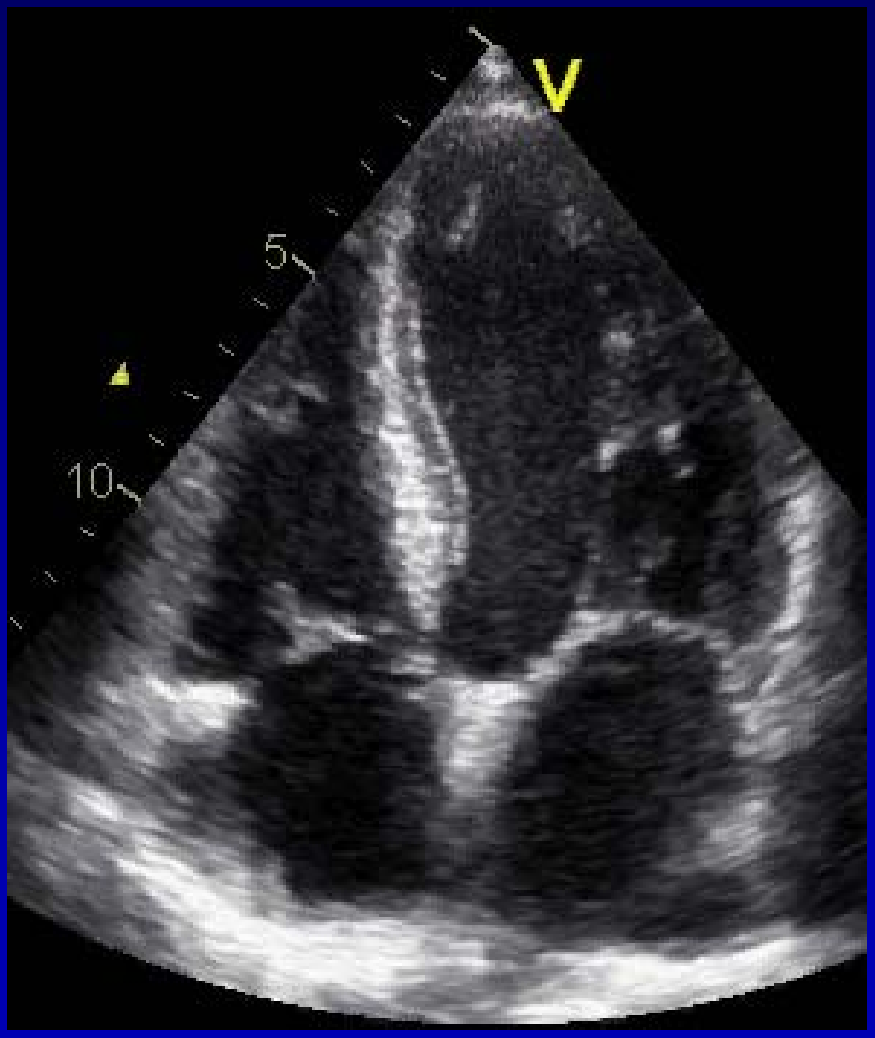
Tricuspid Valve

Anatomy & Function

Anatomy & Function

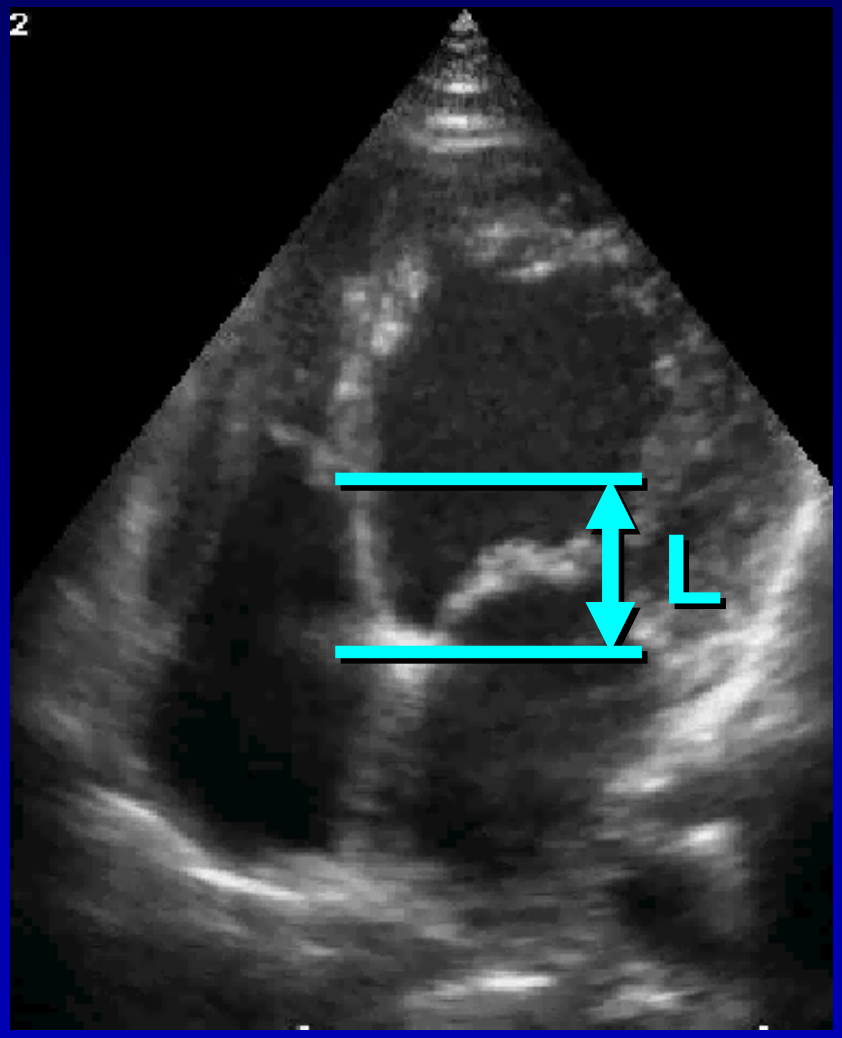


position

„slightly more apical“ than the mitral valve

Lancellotti et al., EJE 2010

Anatomy & Function



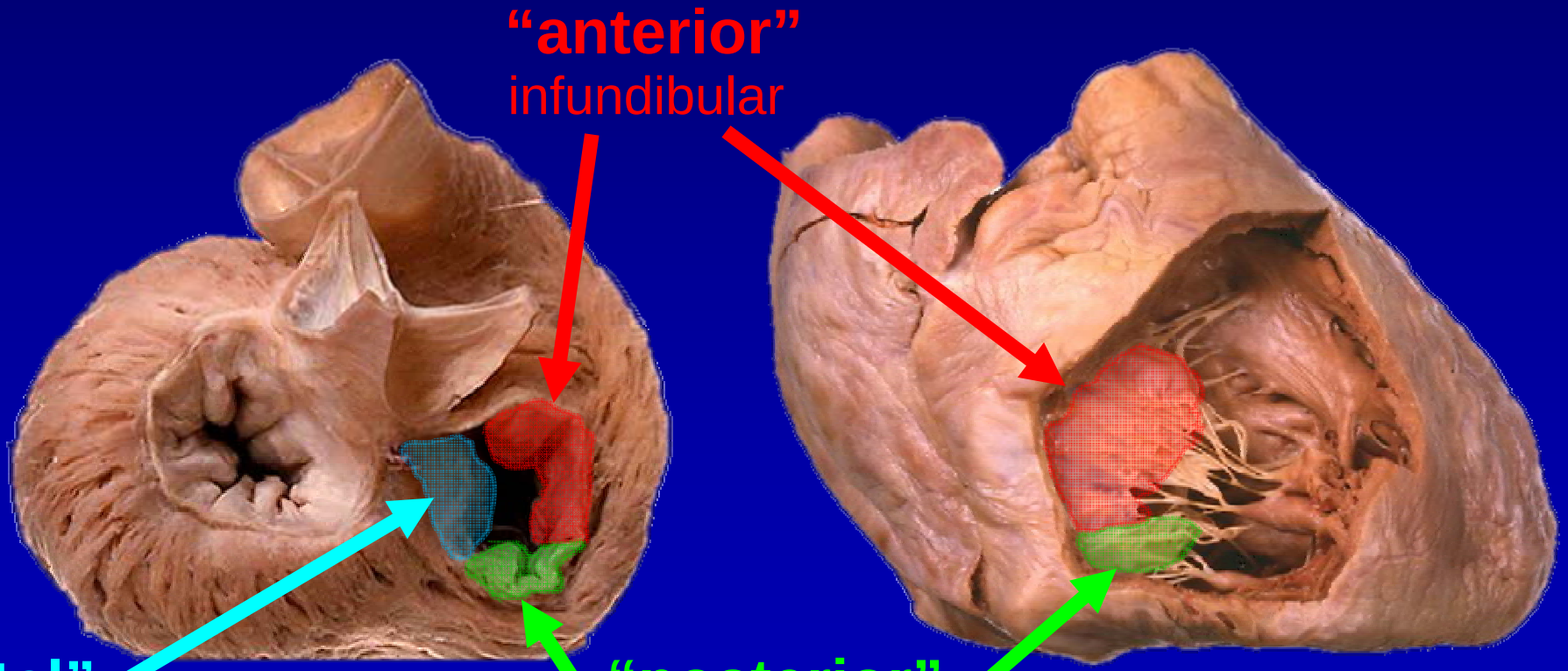
position

Ebstein Anomaly

L > 8mm/m²

Anatomy & Function

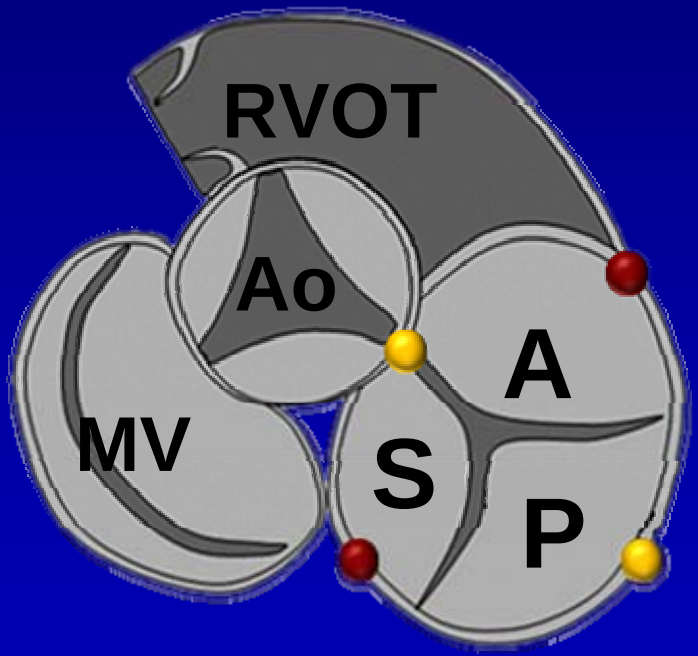
3 leaflets



C. Lawrence

Anatomy & Function

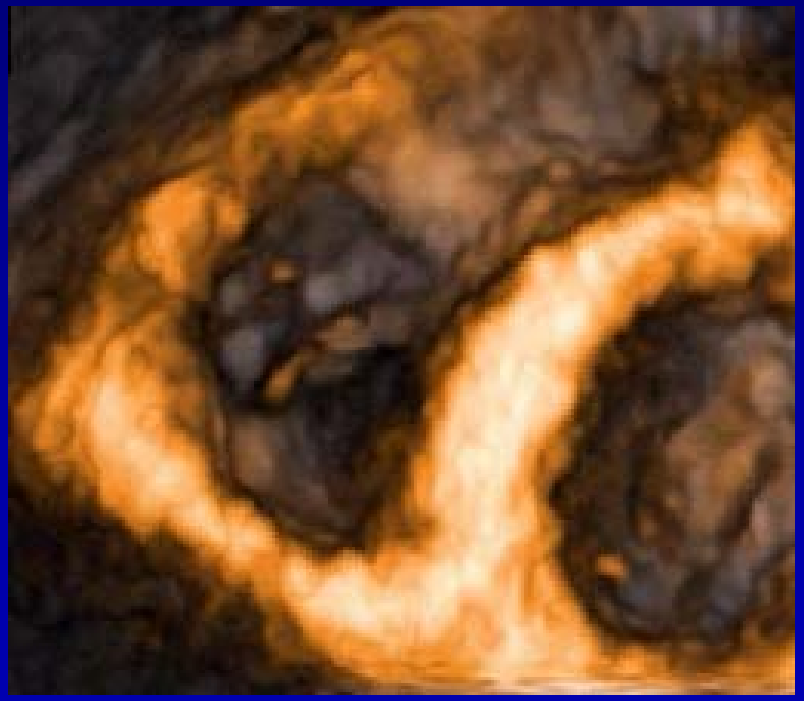
atrial view



C. Lawrence

Anatomy & Function

ventricular view



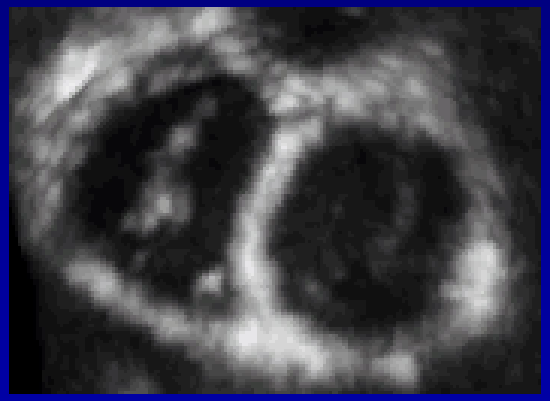
Anatomy & Function

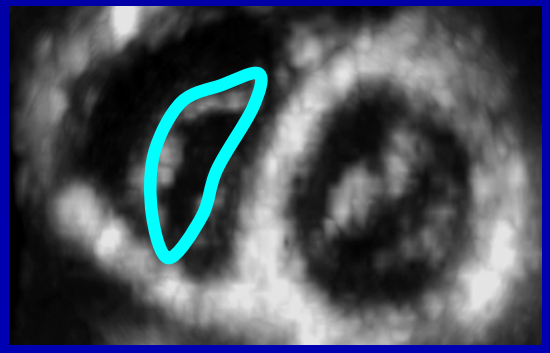
leaftlets

Variable Leaflet Morphology

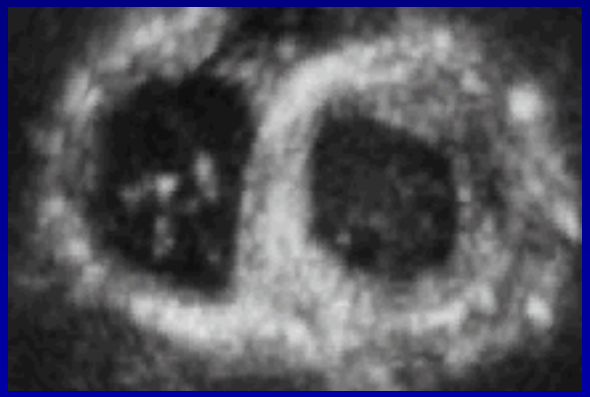
How many leaflets ?

