Echokardiografické hodnocení pravé komory

Radka Kočková

2015

GUIDELINES AND STANDARDS

Recommendations for Cardiac Chamber Quantification by Echocardiography in Adults: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging

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2015 ECHO guidelines

- Levá komora 14 stran
- Pravá komora 4 strany

- Tvar pravé komory je velmi komplexní
- Pravá komora má důležitou roli pro morbiditu a mortalitu pacientů s onemocněním srdce

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- Tento dokument nahrazuje předchozí doporučení z r.2010 (ASE, EACVI, CSE)

Lang MR et al. Chamber quantification 2015

2015 ECHO guidelines

Všechna ECHO vyšetření mají obsahovat:

- více projekcí na PK
- velikost PK (+ pravé síně)
- zhodnocení systolické funkce (≥ 1 parametr)
  - FAC – fractional area change
  - (S´) - DTI-derived tricuspid lateral annular syst.vel. Wave
  - TAPSE - Tricupspid annular plane systolic excursion
  - RIMP - RV index myocardial performance

Lang MR et al. Chamber quantification 2015

2015 ECHO guidelines

Všechna ECHO vyšetření mají obsahovat:

Zhodnocení tlaku v pravé komoře

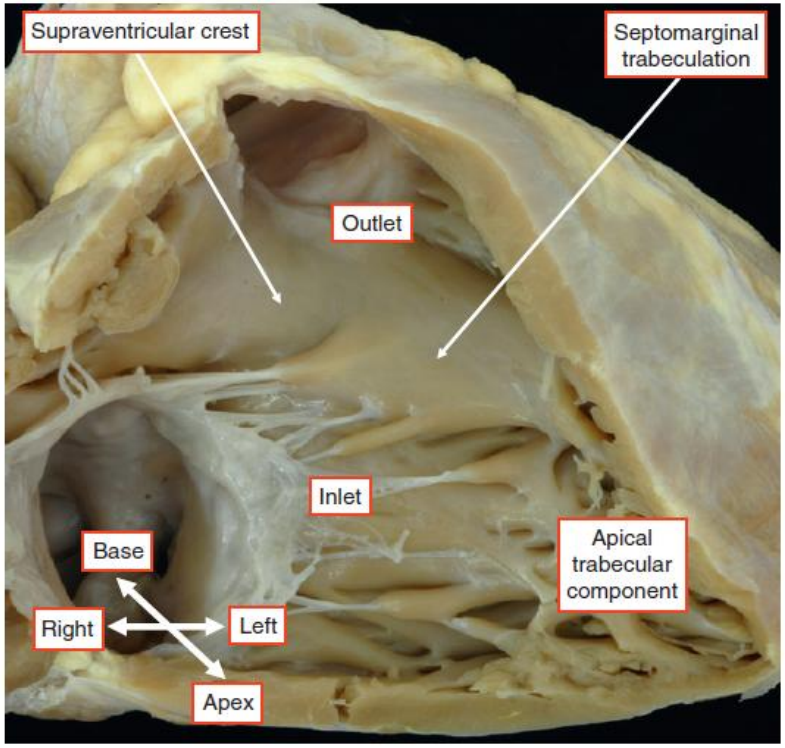
PG max na trik.regurgitaci

Odhad tlaku v pravé síni dle DDŽ

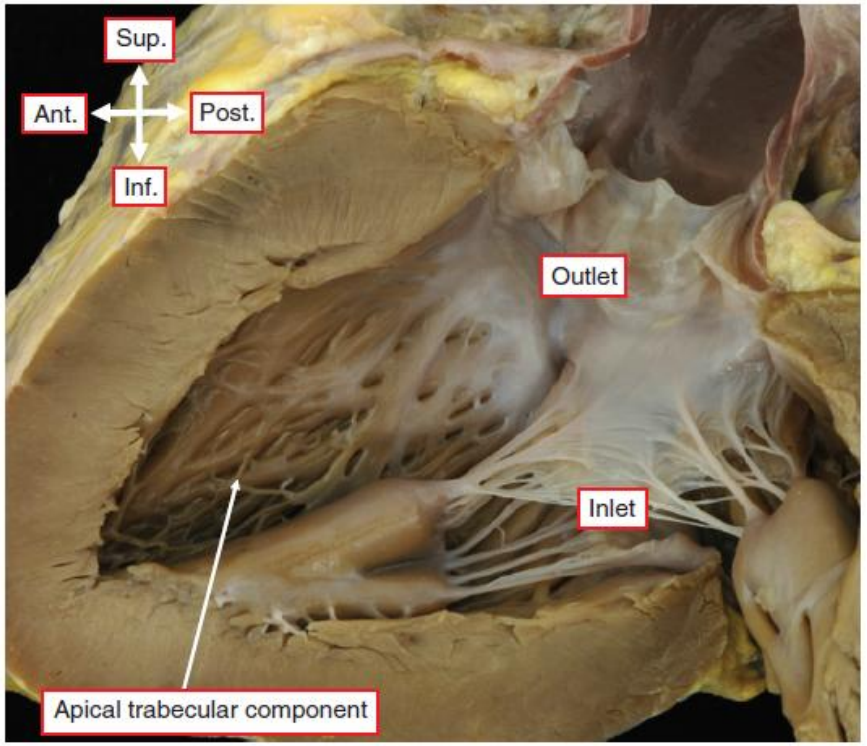
Lang MR et al. Chamber quantification 2015

