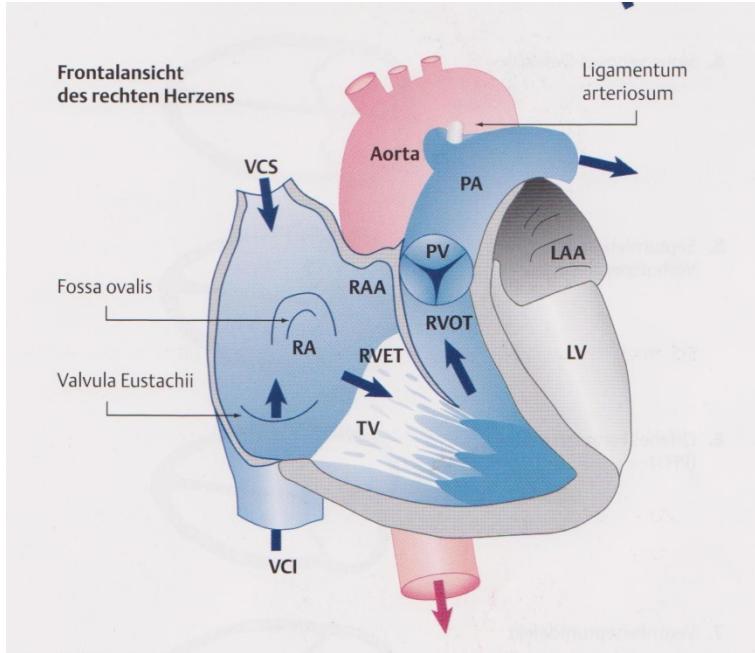


Echokardiographische Beurteilung des rechten Herzens

Anne Winkelmann
07.12.2012

The forgotten chamber



aus: Zeydabadinejad,
Echokardiographie des rechten Herzens, 2006

Funktionelle Bedeutung lange unklar

komplexe Geometrie
inflow/Apex/outflow

starke apikale Trabekularisierung –
Endokarderkennung schwierig

Rotation des RV im Thorax bei
zunehmender Vergrößerung

anteriore Wand oft schlecht erkennbar

GUIDELINES AND STANDARDS

Guidelines for the Echocardiographic Assessment of the Right Heart in Adults: A Report from the American Society of Echocardiography

Endorsed by the European Association of Echocardiography, a registered branch of the European Society of Cardiology, and the Canadian Society of 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.)

Agenda

Morphologie

Standardschnittebenen

2 D

Normalwerte

M-Mode

PA-Druck

systolisch/diastolisch

RVP + ZVD

mean

Flußprofil Pulmonalklappe

Funktion

systolisch

TAPSE

(diastolisch)

FAC

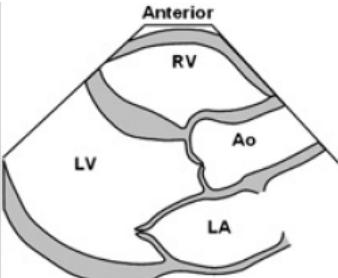
TEI

3 D Volumetrie

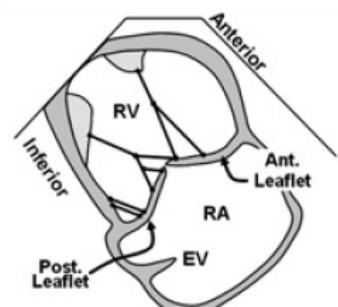
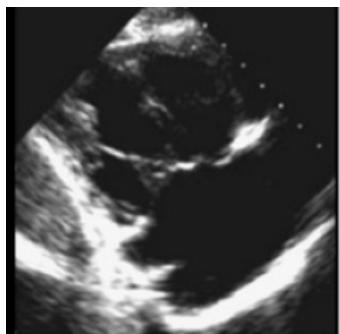
Strain

Morphologie

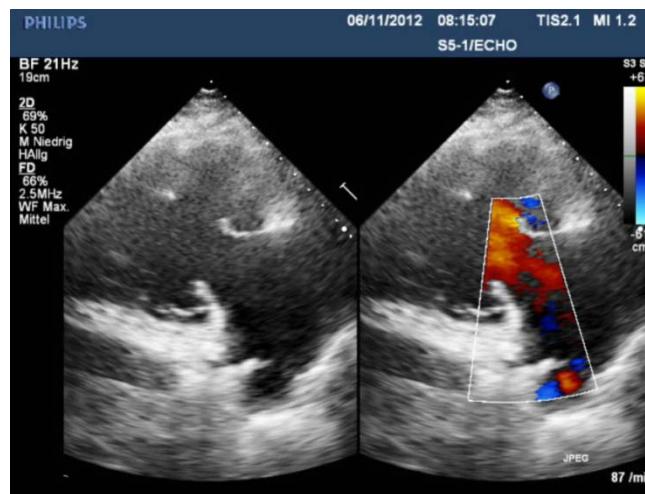
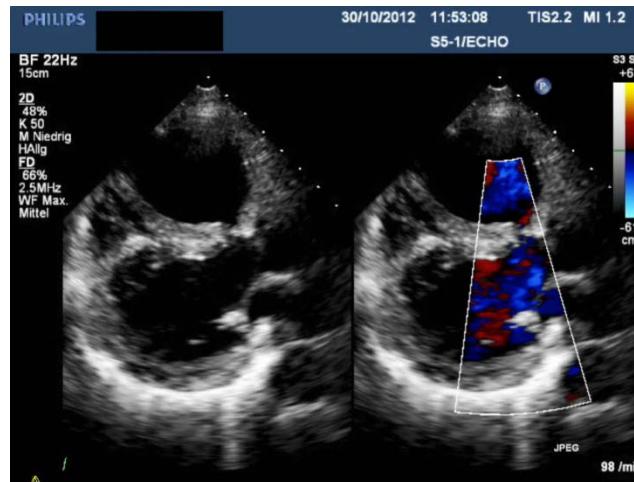
Parasternal lange Achse