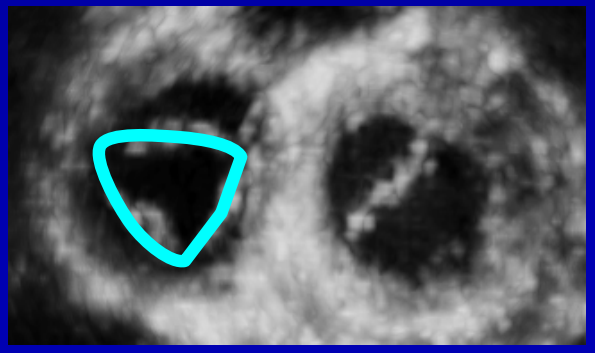
8%





90%





2%

Stankovic, EE 2012

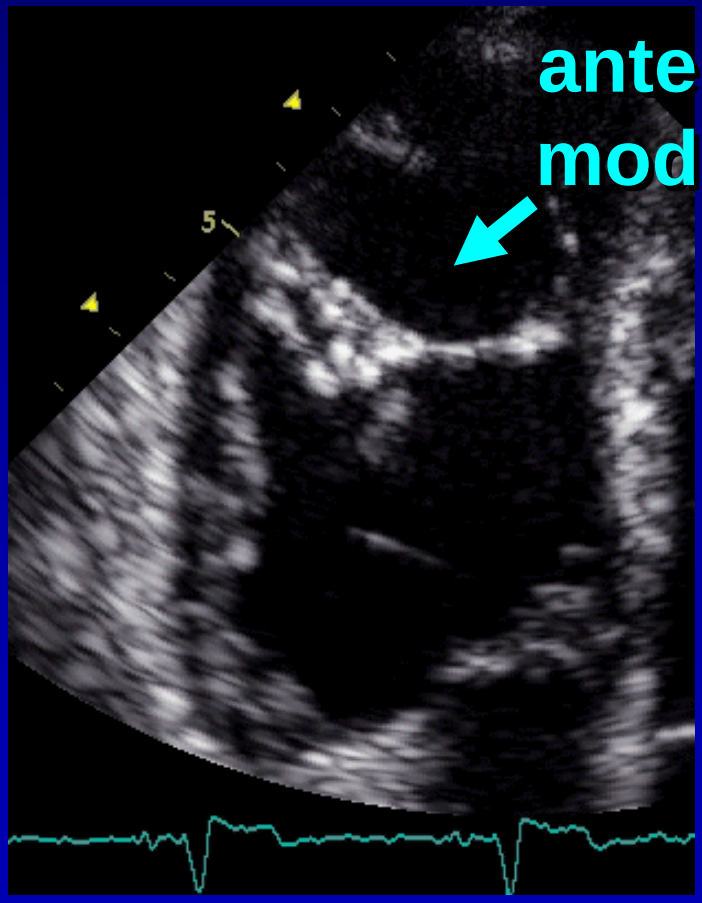
Anatomy & Function

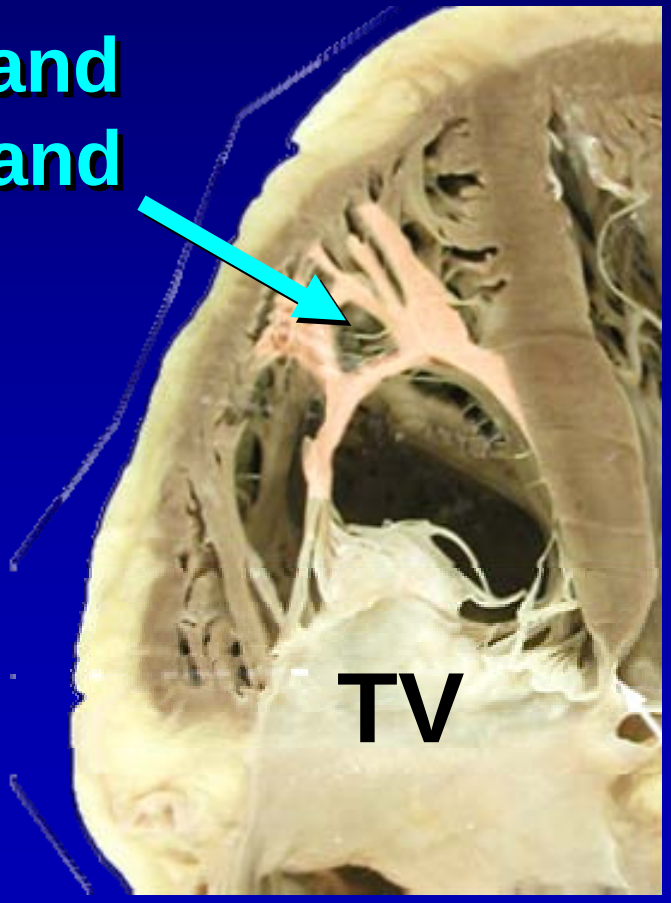
papillary muscles and cordae

P. Iaizzo

Anatomy & Function

papillary muscles and cordae

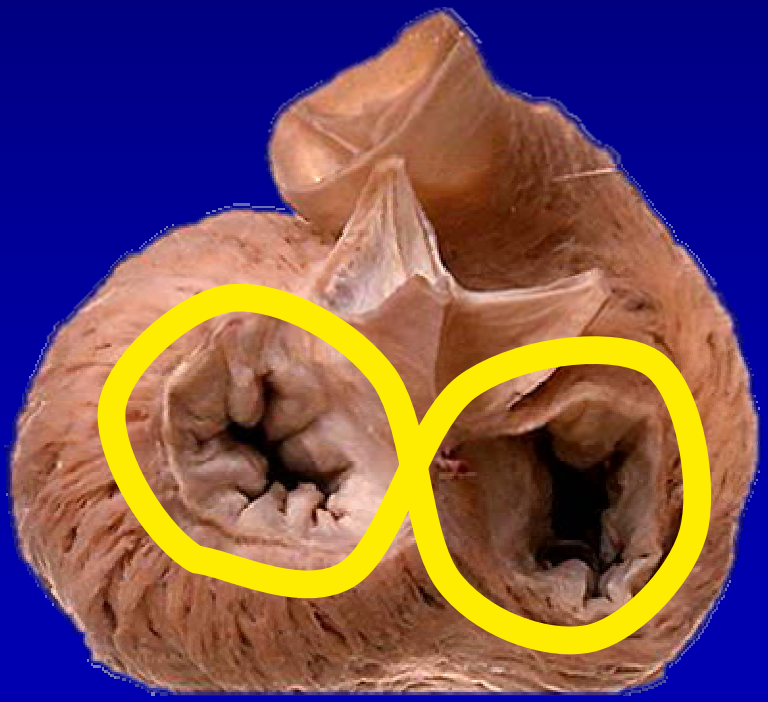




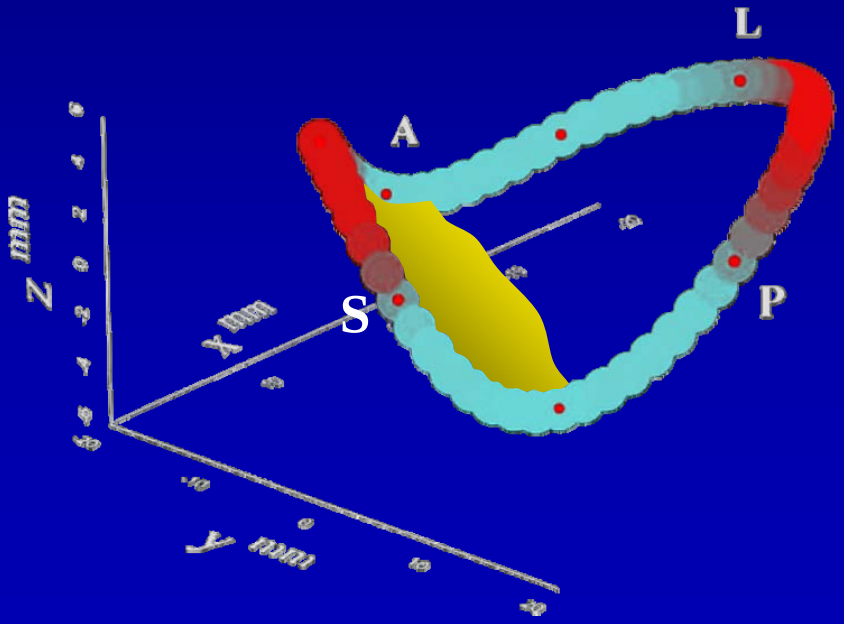
Anatomy & Function

annulus

interlinked with MV



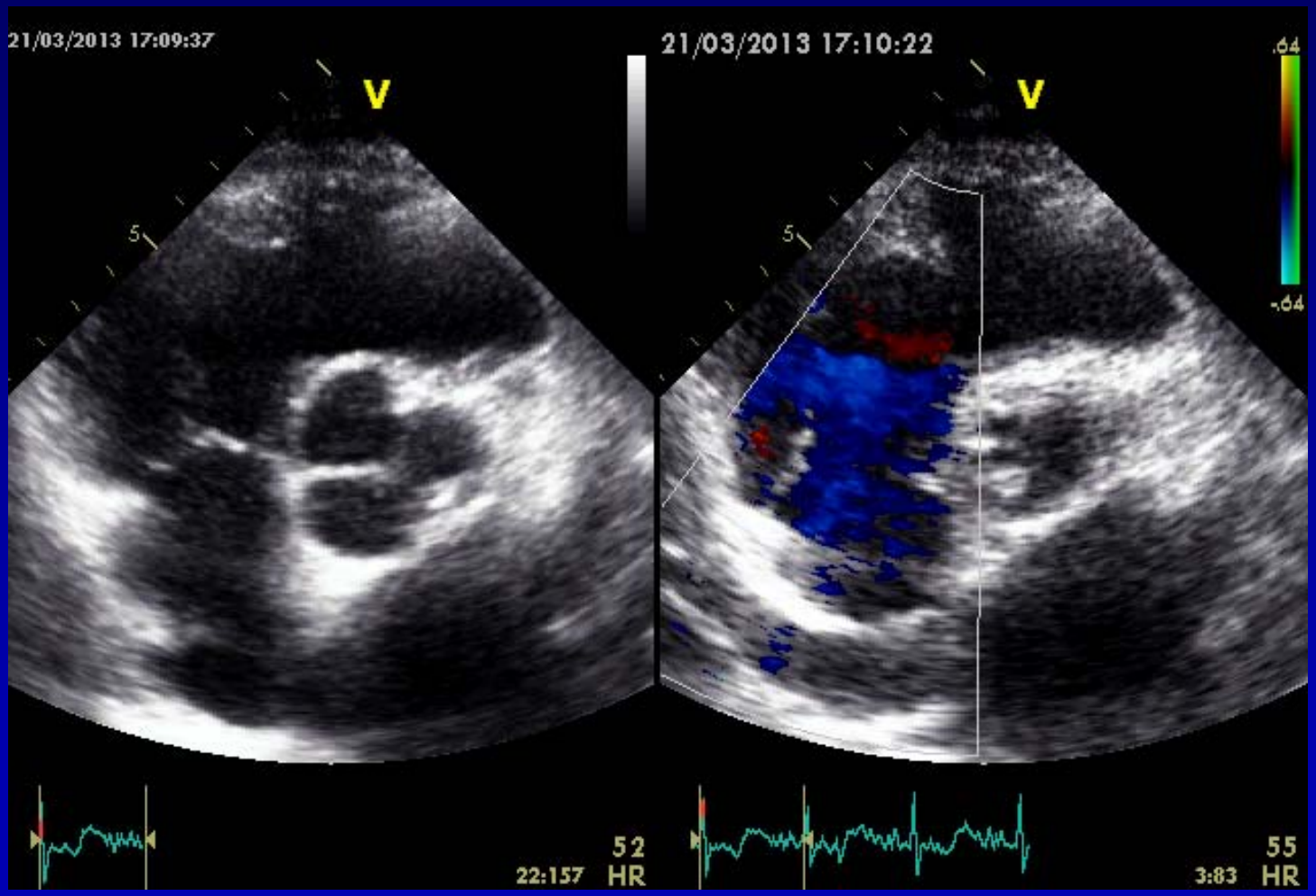
saddle shaped



Fukuda et al., Circ 2006

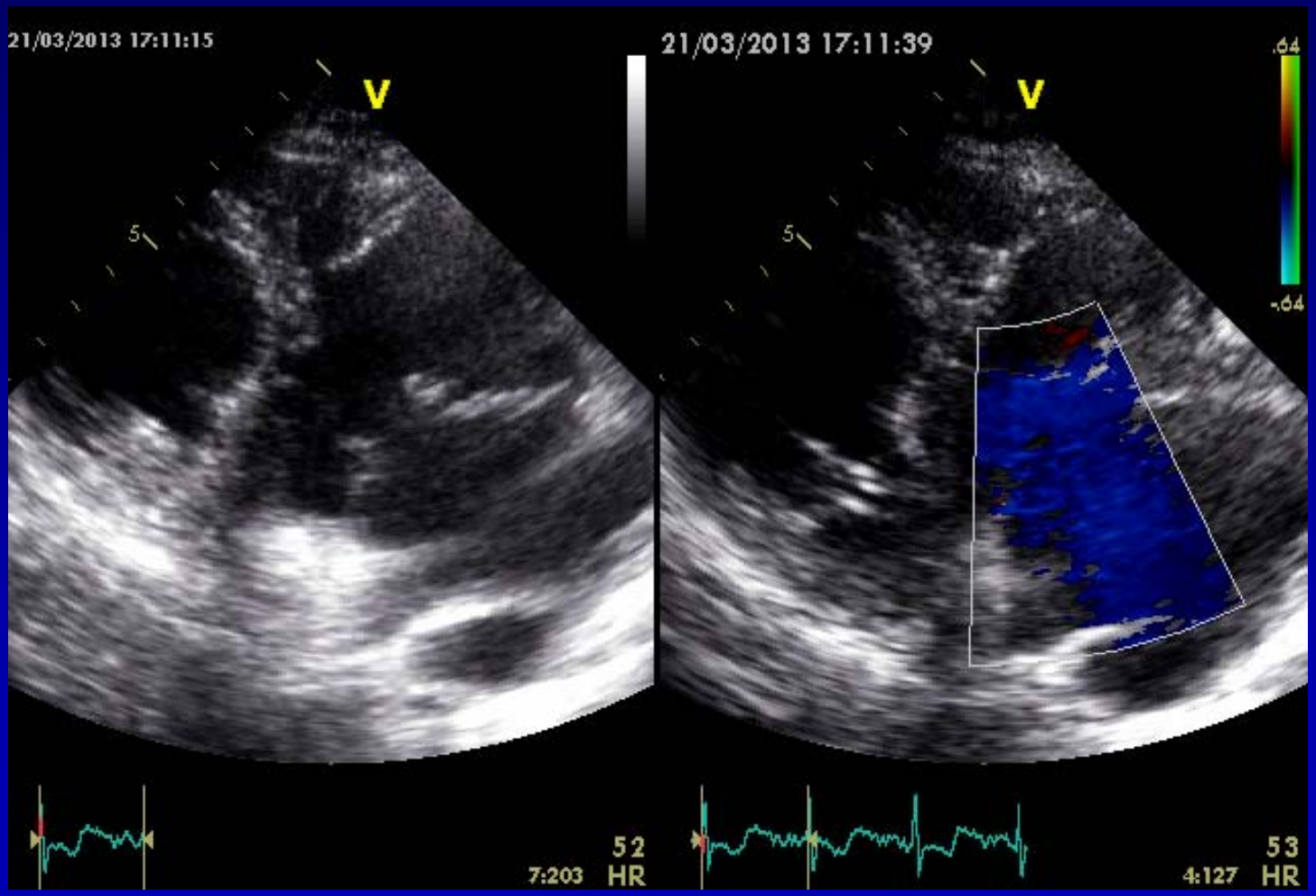
Imaging the Tricuspid Valve

Imaging the TV: Standard Views



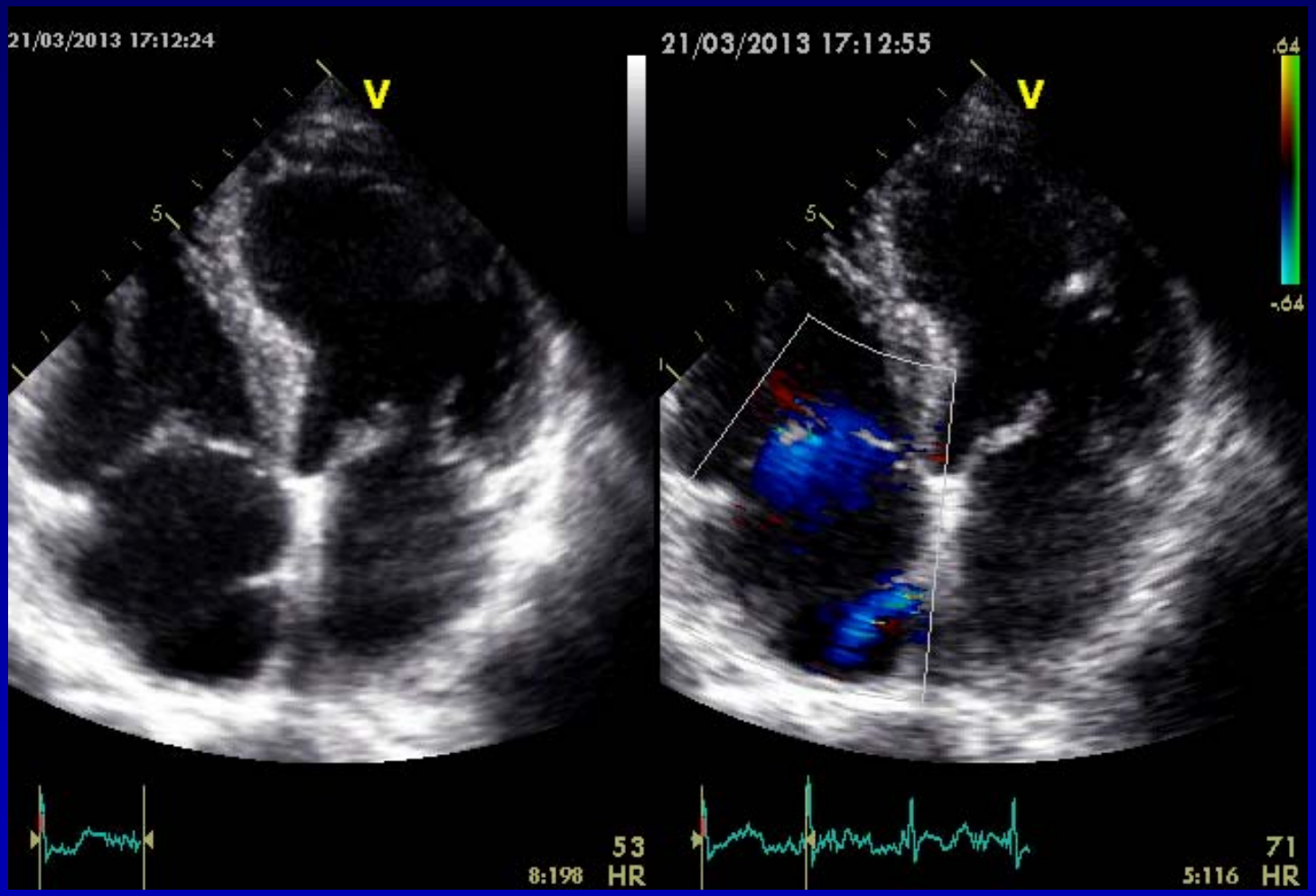
parasternal short axis

Imaging the TV: Standard Views



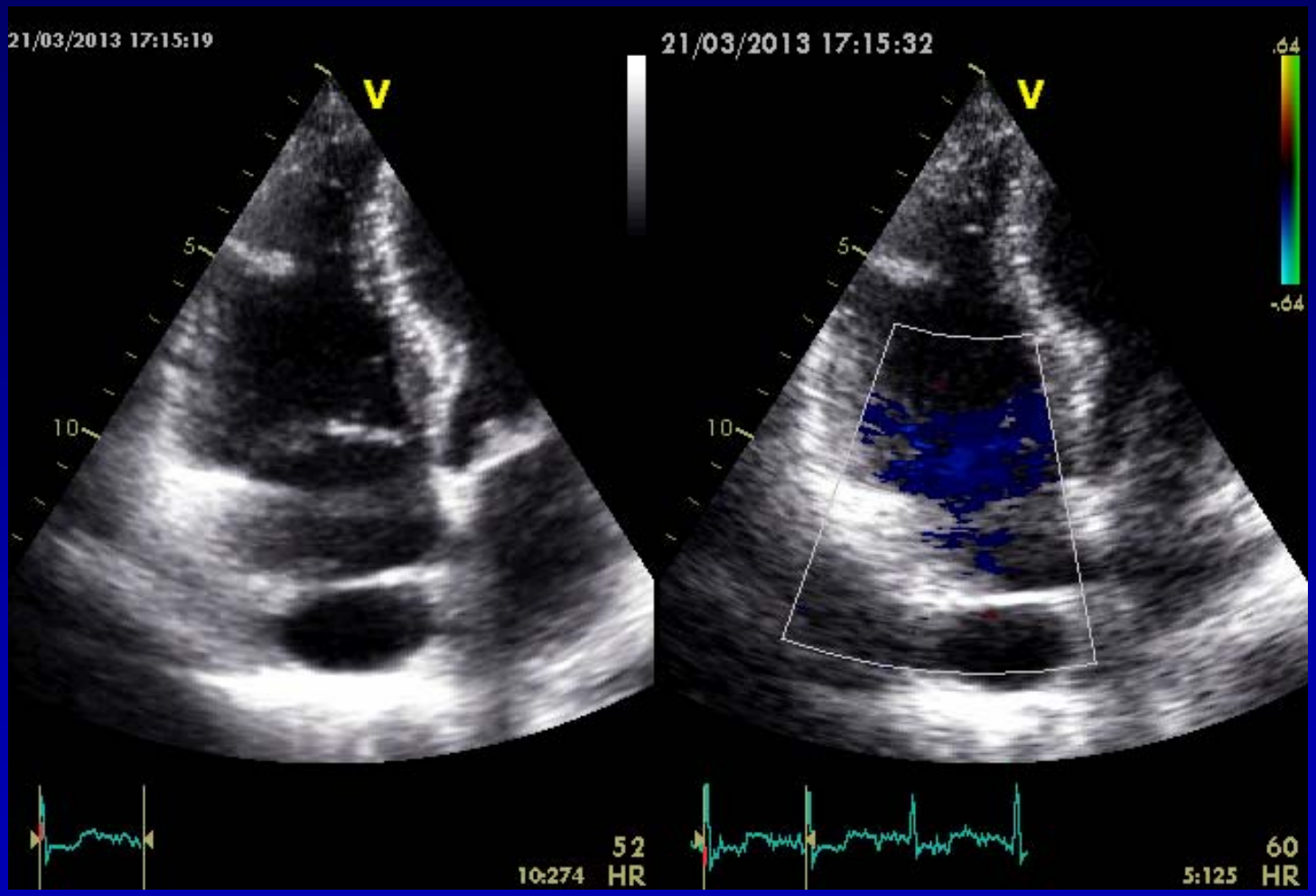
RV Inflow view

Imaging the TV: Standard Views



