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

Ebstein Anomaly

position

$L > 8\text{mm/m}^2$
Anatomy & Function

3 leaflets

“anterior” infundibular

“septal” medial

“posterior” inferior, marginal

C. Lawrence
Anatomy & Function

atrial view

C. Lawrence
Anatomy & Function

ventricular view
Anatomy & Function

leaflets
Variable Leaflet Morphology

How many leaflets?

8%  90%  2%

Stankovic, EE 2012
Anatomy & Function

papillary muscles and cordae
Anatomy & Function

papillary muscles and cordae

anterior PM and moderator band

TV
Anatomy & Function

interlinked with MV

annulus

saddle shaped

Fukuda et al., Circ 2006
Tricuspid Valve

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 view
- 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

![Ultrasound Images]

- V
- AoMV
- RVOT
- MV
- Ao
- PV

![Diagram]

- P
- A
- S
- RVOT
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

prolapses not visible

prolapses visible
Imaging the TV

Which leaflet is which?

RV
RA
LA
LV

SAX RV inflow 4CV subcostal
Leaflet Identification

... using dedicated software
Apical 4 Chamber View

81%
Parasternal Short Axis View

62%
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

RA RV

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

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 cm²
tenting Height = 3.3 mm

severe TR

annulus area = 11.2 cm²
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 $>5$mmHg
- PHT $<190$ms
- valve area (cont. equation) $< 1$cm$^2$

Baumgartner, EJE 2009, EACVI/ASE Recommendations
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 (clinical & technical) information.