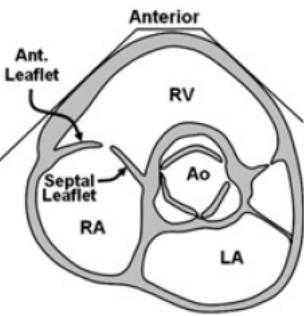
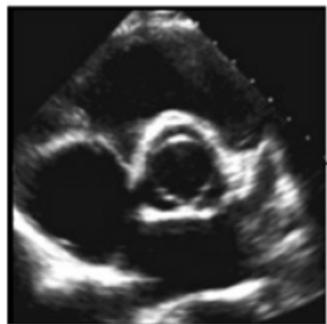
Parasternal long-axis of RV anterior wall



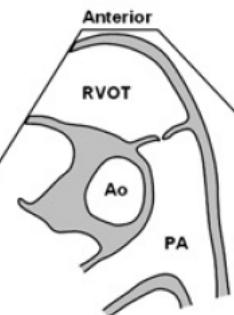
Parasternal long-axis view of RV inflow



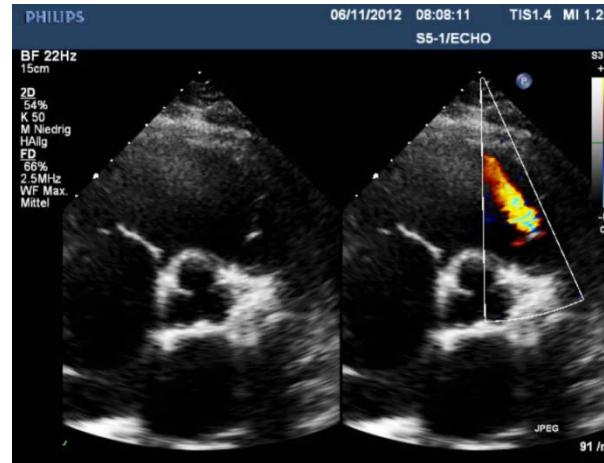
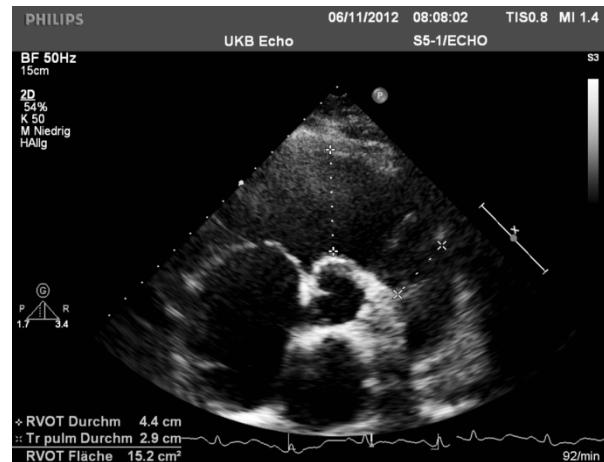
Parasternal kurze Achse



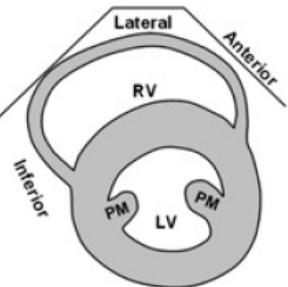
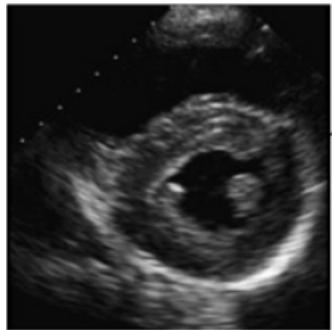
Parasternal short-axis of basal RV



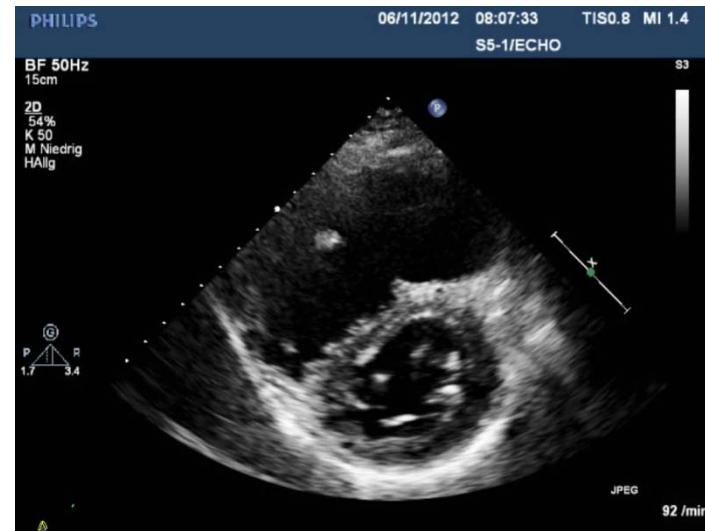
Parasternal short-axis of bifurcation of the PA



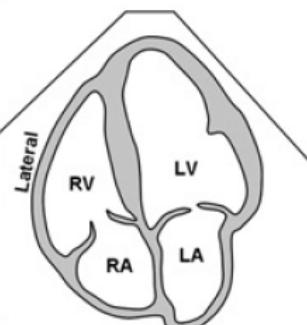
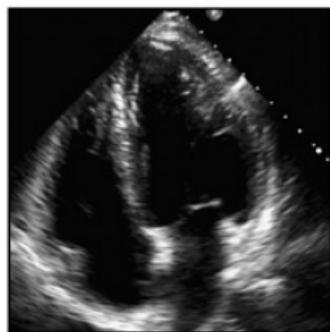
Parasternal kurze Achse