apical 4 chamber view

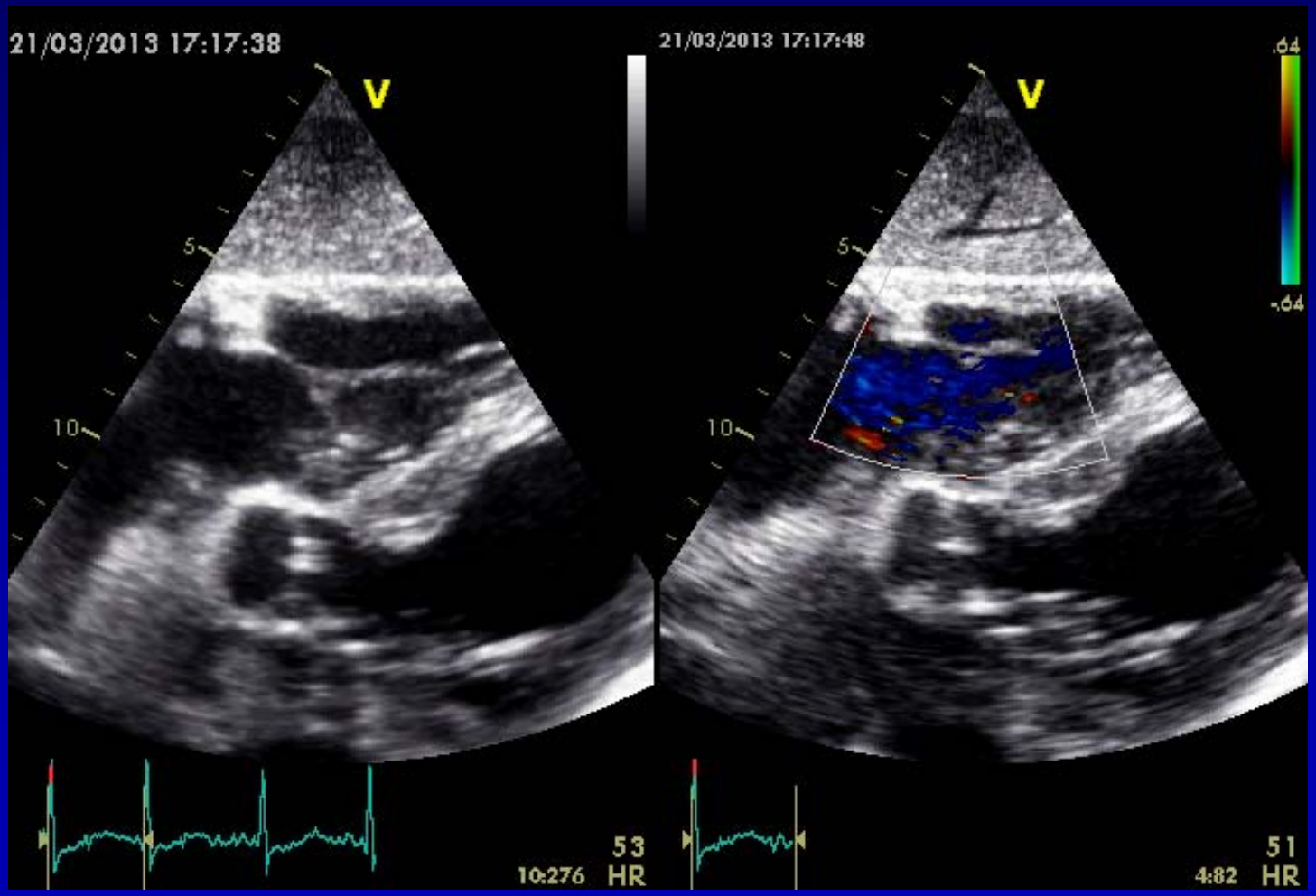
Imaging the TV: Standard Views



apical 4 chamber view

RV only

Imaging the TV: Standard Views



subcostal 4 chamber view

Simultaneous Visualization of 3 Leaflets

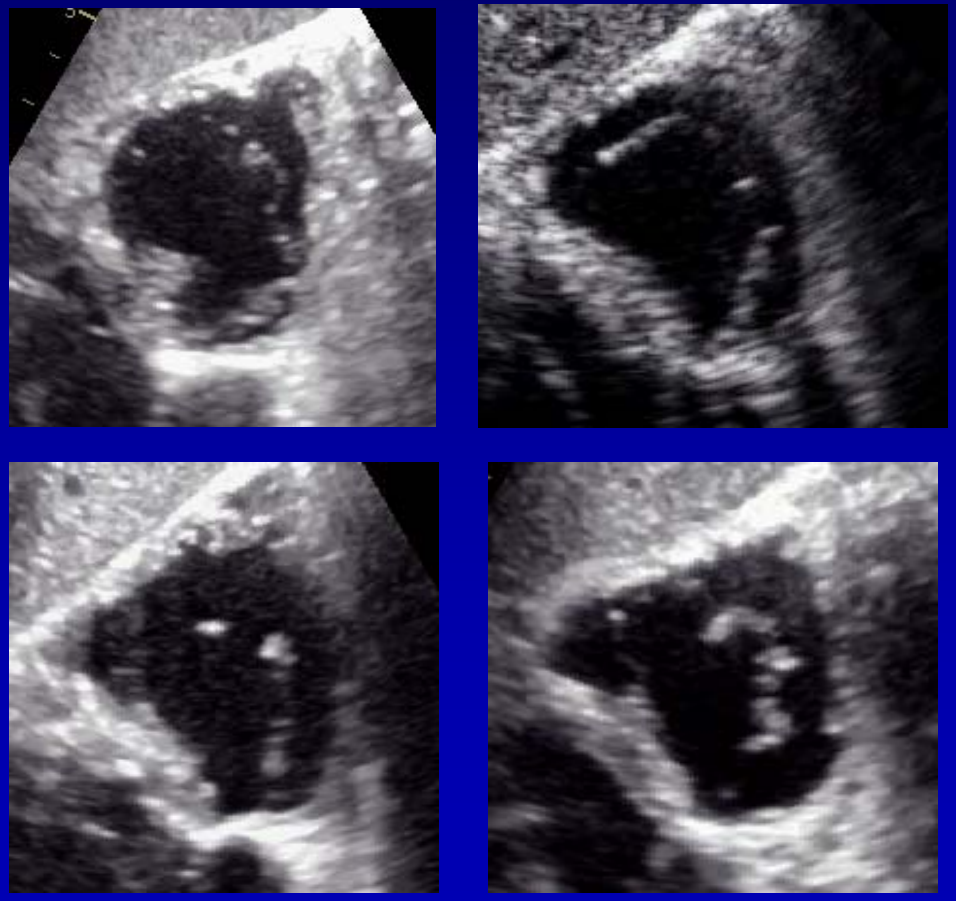
Impossible ?

the anterior, septal and posterior TV cusps were described [2, 3]. Unlike the aortic and mitral valve it is not possible to visualize all TV cusps simultaneously in one cross-sectional view by standard transthoracic two-dimensional echocar-

Anwar et al., Int J Cardiovasc Imaging 2007

Simultaneous Visualization of 3 Leaflets

equally good with 2D and 3D



study:

155 consecutive patients from clinical routine

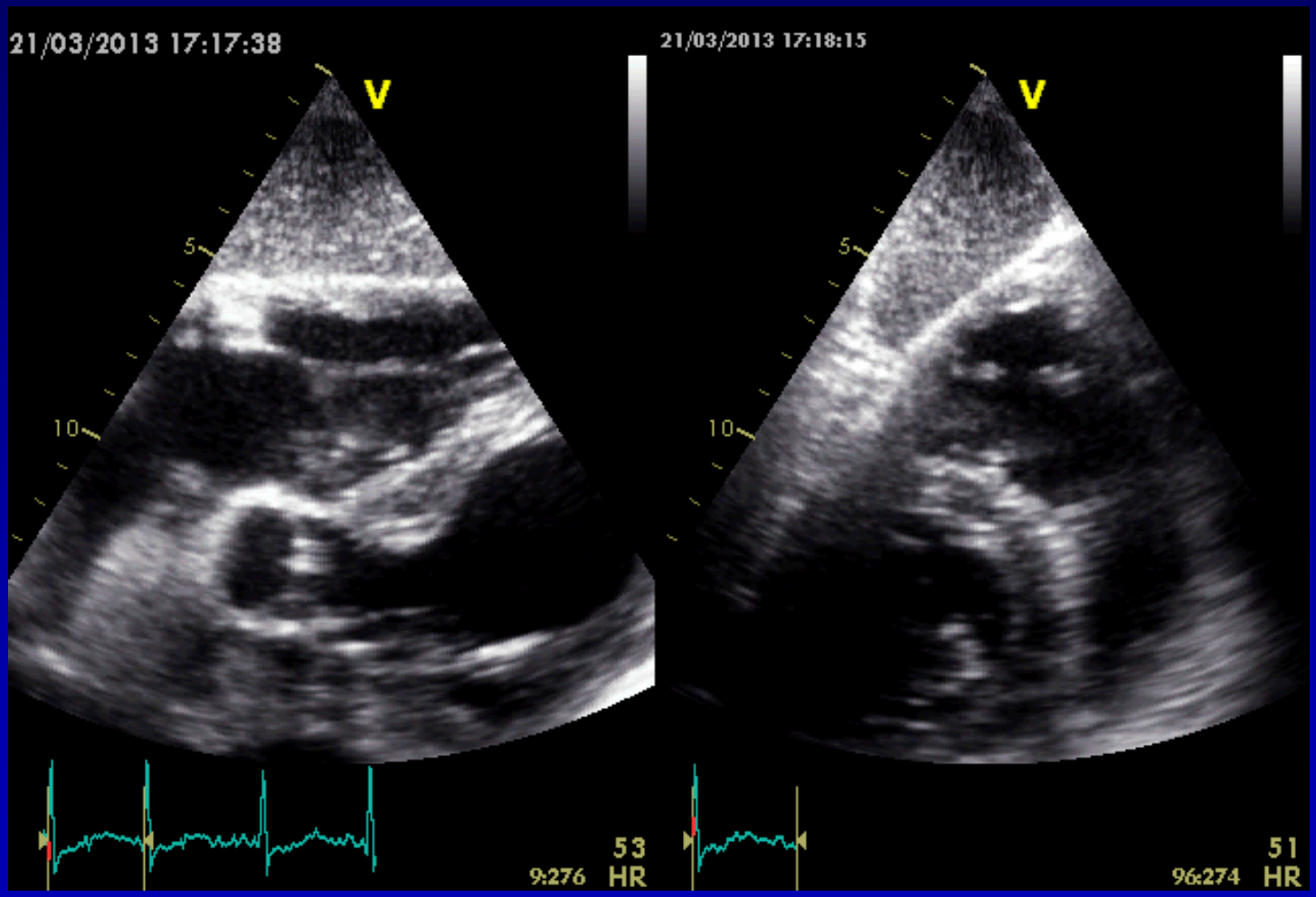
all 3 leaflets visible:

58% **with 2D subcostal view**

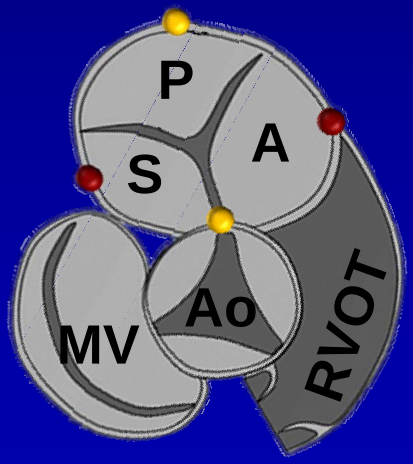
56% **with 3D reconstruction**

Stankovic et al., submitted

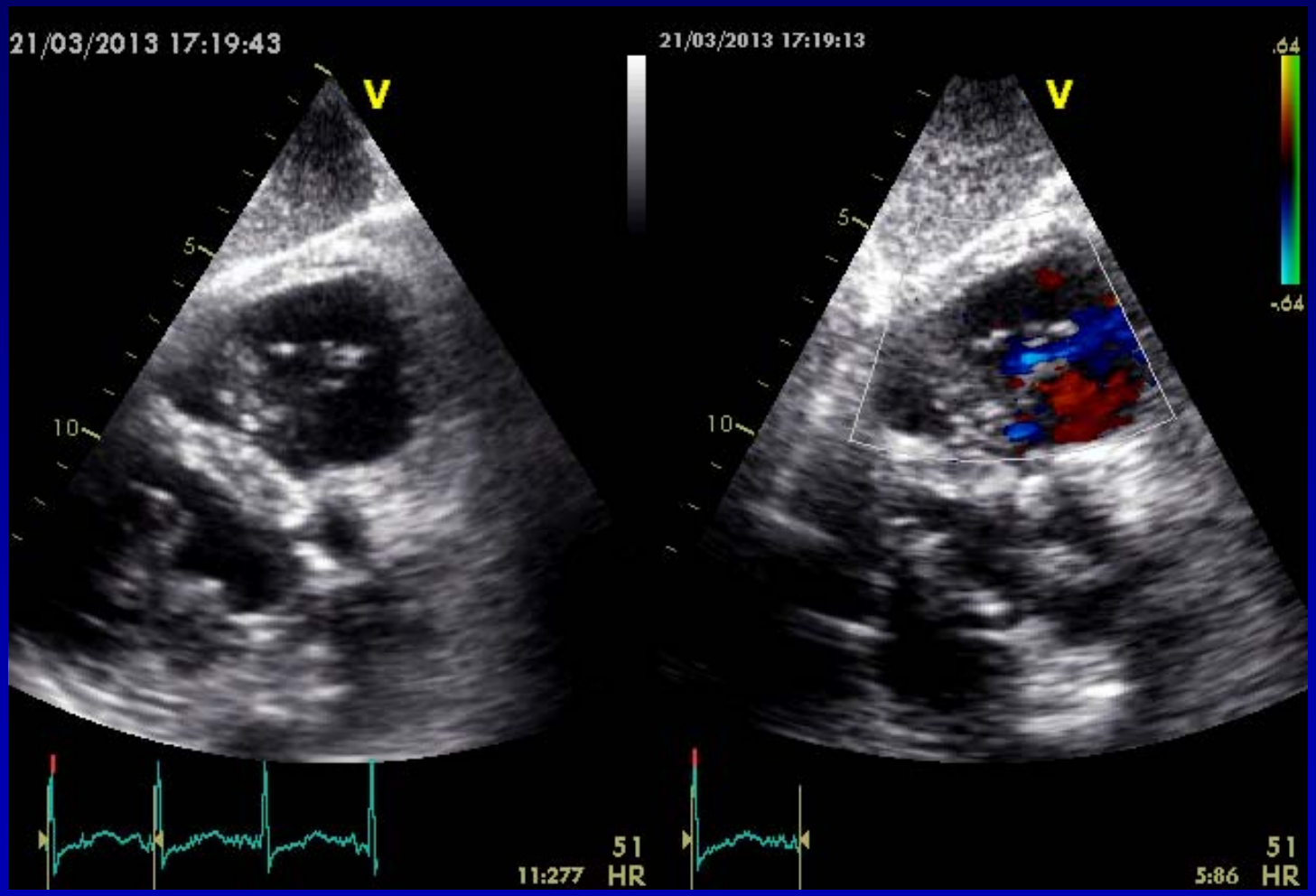
Imaging the TV: Standard Views



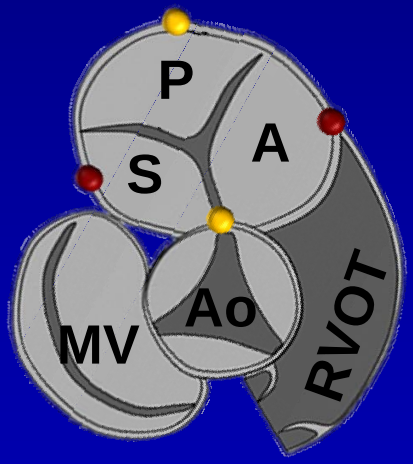
subcostal 4CV und SAX



Imaging the TV: Standard Views



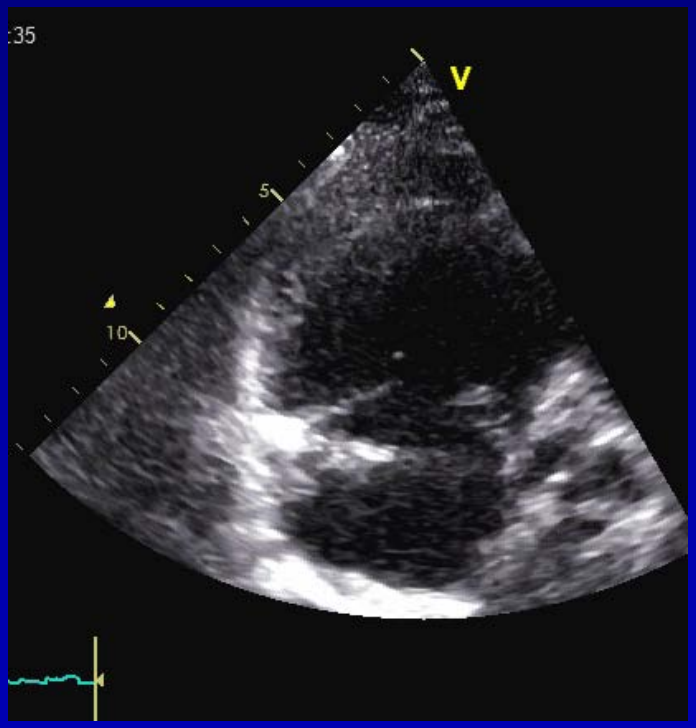
subcostal SAX



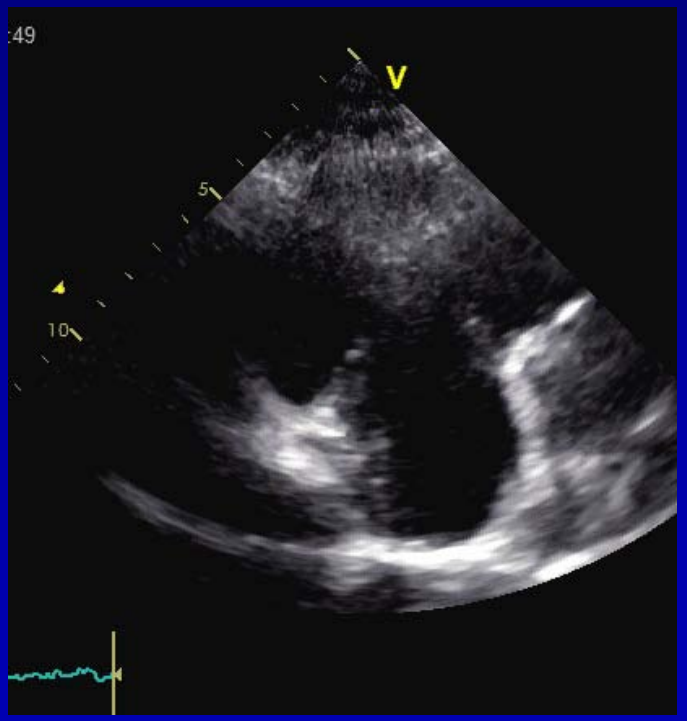
Leaflet Identification

relevant to describe pathology

prolaps not visible



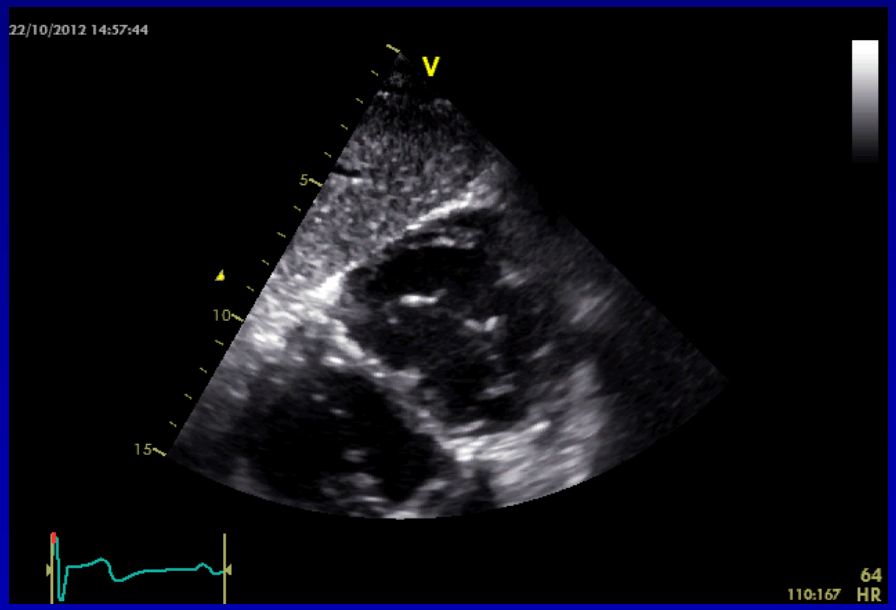
prolaps visible



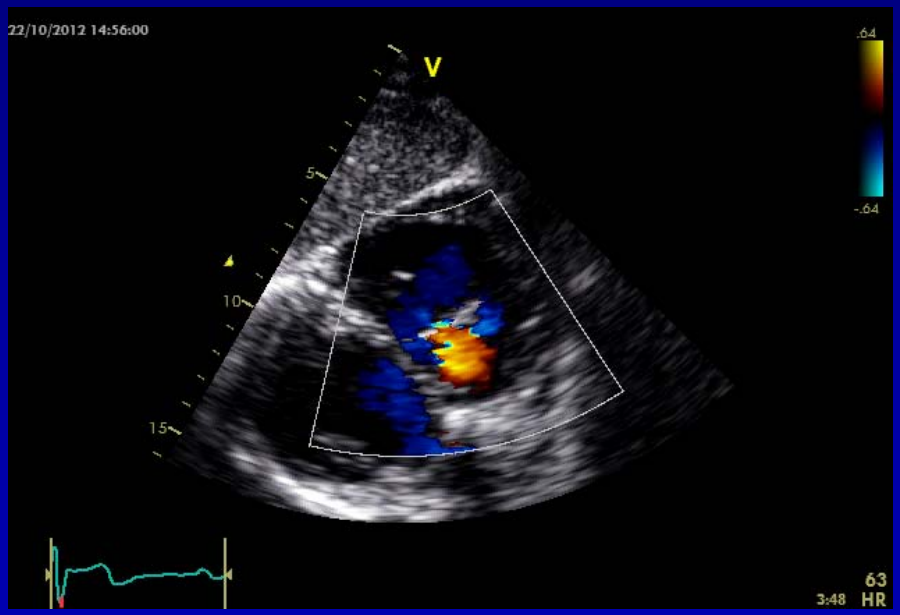
Leaflet Identification

... using the subcostal view

leaflet identification



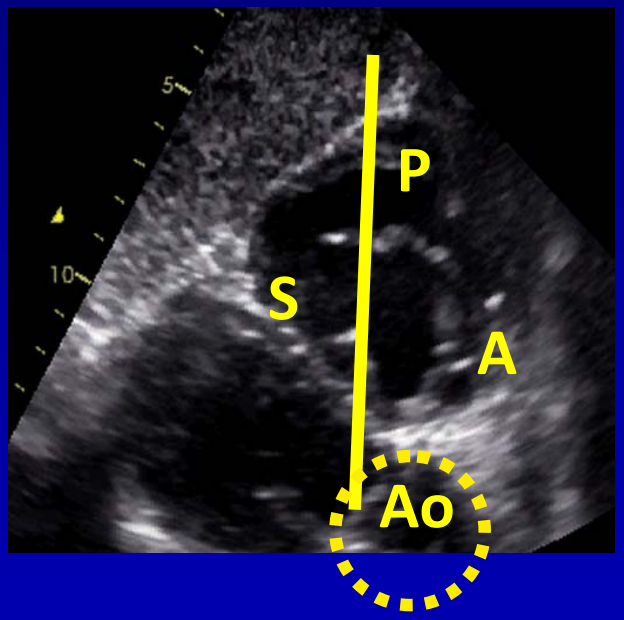
regurgitation assessment



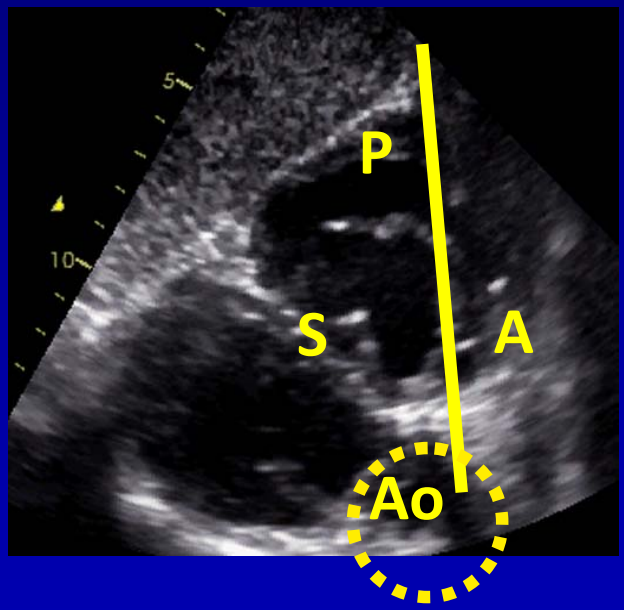
Leaflet Identification

... using the subcostal view

prolaps not visible

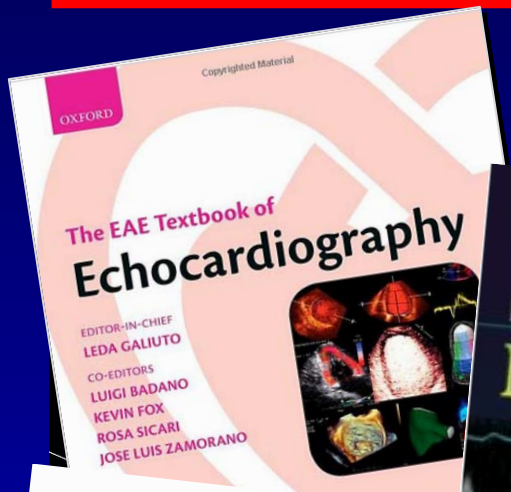


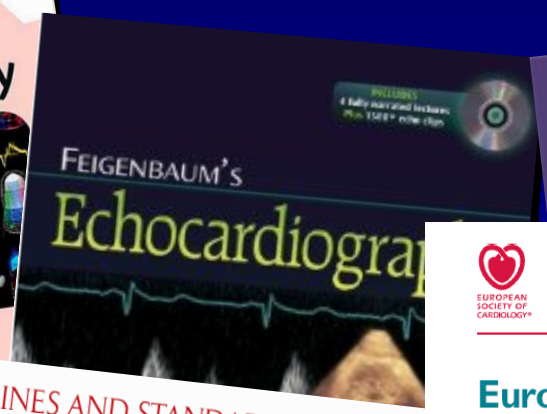
prolaps visible

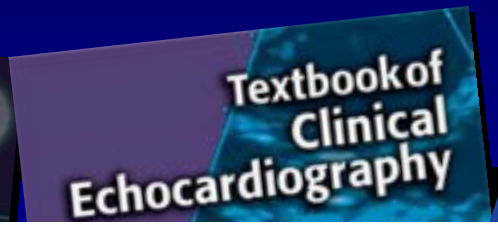


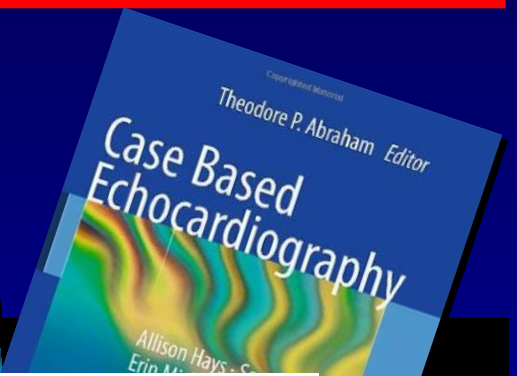
Imaging the TV

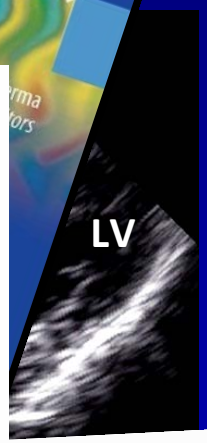
Which leaflet is which ?











