RV Function
An Echo Update

Jens-Uwe Voigt
Dpt. of Cardiology
University Leuven, Belgium

Right Ventricle

Structure & Function

JU Voigt, University Leuven
RV Anatomy

threepart structure

Fibre Direction

epicardial

endocardial

Ho, Heart 2006
RV Function

longitudinal vs. circumferential function

under normal conditions:

- pump for a low impedance circulation
  pumps against 1/6 of systemic resistance
  1/6 of LV mass, 3-4mm wall thickness

- EDV / ESV  ca. 150 / 60 ml
- EF  ca. 60%

JU Voigt, University Leuven

Pettersen, JACC 2007
RV Function

Impairment due to:

- Acute / chronic loading
  Reduced function, dilatation, hypertrophy

- Ischemia
  Involved in 40-50% of inferior infarctions

- Interventricular interaction
  LV elevated enddiast. pressures, constriction

Loading the Right Heart

Volume load
(PV regurgitation)

Pressure load
(D-TGA)
Loading the Right Heart

volume load  
(PV regurgitation)

pressure load  
(D-TGA)

Right Ventricular Function

Does it matter?
Does RV Function Matter?

univentricular Heart, Fontan circulation

Study:
377 heart failure patients
NYHA II-IV
mean EF 22%
- right heart cath
- 17±9 months follow up

Ghio, JACC 2001
RV Function Matters!

RV function vs. outcome

Right Ventricular Function

Conventional Indicators of RV function.

JU Voigt, University Leuven

Ghio, JACC 2001
RV Function Assessment

Gold standard: pressure-volume-loops

Load dependence - always relate to load

JU Voigt, University Leuven

Bleeker, Heart 2006

RV Function Assessment

EF as surrogate „gold standard“

by MRI

JU Voigt, University Leuven

Alfakih, J MRI 2003
RV Function Assessment

3D echo

3D echocardiography

RV reconstruction

RV volume curve
RV Function Assessment

"myocardial performance index" (Tei index)

\[ MPI = \frac{a - b}{b} \]

Tei index in RV dysfunction

Pseudonormalized Tei Index

Control Mild RV Infarction Severe RV Infarction

RV Inflow

RV Outflow

Yoshifuku, AJC 2003

JU Voigt, University Leuven

Eidem, JASE 1998
RV Function Assessment

tricuspid anular plane systolic excursion

TAPSE vs. RVEF event free survival

Ghio, AJC 2000

140 pts.
EF < 35%
2 years follow up
TAPSE = RV Function?

changes after pulmonalis TEA

preop 1 week postop

S. Giusca, Heart 2009
Right Ventricular Function

Strain / ~Rate

Strain Rate Imaging

tissue deformation properties

\[ \text{Strain Rate} = \frac{v_1 - v_2}{d} \]

\[ \text{Strain} = \int \text{Strain Rate} \cdot d \, t \]
Strain Rate Imaging

velocity gradient calculation

\[
\text{Strain Rate} = \frac{v_1 - v_2}{d}
\]

- no influence of translation
- really local information

JU Voigt, University Leuven

---

Strain Rate Imaging

speckle tracking based strain

JU Voigt, University Leuven
Describing Muscle Function

**absolute variables**

- $\Delta l$: length change
- $v$: velocity of shortening
- Force

---

Describing Muscle Function

**relative variables**

- $l_0$: initial length
- $l$: length
- Force / cross section
- Velocity of shortening / length
Describing Muscle Function

relative variables

strain [\%]

stress \( \text{N/m}^2, \text{Pa} \)

strain rate \( \text{s}^{-1} \)

Describing Muscle Function

afterloaded contraction

stress

isometric

isotonic

strain

peak strain

strain rate

time

JU Voigt, University Leuven
Describing Muscle Function

afterloaded contraction

stress
strain
strain rate
time

peak strain

Describing Muscle Function

RV Function Assessment

normal

PHT

JU Voigt, University Leuven

Dambrauskaite, J Am Soc Echo 2007
RV Function Assessment

acute afterload increase

baseline pulm. constriction


RV Function Assessment

acute afterload increase

JU Voigt, University Leuven  De Vroomen, Am J Physiol 2000
Preload Decrease after ASD Closure

before 1 month after

JU Voigt, University Leuven

Summary

Right ventricular function is complex and difficult to evaluate.

RV ejection fraction may be estimated by MRI or Echo. Tei index and TAPSE need caution.

Strain rate imaging is a good estimator of regional RV function

Besides invasive gold standards, all parameters are subject to geometry and reflect loading conditions.

JU Voigt, University Leuven
The echocardiographic assessment of the right ventricle: what to do in 2010?

Ruxandra Jurcut\textsuperscript{1,}\textsuperscript{1}, Sorin Giusca\textsuperscript{1,2}, André La Gerche\textsuperscript{2}, Simona Vasile\textsuperscript{1}, Carmen Ginhina\textsuperscript{1}, and Jens-Uwe Voigt\textsuperscript{2}

\textsuperscript{1}Department of Cardiology, University of Medicine and Pharmacy 'Carol Davila', Bucharest, Romania, and \textsuperscript{2}Department of Cardiology, Catholic University Leuven, Leuven, Belgium

Received 17 August 2009; accepted after revision 28 December 2009; online publication date 4 April 2010

JU Voigt, University Leuven

Jurcut, EJE 2010