Parasternal RV short-axis at papillary muscle (PM) level



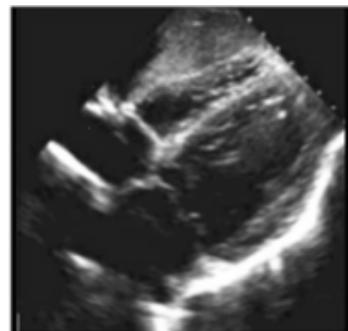
Apikaler 4 Kammerblick



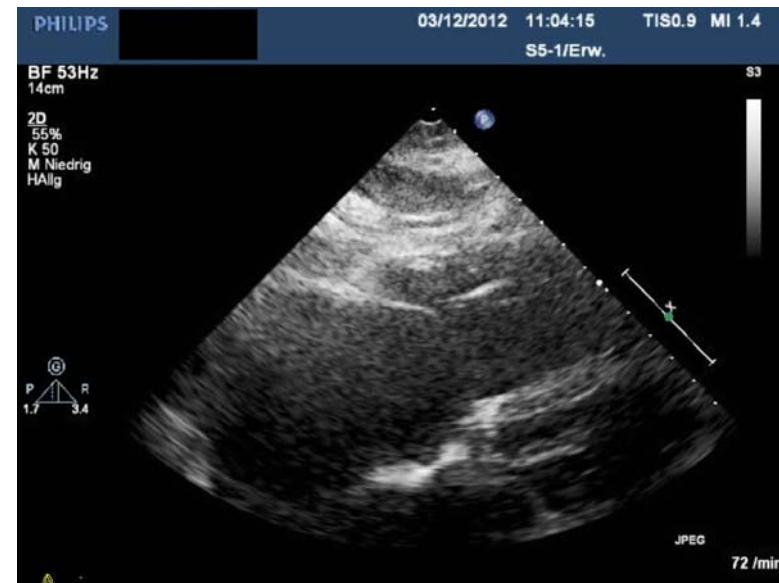
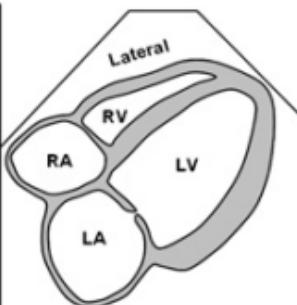
Apical 4-chamber



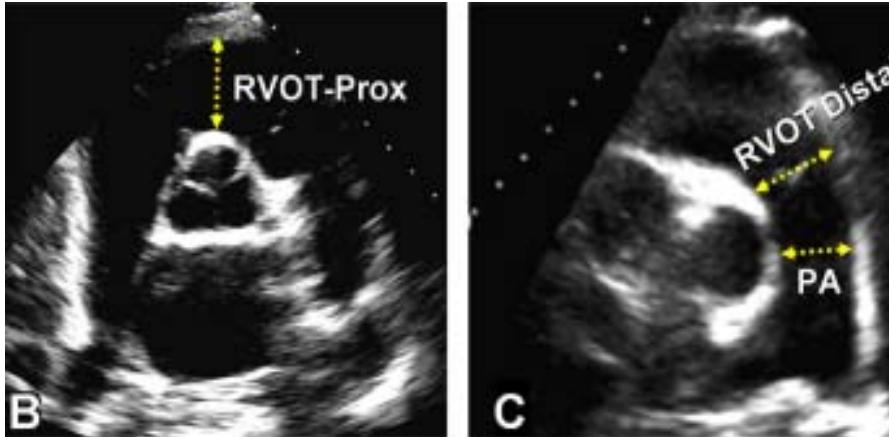
Subcostaler 4 Kammerblick



RV subcostal 4-chamber



Meßwerte



Normwerte:
RVOT prox < 33 mm
RVOT distal < 27 mm

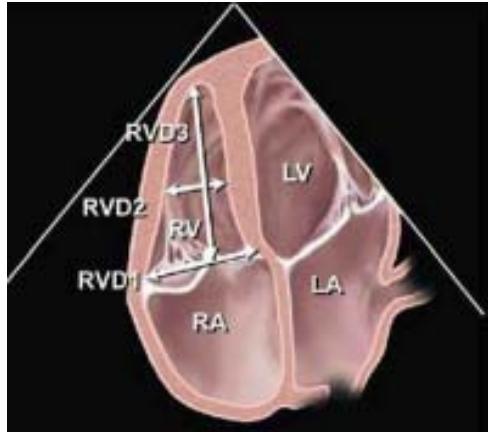


Normwerte:
Exzentrizitätsindex < 1,0

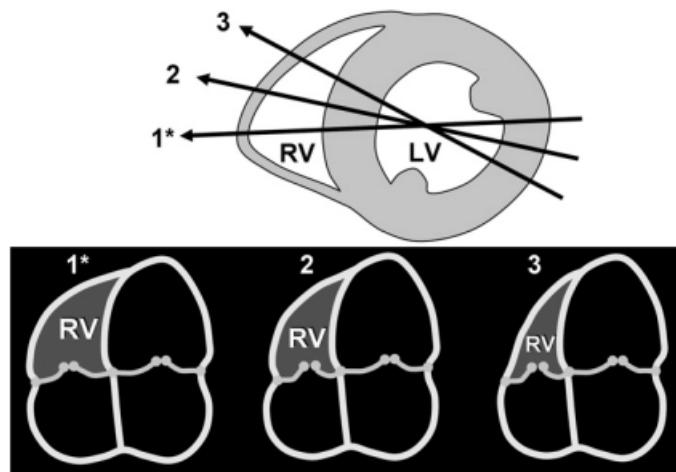
nur diast: Volumenbelastung
diast/syst: Druckbelastung