GUIDELINES AND STANDARDS

Guidelines for the Echocardiographic Assessme
the Right Heart in Adults: A Report from the Ame
Society of Echocardiography
Endorsed by the European Association of Echocardiography, a
branch of the European Society of Cardiology, and the Canadiar
Echocardiography

Lawrence G. Rudski, MD, FASE, Chair, Wyman W. Lai, MD, MPH, FASE, Jonathan Afilalo, MD, Msc, Lanqi Hua, RDCS, FASE, Mark D. Handschumacher, BSc, Krishnaswamy Chandrasekaran, MD, FASE, Scott D. Solomon, MD, Eric K. Louie, MD, and Nelson B. Schiller, MD, *Montreal, Quebec, Canada; New York, New York; Boston, Massachusetts; Phoenix, Arizona; London, United Kingdom; San Francisco, California*

(J Am Soc Echocardiogr 2010;23:685-713.)

European Journal of Echocardiography (2010) **11**, 307–332
doi:10.1093/ejechocard/jeq031

RECOMMENDATIONS

European Association of Echocardiography recommendations for the assessment of valvular regurgitation. Part 2: mitral and tricuspid regurgitation (native valve disease)

Patrizio Lancellotti (Chair)[1]*, Luis Moura[2], Luc A. Pierard[1], Eustachio Agricola[3]
Bogdan A. Popescu[4], Christophe Tri
Luigi Badano[8], a
Echocardiography

Document Revie

Int J Cardiovasc Imaging (2007) 23:717–724
DOI 10.1007/s10554-007-9210-3

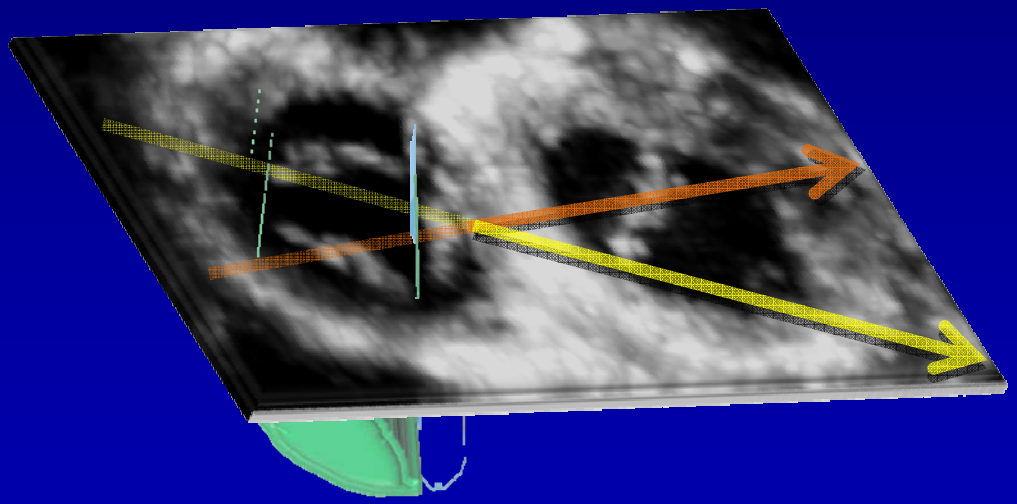
ORIGINAL PAPER

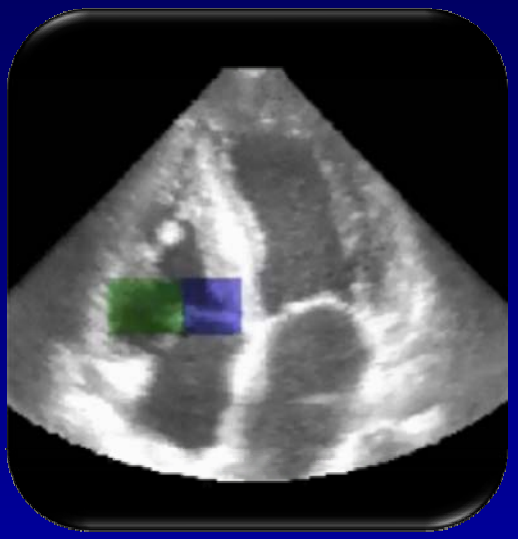
Assessment of normal tricuspid valve anatomy in adults by real-time three-dimensional echocardiography

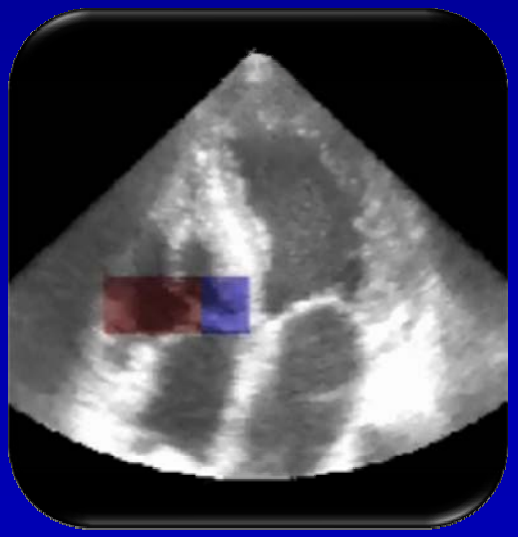
Ashraf M. Anwar · Marcel L. Geleijnse · Osama I. I. Soliman · Jackie S. McGhie · René Frowijn · Attila Nemes · Annemien E. van den Bosch · Tjebbe W. Galema · Folkert J. ten Cate