Mortalitäts-Prädiktior bei PAH

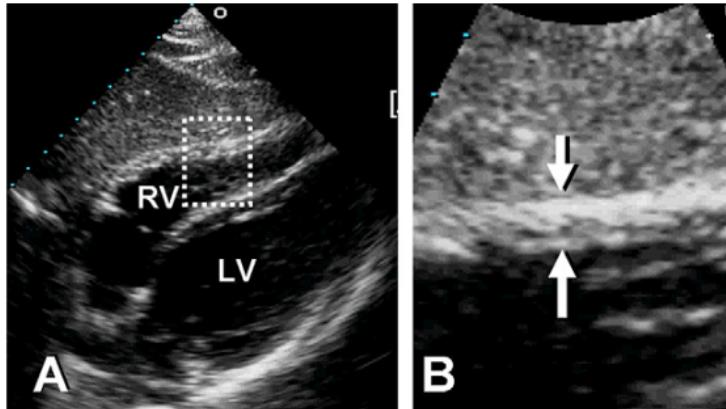
Meßwerte



Normwerte:
RV midcavität < 36 mm
RV basal < 42 mm

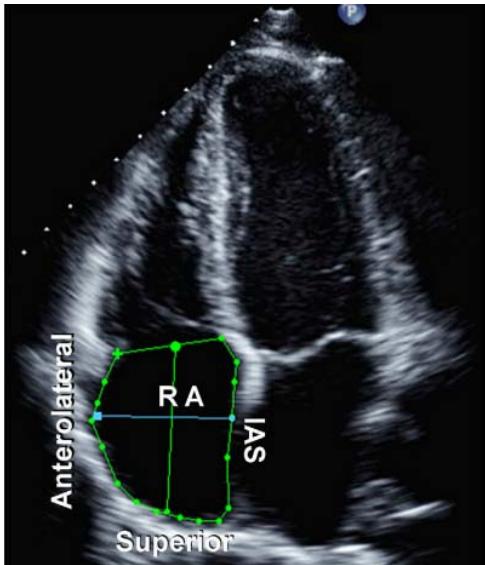


Meßwerte



Normwerte:
RV freie Wand < 5 mm

Meßwerte

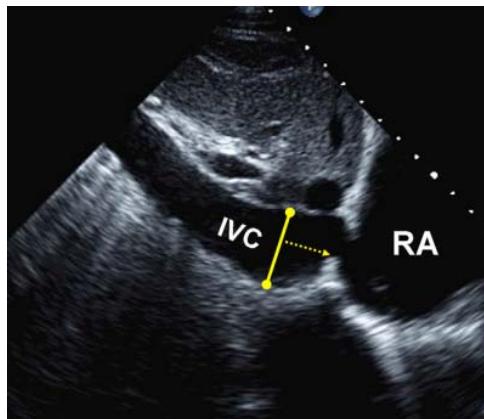


Normwerte:

RA Fläche < 18 cm²

RA Länge < 53 mm

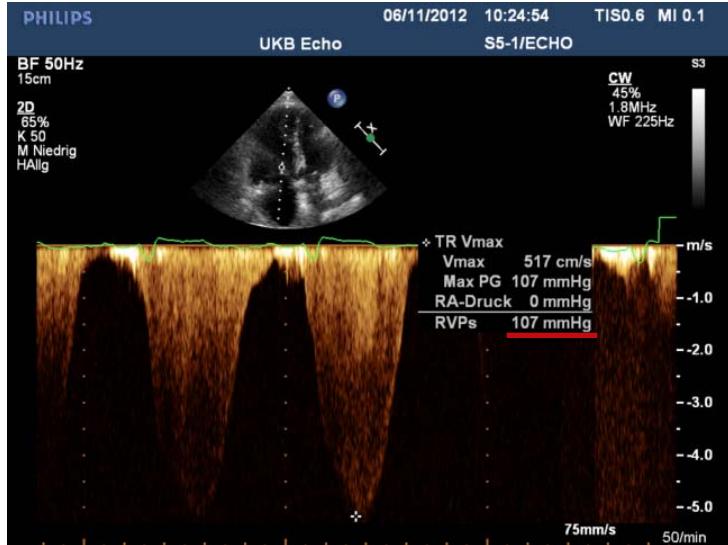
RA Breite < 44 mm



Normwerte:

VCI < 21 mm

Abschätzung PA-Druck



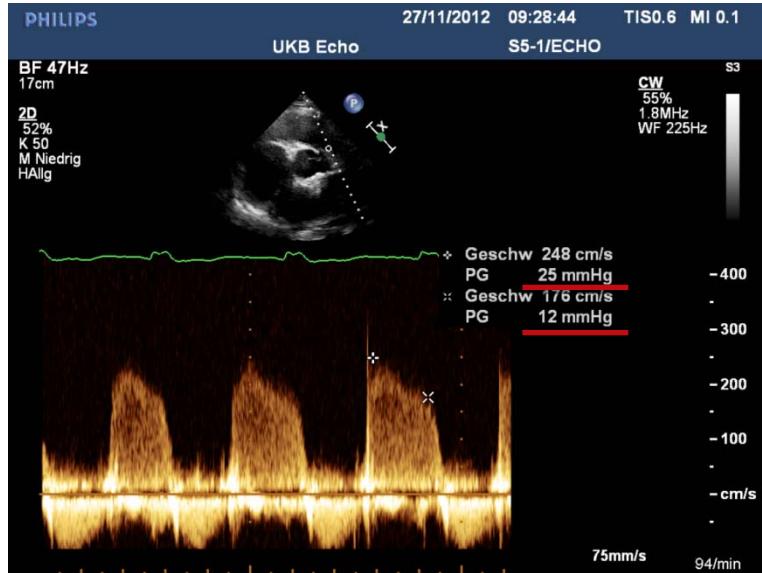
Bernoulli-Gleichung über die TI

Normwert:

PAPsyst < 30 mmHg + ZVD

bei kalk PAPsyst > 50 mmHg
weitere Abklärung empfohlen

PAPmean/diast



Normwert:
PAPmean < 19 mmHg

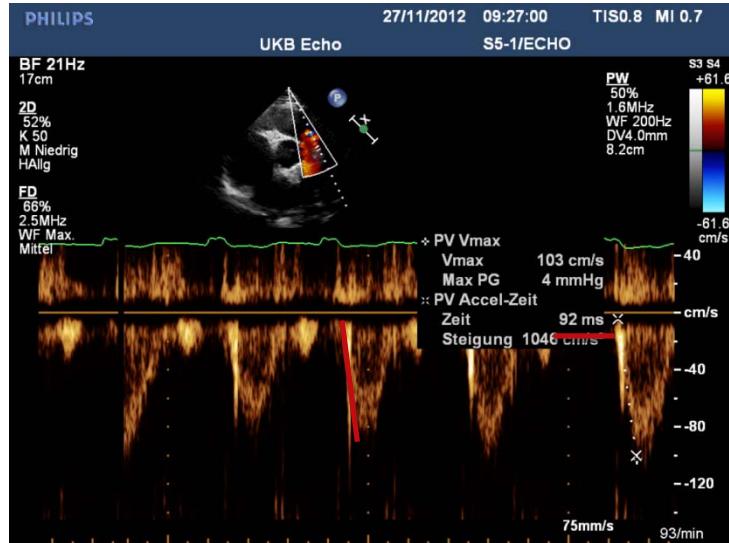
PAPmean:
max. Geschwindigkeit der
PI zum Beginn der
Diastole

PAPdiast:
Geschwindigkeit der PI
zum Ende der Diastole

Table 3 Estimation of RA pressure on the basis of IVC diameter and collapse

Variable	Normal (0-5 [3] mm Hg)	Intermediate (5-10 [8] mm Hg)	High (15 mm Hg)
IVC diameter	≤ 2.1 cm	≤ 2.1 cm	>2.1 cm
Collapse with sniff	>50%	<50%	>50%
Secondary indices of elevated RA pressure	<ul style="list-style-type: none">• Restrictive filling• Tricuspid E/E' > 6• Diastolic flow predominance in hepatic veins (systolic filling fraction < 55%)		

AT über der PK

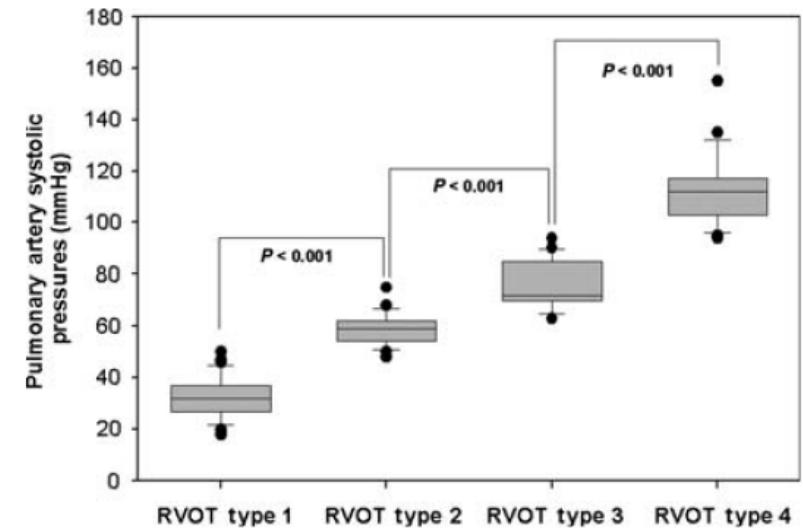
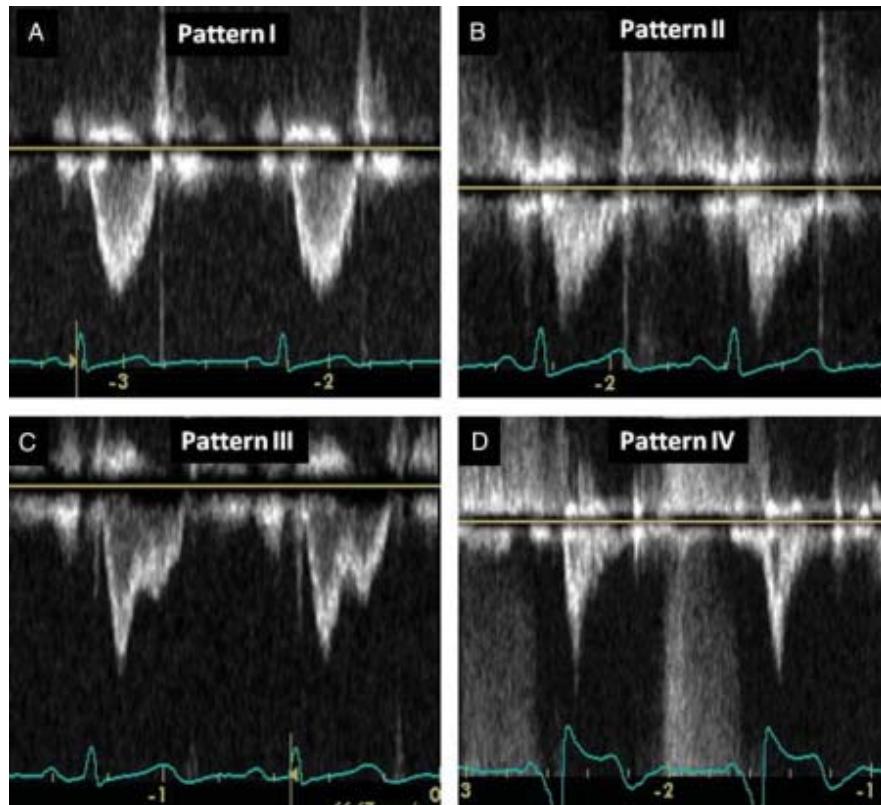


Normwert:
AT > 120 ms

PAPmean < 20 mmHg
PAPmean 20 – 40 mmHg
PAPmean > 40 mmHg

AT 100 – 120 ms
AT 70 – 90 ms
AT < 70 ms

Flußkurven RVOT



Candales, Cardiovasc Imaging, 2012

RV-Funktion

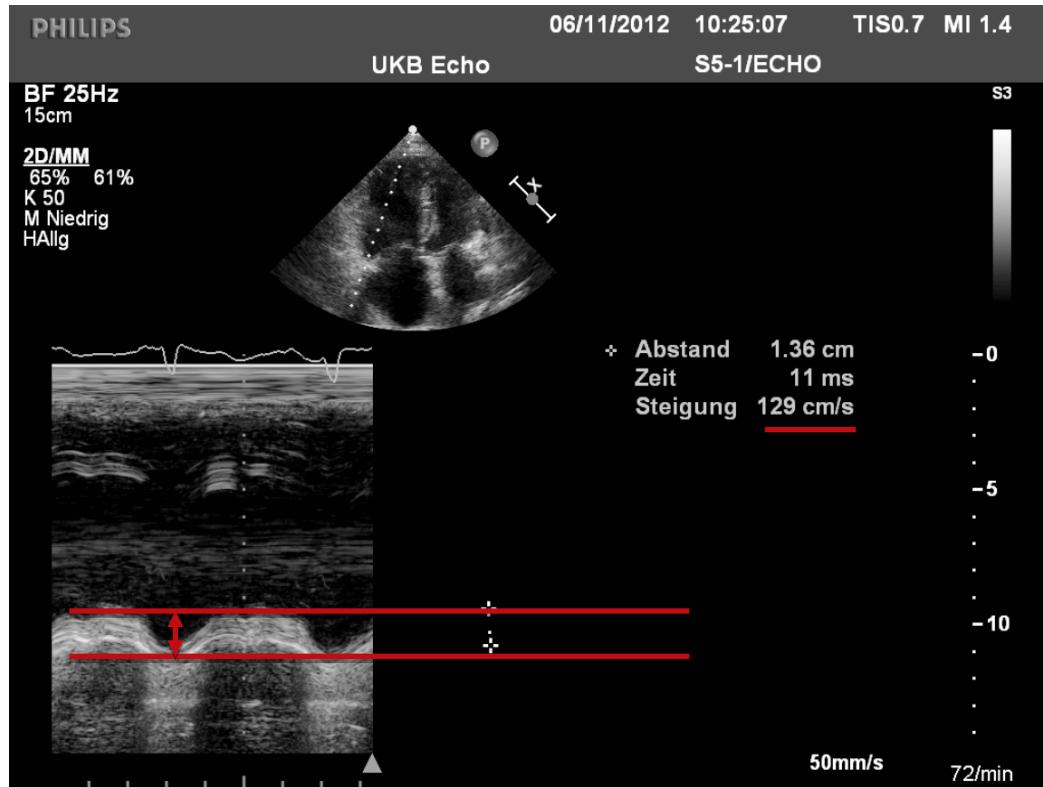
Im Vergleich zum linken Ventrikel schwer direkt zu bestimmen

Goldstandard Volumetrie im MRT, Radionuklidventrikulographie
je nach Methode Normwerte zwischen 40 - 70%
im cMRT Normwert 61 +/- 7%

Surrogatparameter zur Abschätzung erforderlich, um trotzdem
eine rasche Einschätzung zu ermöglichen