Leaflet Identification

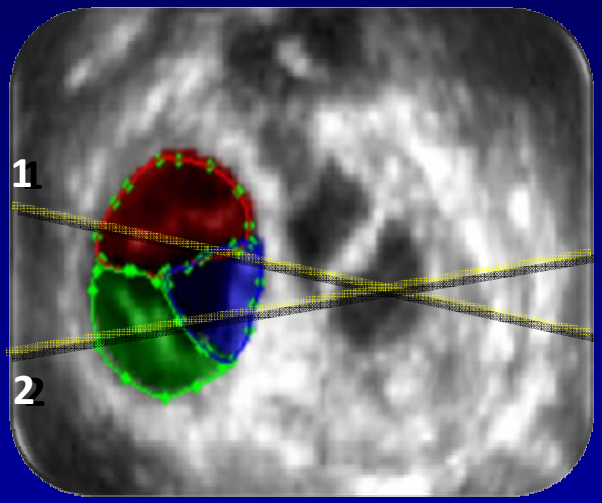
... using
dedicated software

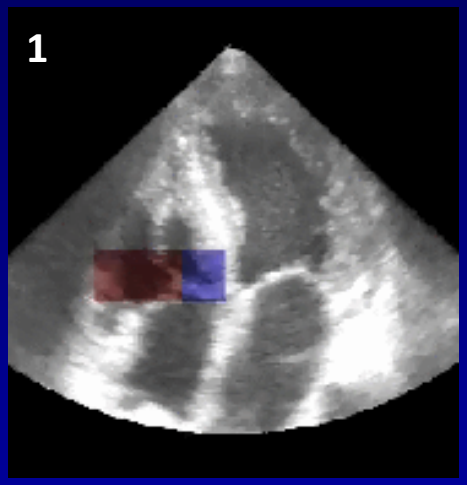


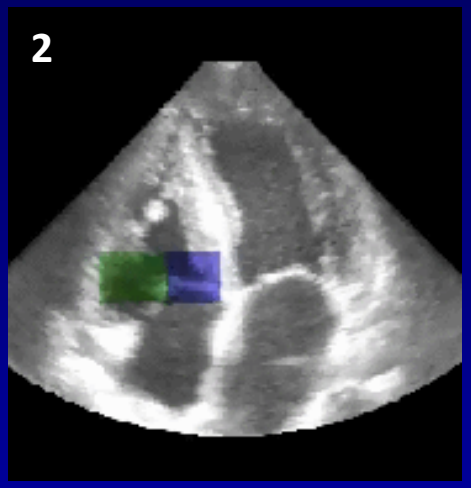


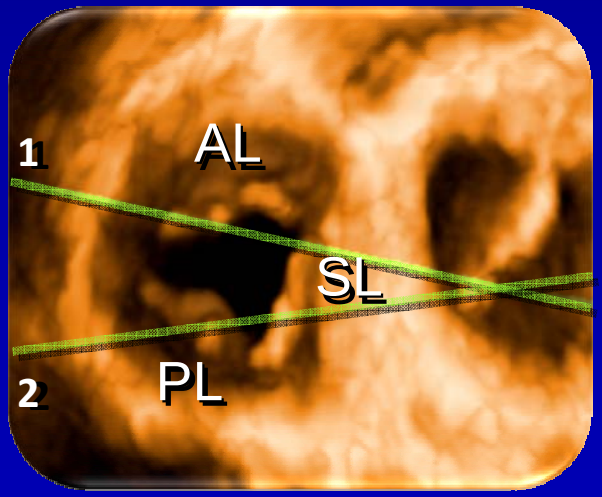


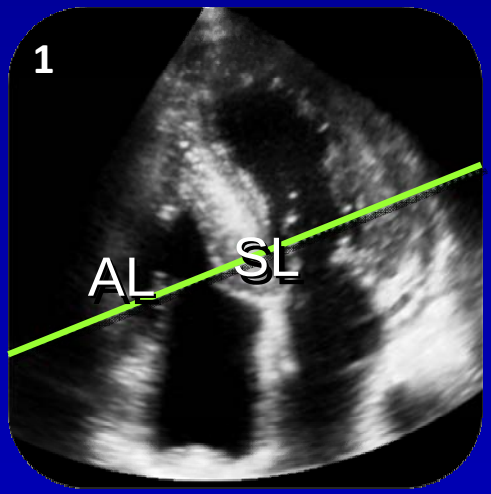
Apical 4 Chamber View

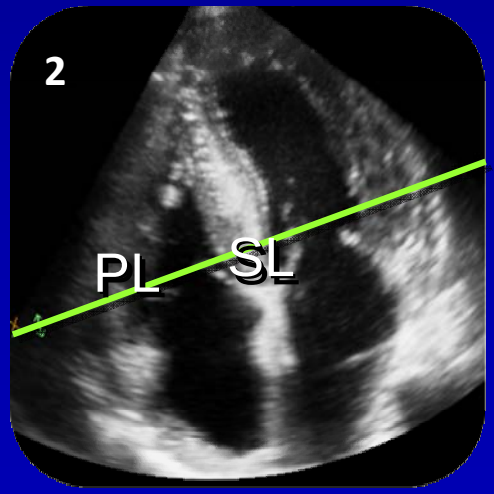






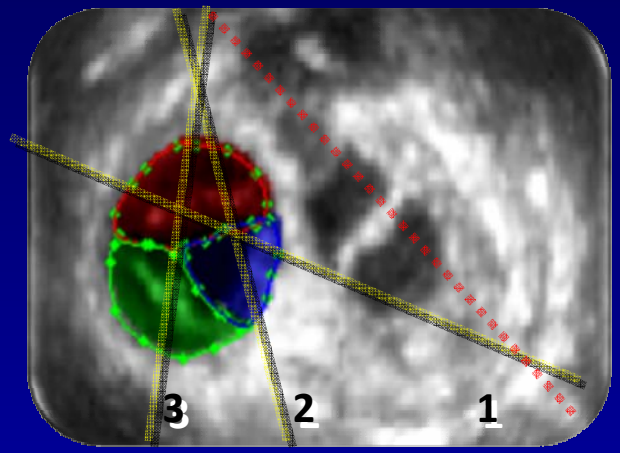


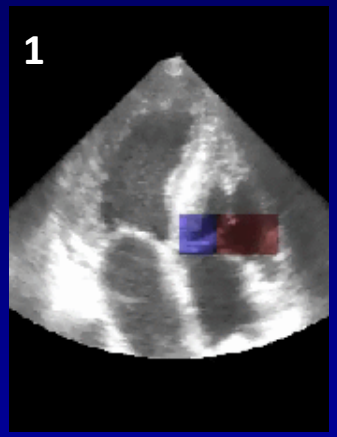


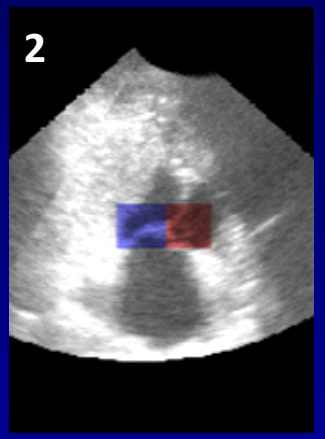


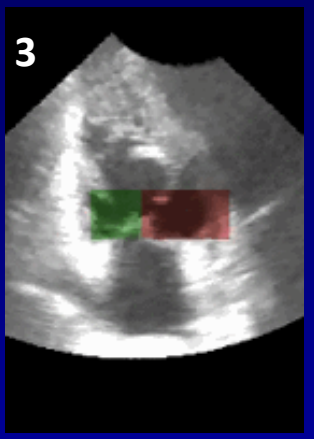
81%

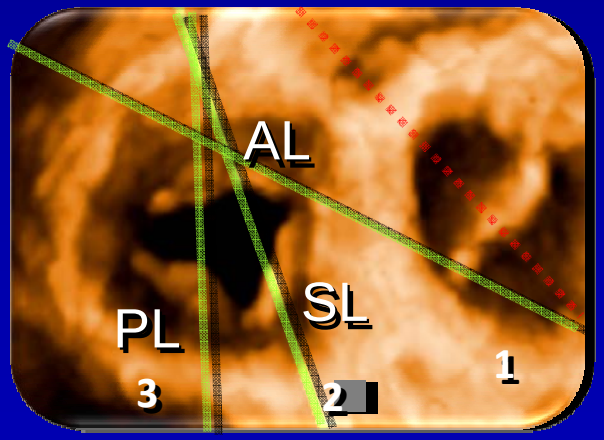
RV Inflow View

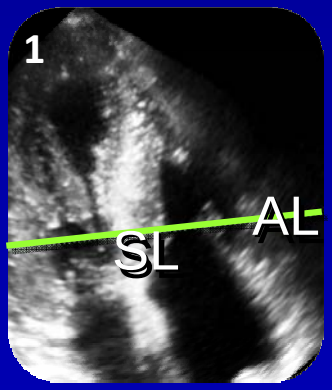


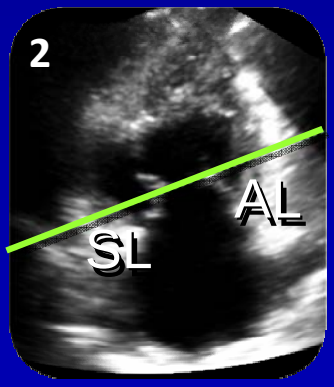


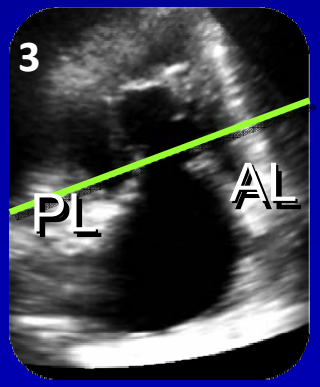








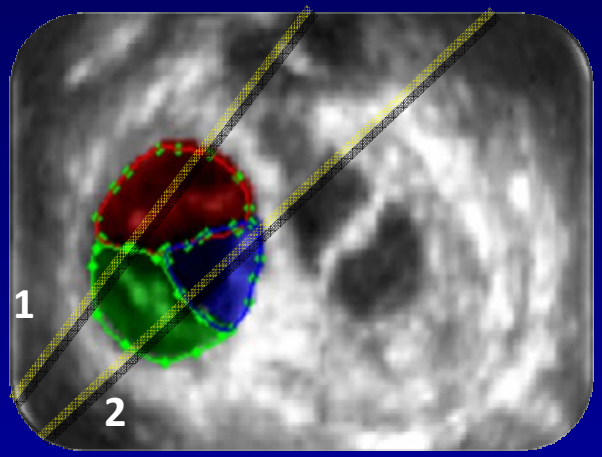


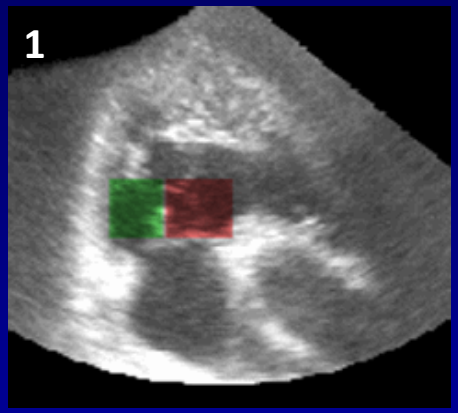


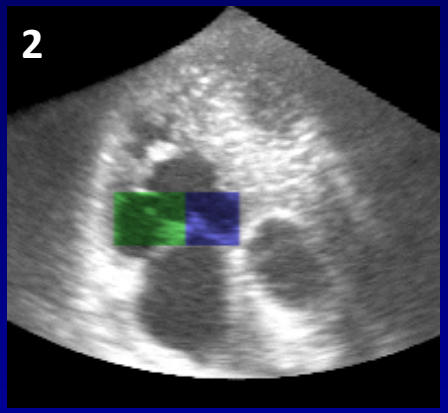
100%

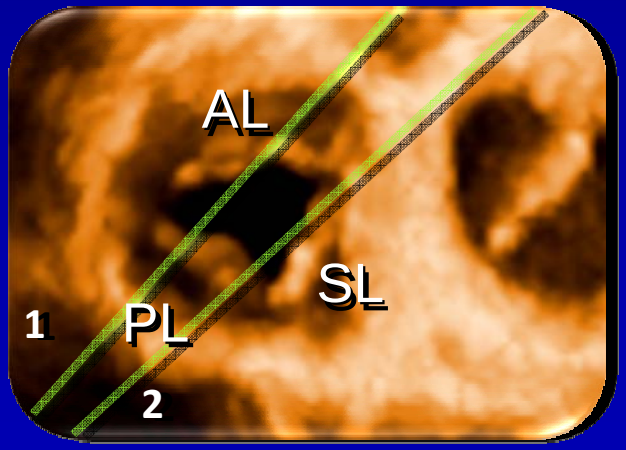
77%

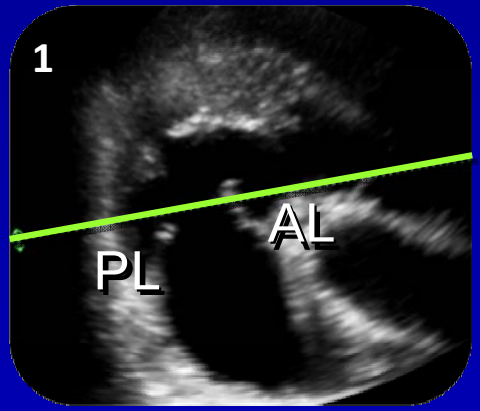
Parasternal Short Axis View

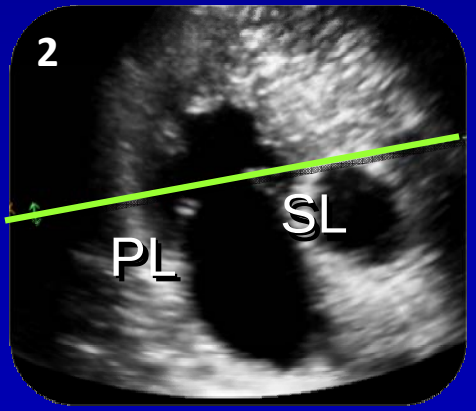










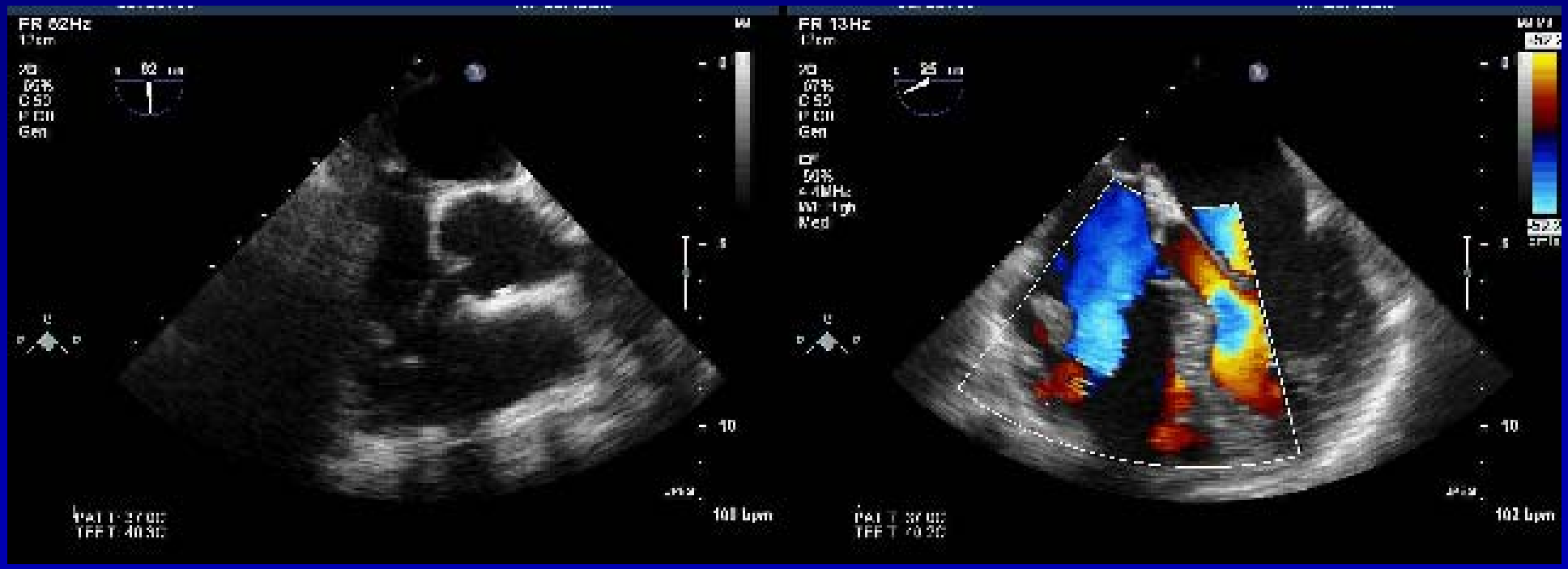


62%

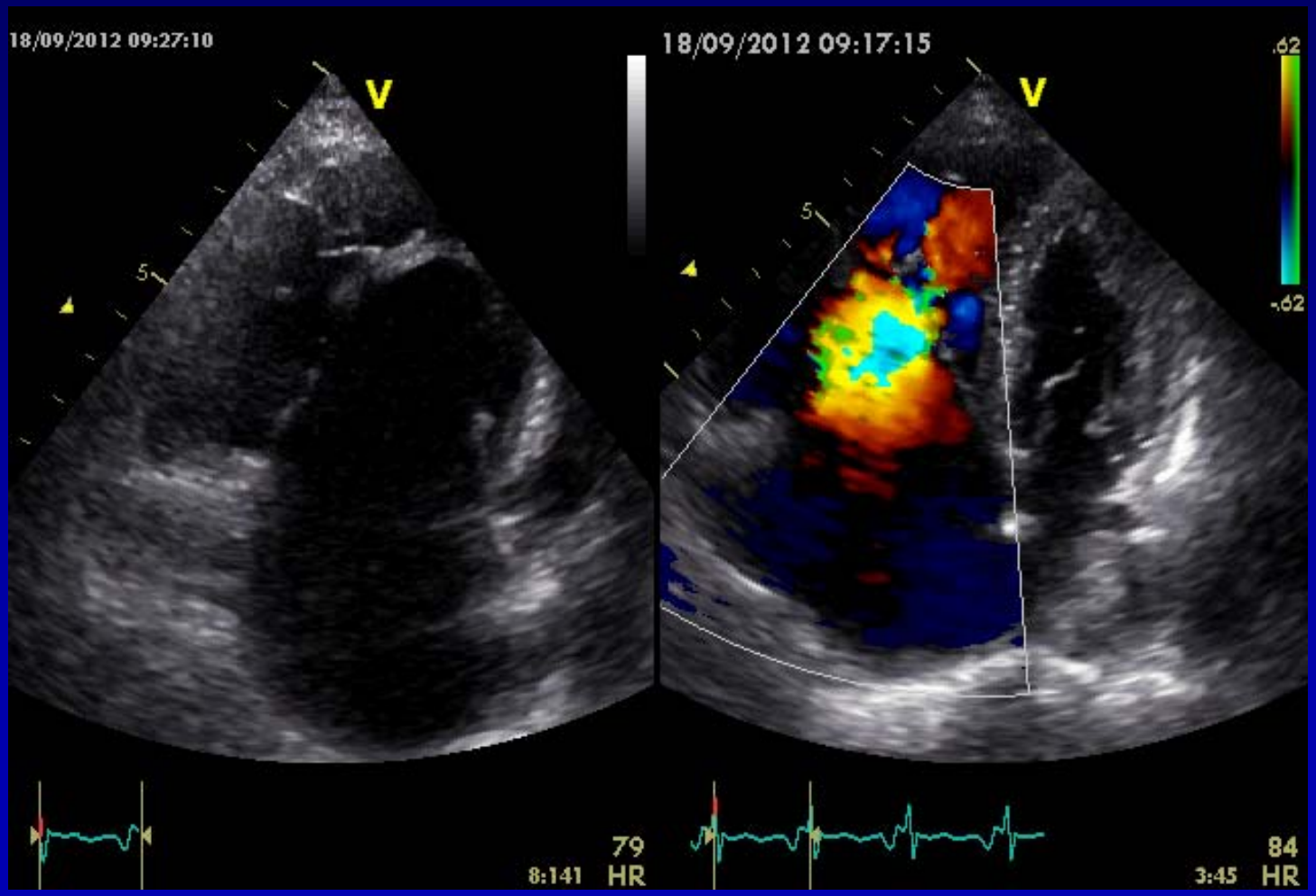
Assessing Tricuspid Valve Pathology

Primary Tricuspid Regurgitation

pacemaker lead endocarditis

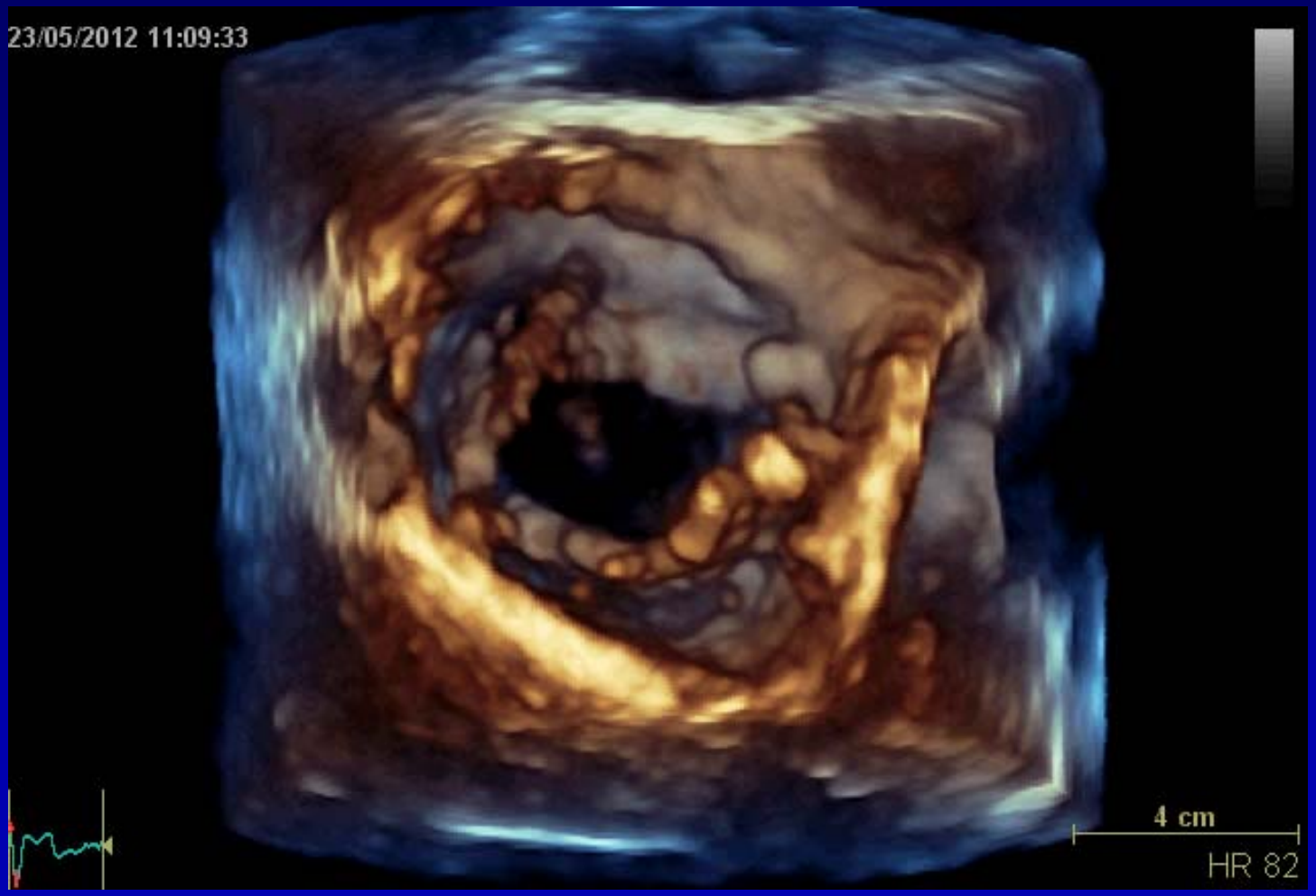


Primary Tricuspid Regurgitation



carcinoid

Primary Tricuspid Regurgitation

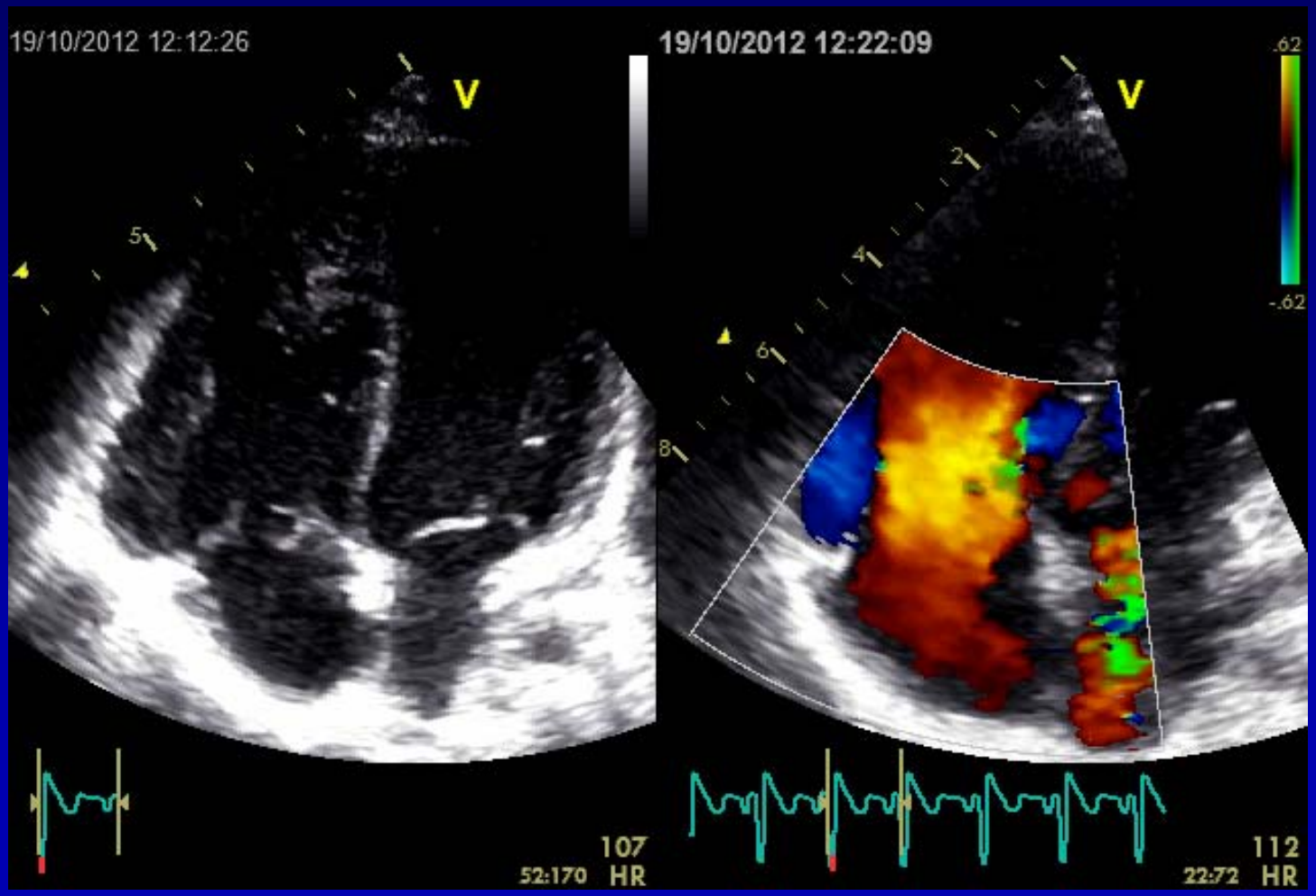


trauma

cordarupture and flail after chest trauma in childhood

image courtesy of: D. Muraru, Padua

Primary Tricuspid Regurgitation



iatrogen

anterior flail after pulmonary valve stenting

Tricuspid Valve Regurgitation

secondary (functional) TR is frequent

mechanisms:

annulus dilatation

- **RV dilatation**
- **RA dilatation**

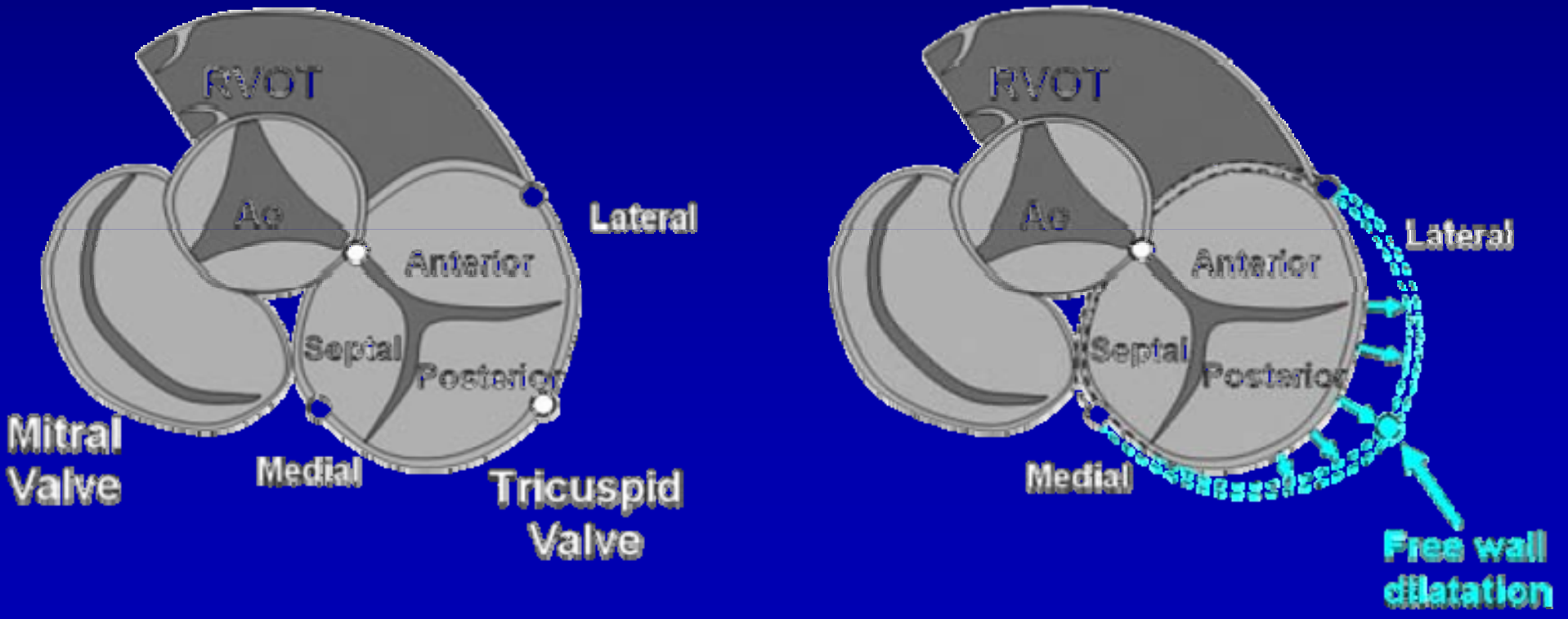
tethering / tenting

- **RV dilatation**
- **papillary muscle displacement**

Functional Tricuspid Regurgitation

TV annulus dilatation

normal **dilated**



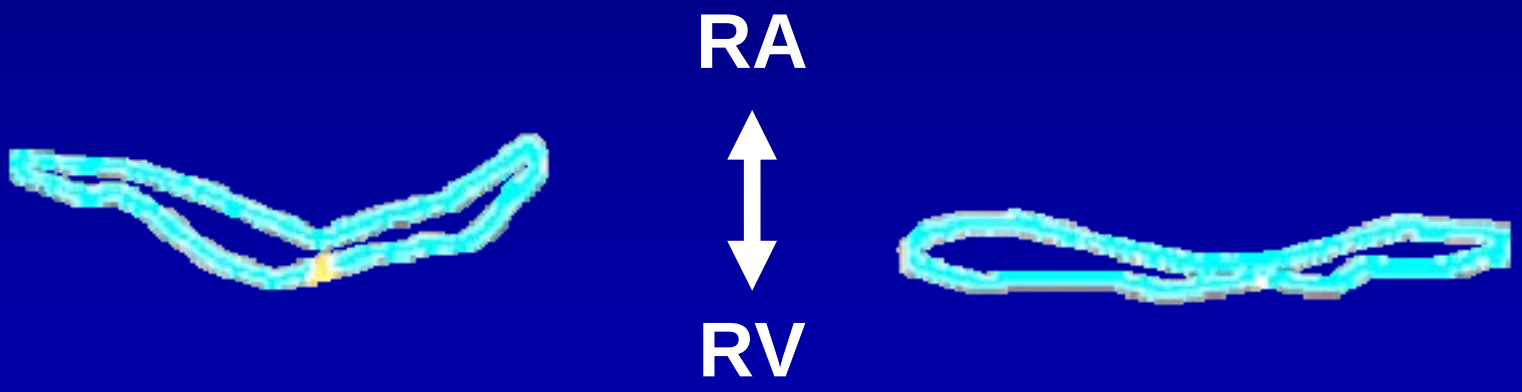
Ton-Nu et al., Circulation 2006

Functional Tricuspid Regurgitation

TV annulus flattening

normal

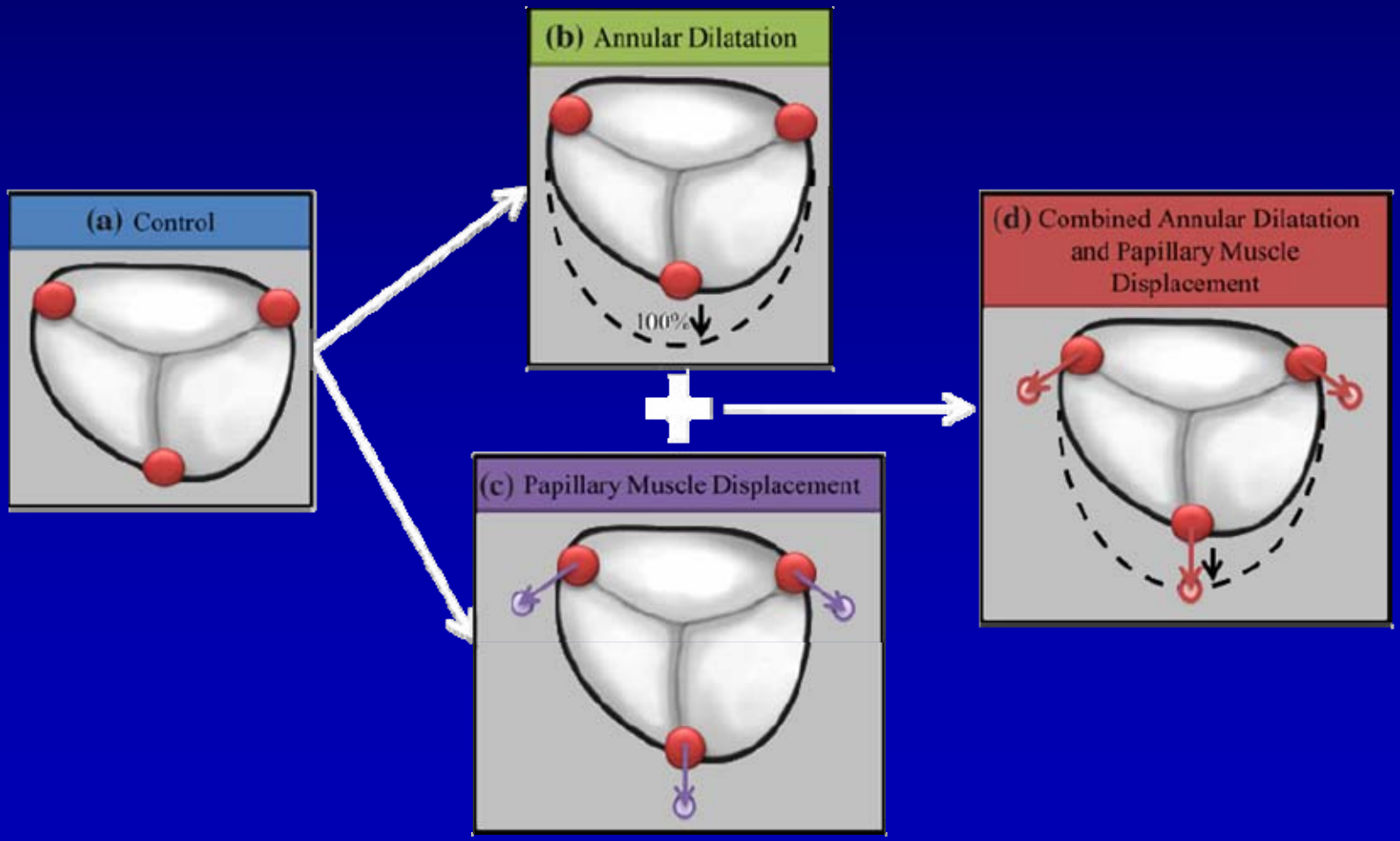
dilated



Ton-Nu et al., Circulation 2006

Functional Tricuspid Regurgitation

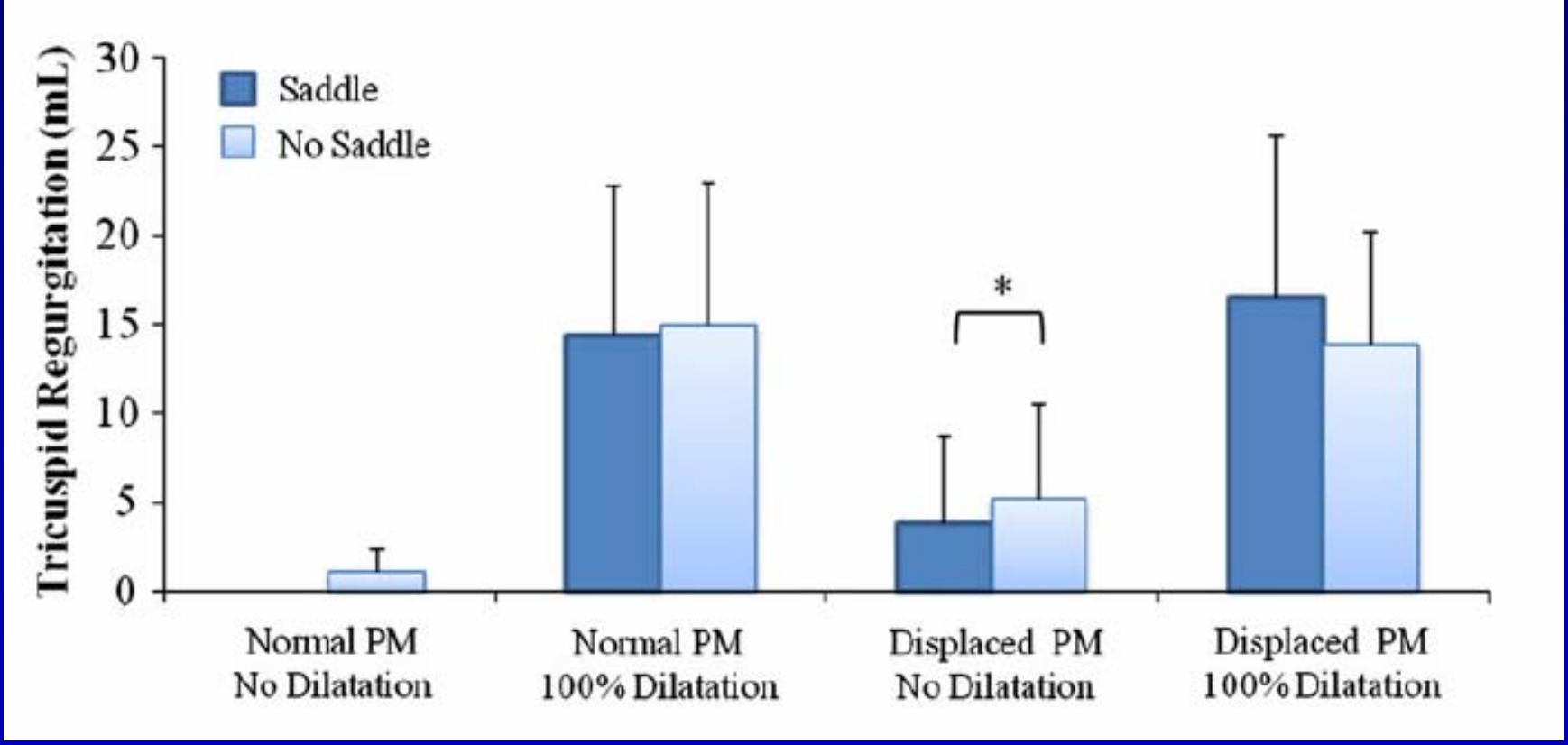
annulus dilatation + papillary muscle displacement