3 D Volumetrie vielversprechend, jedoch auch mit Limitationen
verbunden

TAPSE: tricuspid anular plane systolic excursion

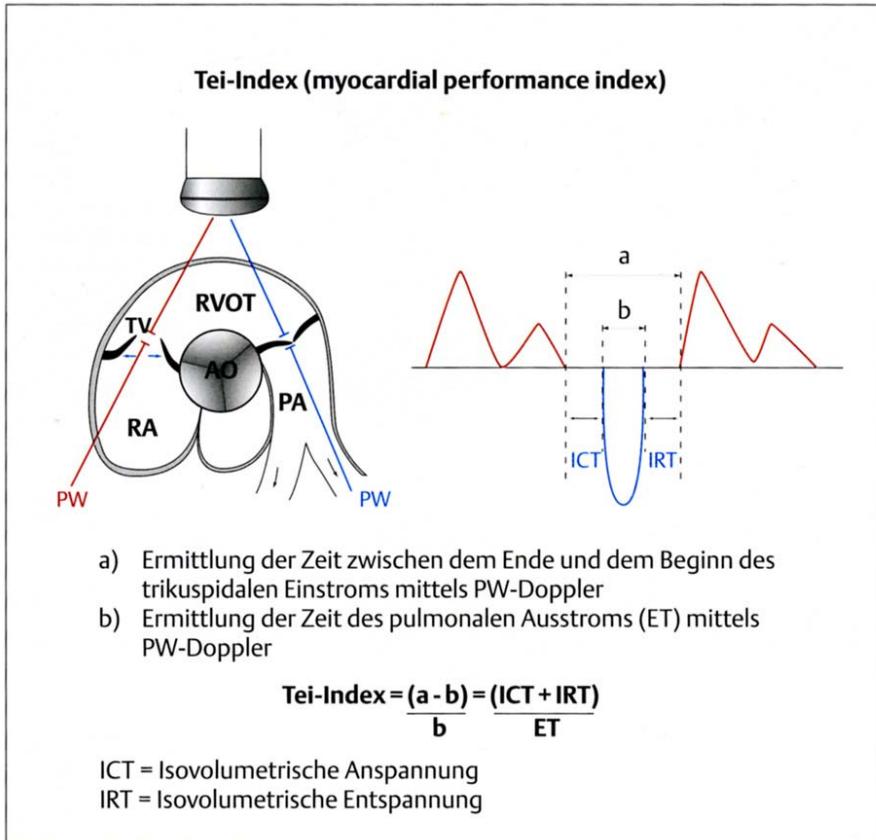


Normwert:
TAPSE > 20 mm

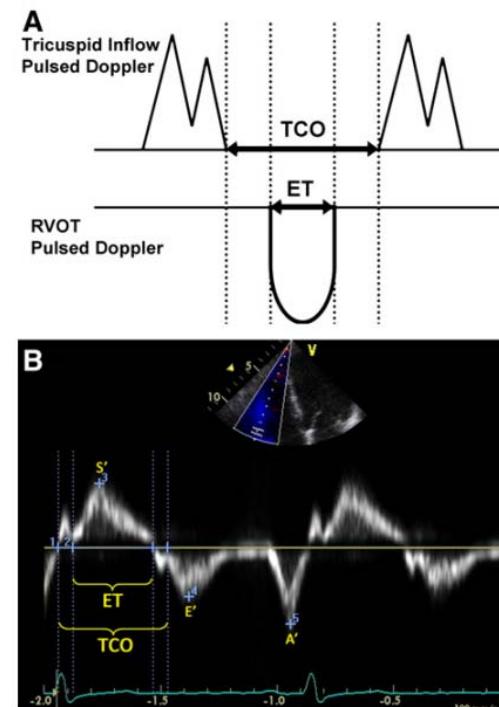
pathologisch < 16 mm
Hochgradig < 10 mm

- Systolische Funktion
- bei fast allen Patienten mgl.
- kaum untersucherabhängig
- winkelabhängig
- nur long. Funktion
- Septum nicht repräsentiert
- post OP nicht verwertbar

Tei-Index



aus: Zeydabadinejad,
Echokardiographie des rechten Herzens, 2006



tricuspid closure time/
pulmonary ejection time

Normwert: 0,28 +/-4

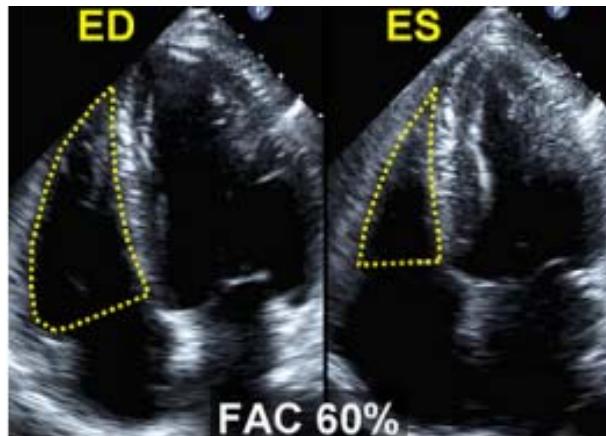
pathologisch:

Tei-Index > 0,4 (pw-Doppler)

Tei-Index > 0,5 (TDI)

- Systolische und diastolische Funktion
- bei Vorhofflimmern und Blockbildern ungenau
- bei pw-Doppler Messung in unterschiedliche Herzzyklen
→ Messung im TDI
- beeinflusst durch erhöhtem RA-Druck, dadurch Verkürzung der isovolumetrischen Relaxationszeit

FAC: fractional area change

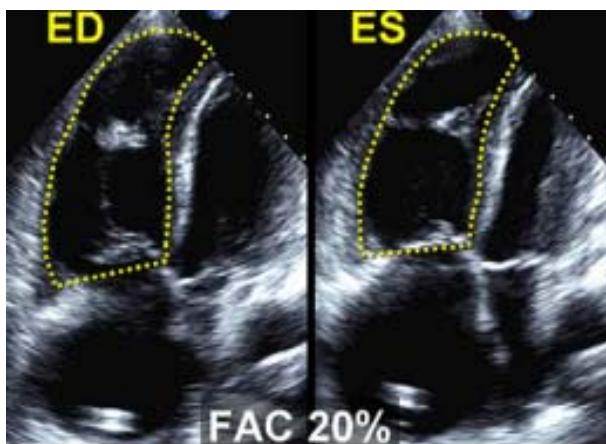


$$\text{Formel: } \text{FAC} = 100 \times \frac{(\text{RVEDA} - \text{RVESA})}{\text{RVEDA}}$$

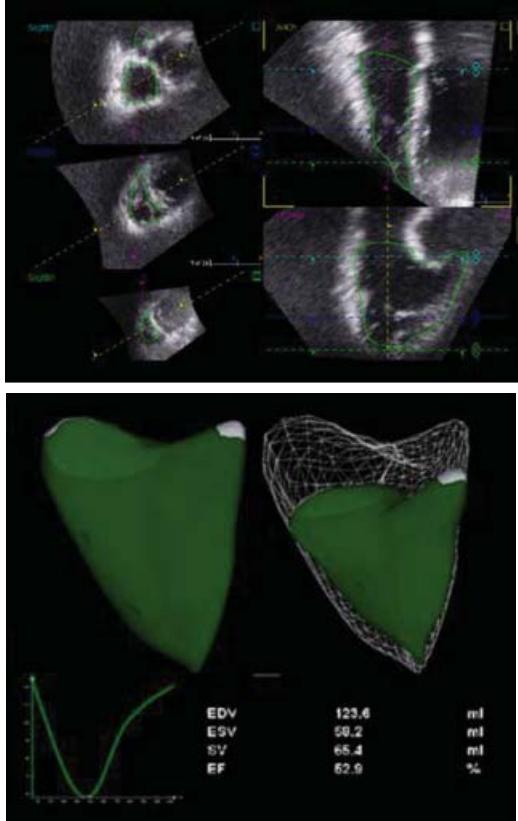
Normwert: $\text{FAC} > 35\%$

Gute Korrelation zu MR-Volumetrie
Erkennung anterioren Wand limitierend

Bestimmung der RV EF auf Flächen-
Längen oder Scheiben- Summations-
Methode nicht empfohlen



3 D Volumetrie



Normwerte

RV EDV < 89ml/m²

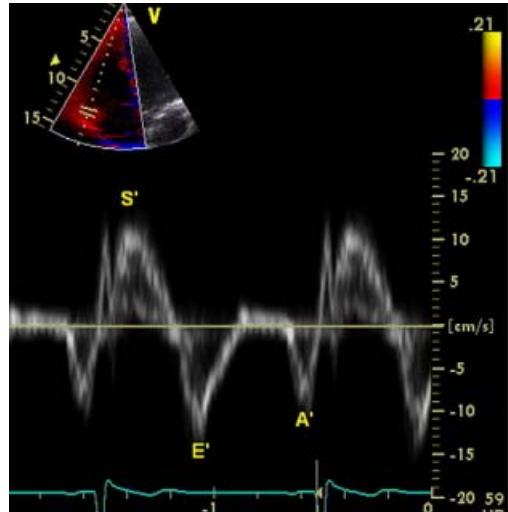
RV ESV < 45ml/m²

RV EF > 44% (?)

Volumenindices 10 – 15 % kleiner
für Frauen

- technische Voraussetzungen
- Training
- große Ventrikel oft nicht vollständig zu erfassen
- Apnoe erforderlich
- Arrhythmien ungünstig

Jurcut, Eur J Echocardiography 2010



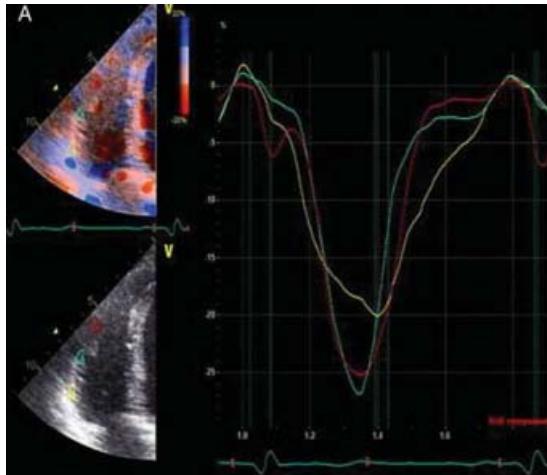
Systolische myokardiale Geschwindigkeit

Normwert 15 cm/s (?)
pathologisch < 10 cm/s



- gute Korrelation zu RNV
- gut reproduzierbar,
- lat. TK Annulus fast immer darstellbar
- winkelabhängig
- Normwert altersabhängig ?

TDI - Strain



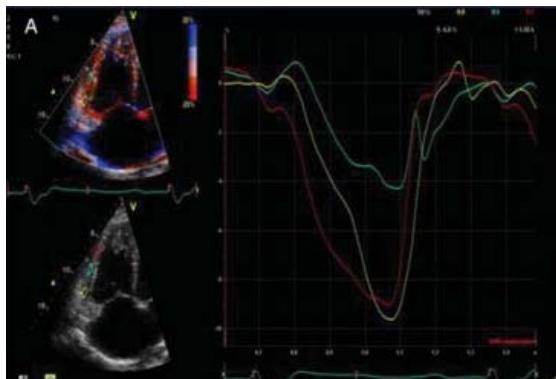
Strain: prozentuale Veränderung
Gewebedeformierung

Strain rate: Strain über die Zeit
Angabe für einzelne Wandabschnitte

Normwerte ????

Strain – 30

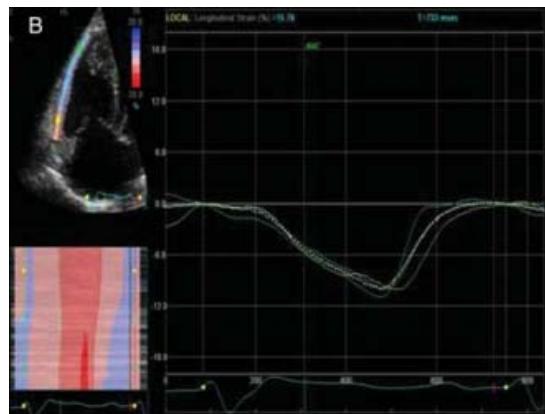
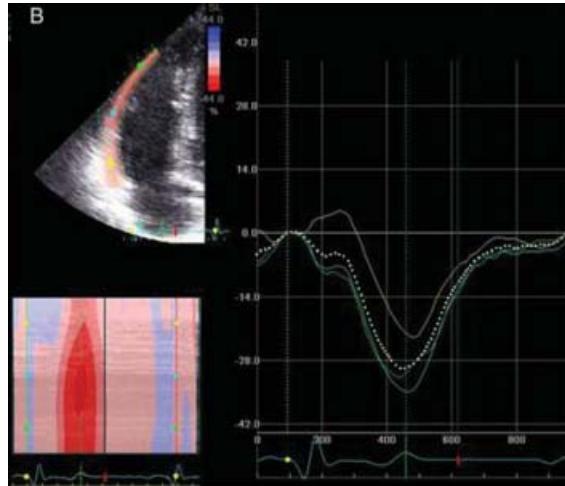
Strain rate: 1,8 – 2,0



- Vergleichswerte
- Nur longitudinale Funktion
- Winkelabhängigkeit
- nicht als Routine empfohlen

Jurcut, Eur J Echocardiography 2010

Speckle Tracking - Strain



direkte Messung der Gewebe-deformation aus 2 D Datensätzen

Verfolgung einzelner Speckles

- Regionale und globale Funktionsanalyse
- nicht winkelabhängig
- gute Schallbarkeit erforderlich
- anwenderfreudlicher
- Normwerte??
- Mäßige Korrelation zu Meßwerten aus TDI
- Auch 3 D möglich

Zusammenfassung

Morphologie

RVOT

RVEDD

freie Wand

PA-Druck

RVP + ZVD

systolisch

AT Pulmonalklappe

Funktion

TAPSE

systolisch

Chamber dimensions		
RV basal diameter	cm	>4.2
RV subcostal wall thickness	cm	>0.5
RVOT PSAX distal diameter	cm	>2.7
RVOT PLAX proximal diameter	cm	>3.3
RA major dimension	cm	>5.3
RA minor dimension	cm	>4.4
RA end-systolic area	cm ²	>18
Systolic function		
TAPSE	cm	<1.6
Pulsed Doppler peak velocity at the annulus	cm/s	<10
Pulsed Doppler MPI	—	>0.40
Tissue Doppler MPI	—	>0.55
FAC (%)	%	<35
Diastolic function		
E/A ratio	—	<0.8 or >2.1
E/E' ratio	—	>6
Deceleration time (ms)	ms	<120