Spinner et al., Ann Biomed Engineering 2012

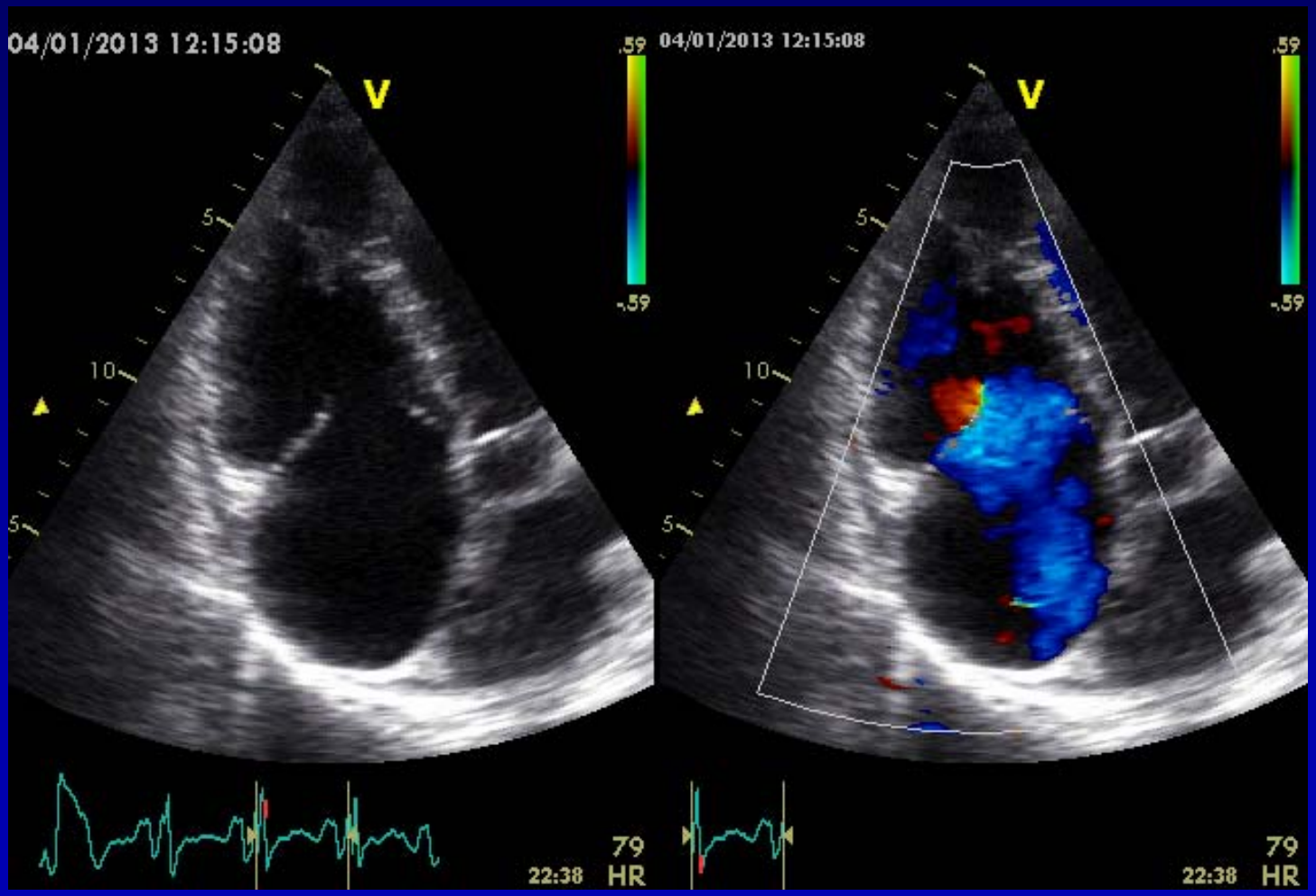
Functional Tricuspid Regurgitation

annulus dilatation + papillary muscle displacement



Spinner et al., Ann Biomed Engineering 2012

Functional Tricuspid Regurgitation



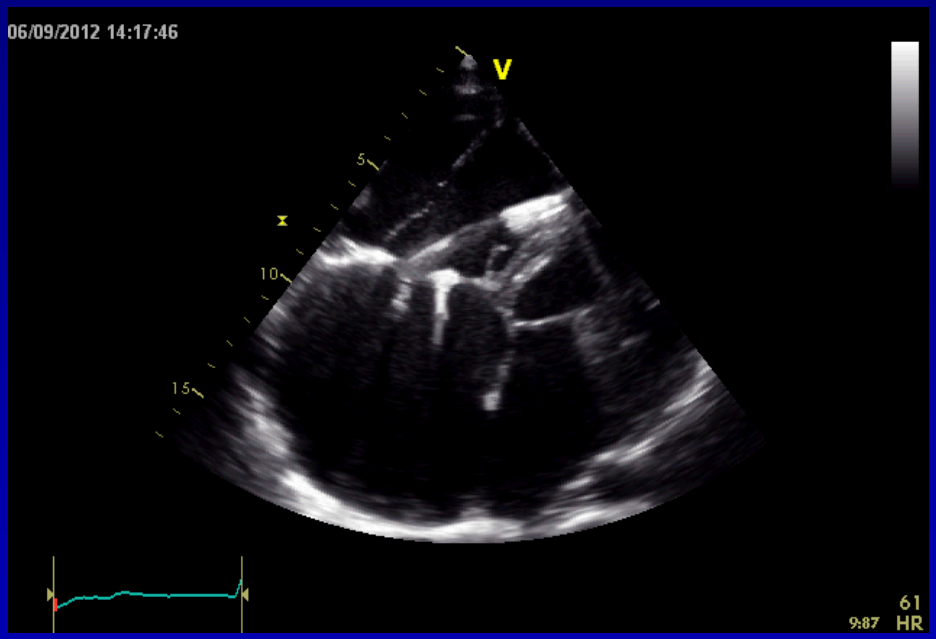
tethering (tenting)

+

annulus dilatation

Functional Tricuspid Regurgitation

failed repair: recurrent TR



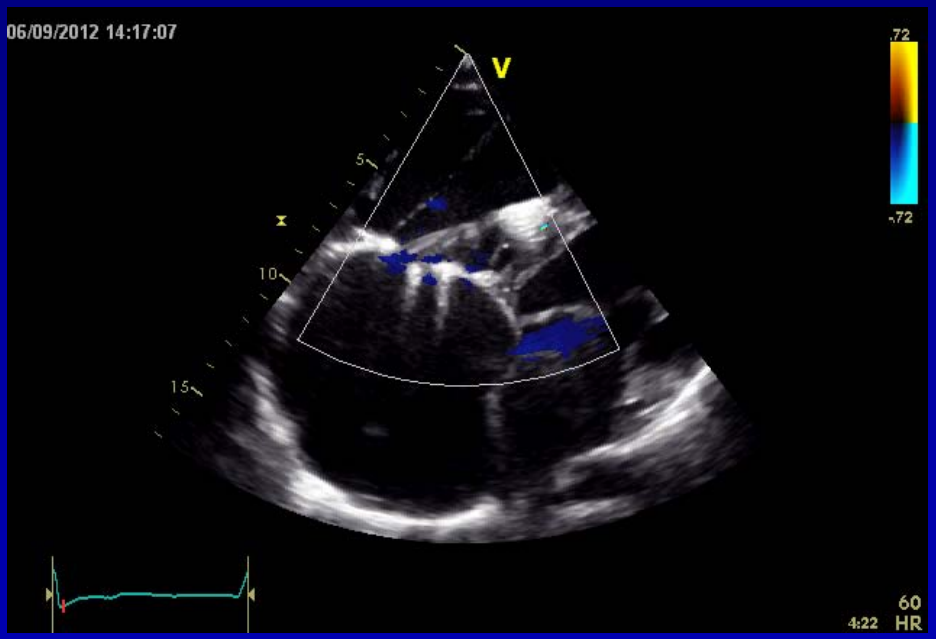


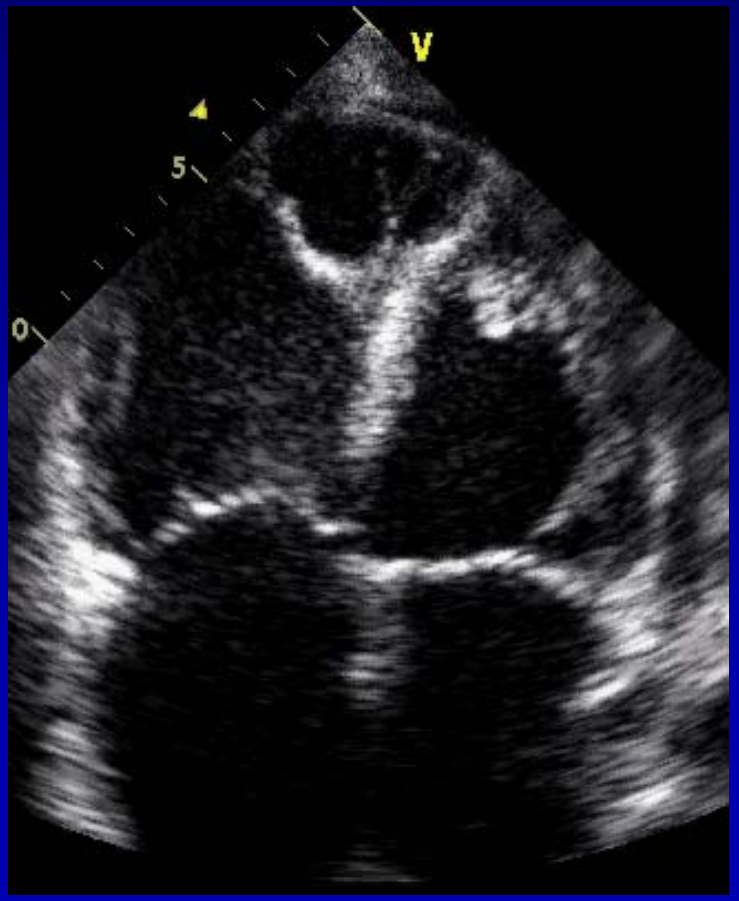
image courtesy of: D. Muraru, Padua

Tricuspid Valve Work-Up

RV Geometry & Function

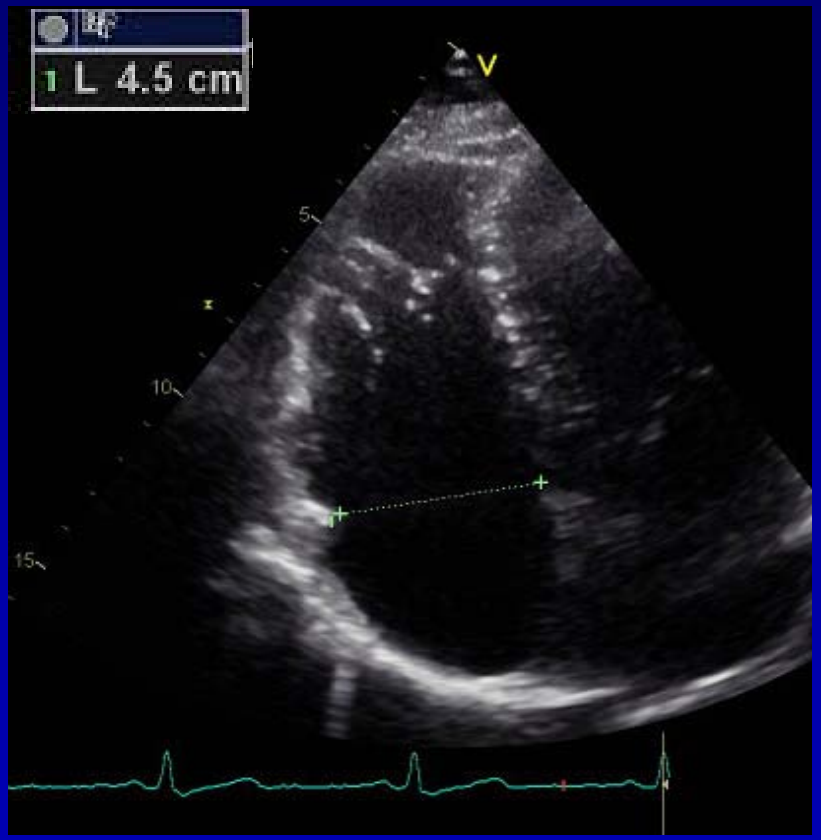
normal

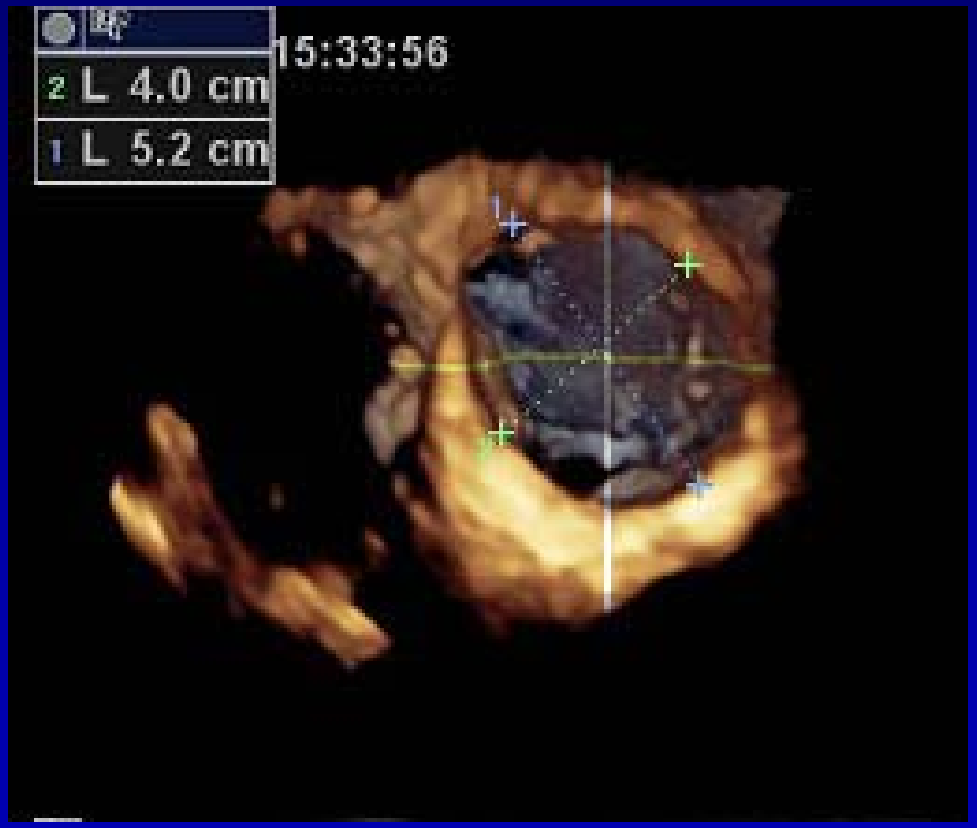
dilated RV + annulus



Annulus Sizing

3D has advantageous



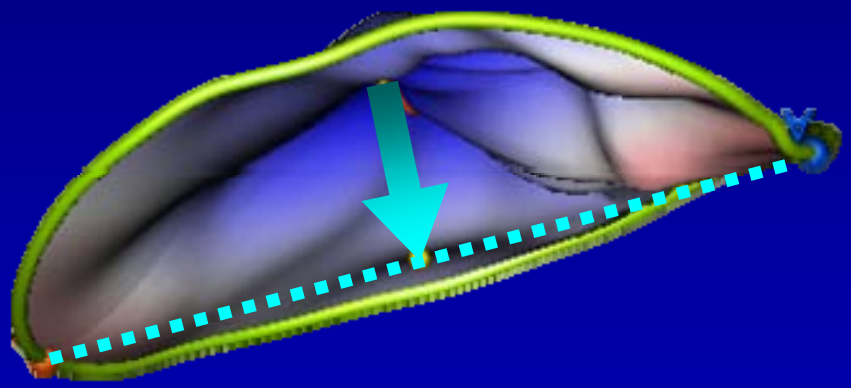


D. Muraru, Padua

Assessing Tenting

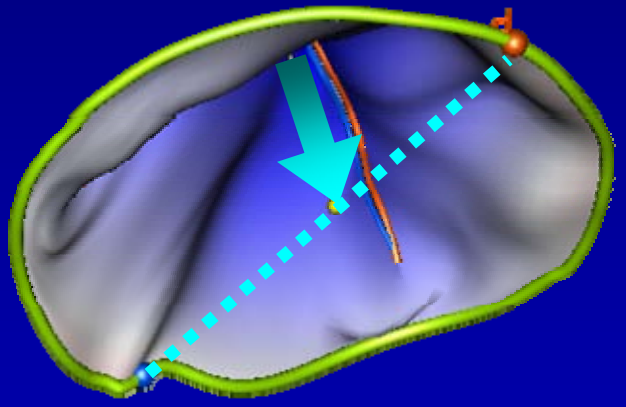
tenting indicates severity of valve dysfunction

mild TR



annulus area = 11.0 cm^2
tenting Height = 3.3 mm

severe TR



annulus area = 11.2 cm^2
tenting height = 8.8 mm

Spinner E et al., Circulation 2011

Morphology Assessment

relevant abnormality of TV

TV annulus diameter	>40mm (21mm/m²)
coaptation height (tenting)	>8mm

relevant abnormality of RV

RVed Area	>20cm²
excentricity Index	>2

relevant RV dysfunction

TAPSE	<15mm
Vpeaksys	<11cm/s

Vahanian, EHJ 2012, ESC Guidelines
Lancellotti, EJE 2010, EACVI Recommendations

Grading TR Severity

qualitative

TR jet signal density (CW)	dens
hepatic veins	syst. flow reversal
systolic inflow	dominat E wave

quantitative

vena contracta width	>7mm
Reg Vol (PISA)	>45ml

Lancellotti, EJE 2010, EACVI Recommendations

Significant Tricuspid Stenosis

qualitative

right atrium	severely enlarged
IVC	dilated

quantitative

mean pressure gradient	>5mmHg
PHT	<190ms
valve area (cont. equation)	< 1cm²

Baumgartner, EJE 2009, EACVI/ASE Recommendations

Summary

Tricuspid valve function is complex and depends on size and function of RV, RA, papillary muscles, leaflets and cordae.

Echocardiography is the method of choice to assess TV function.

Grading of TV dysfunction is difficult due to a lack of reproducible parameters and reliable normal values.

Assessment of TV function must therefore integrate all available (clincal & technical) information.