Komplexní tvar PK

Pravá komora



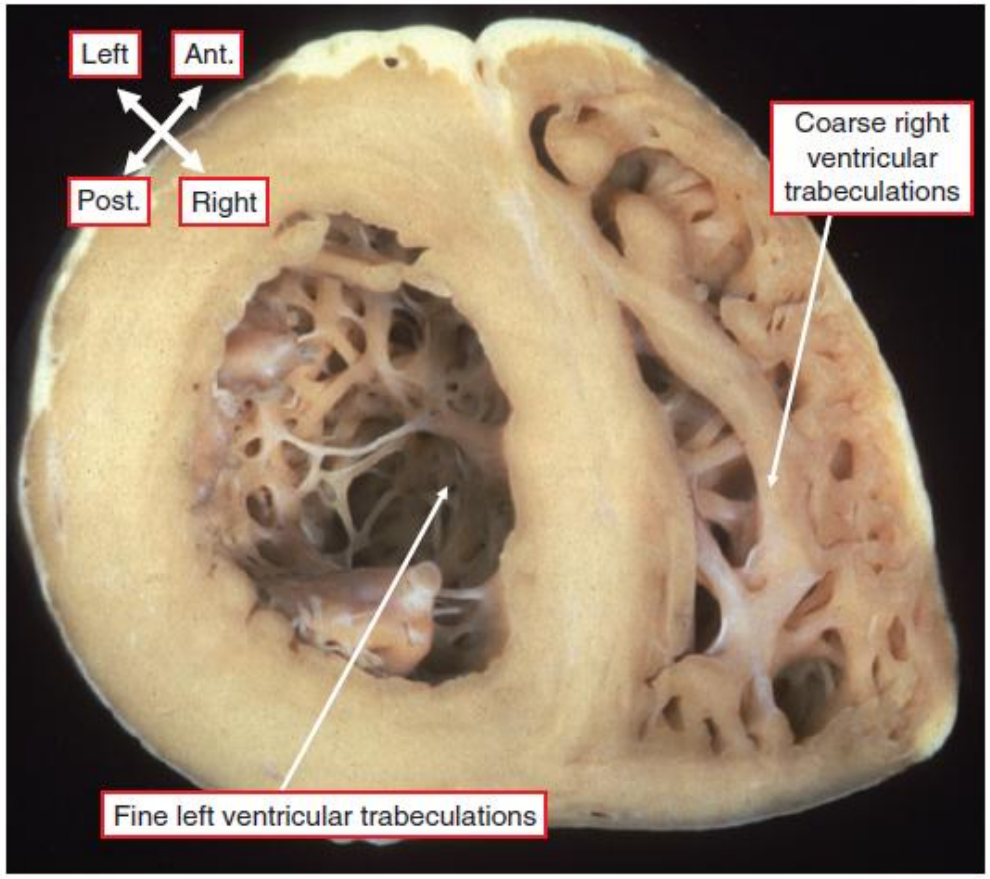
Levá komora



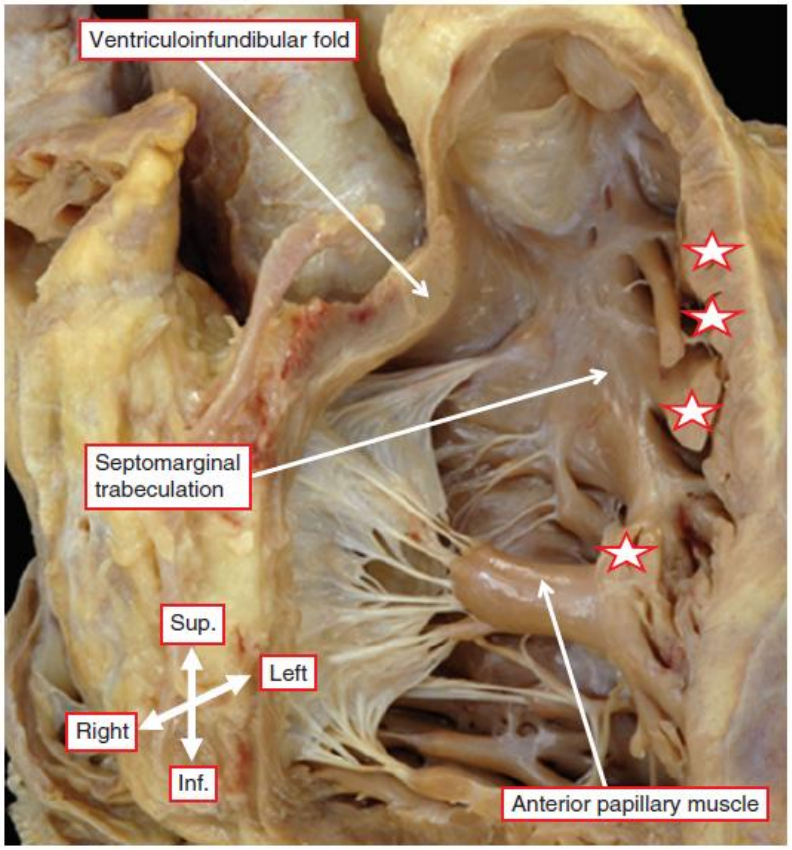
Anderson RH. Wilcox´s Surgical Anatomy 2013

Komplexní tvar PK

PK ovinutá kolem LK



Pravá komora

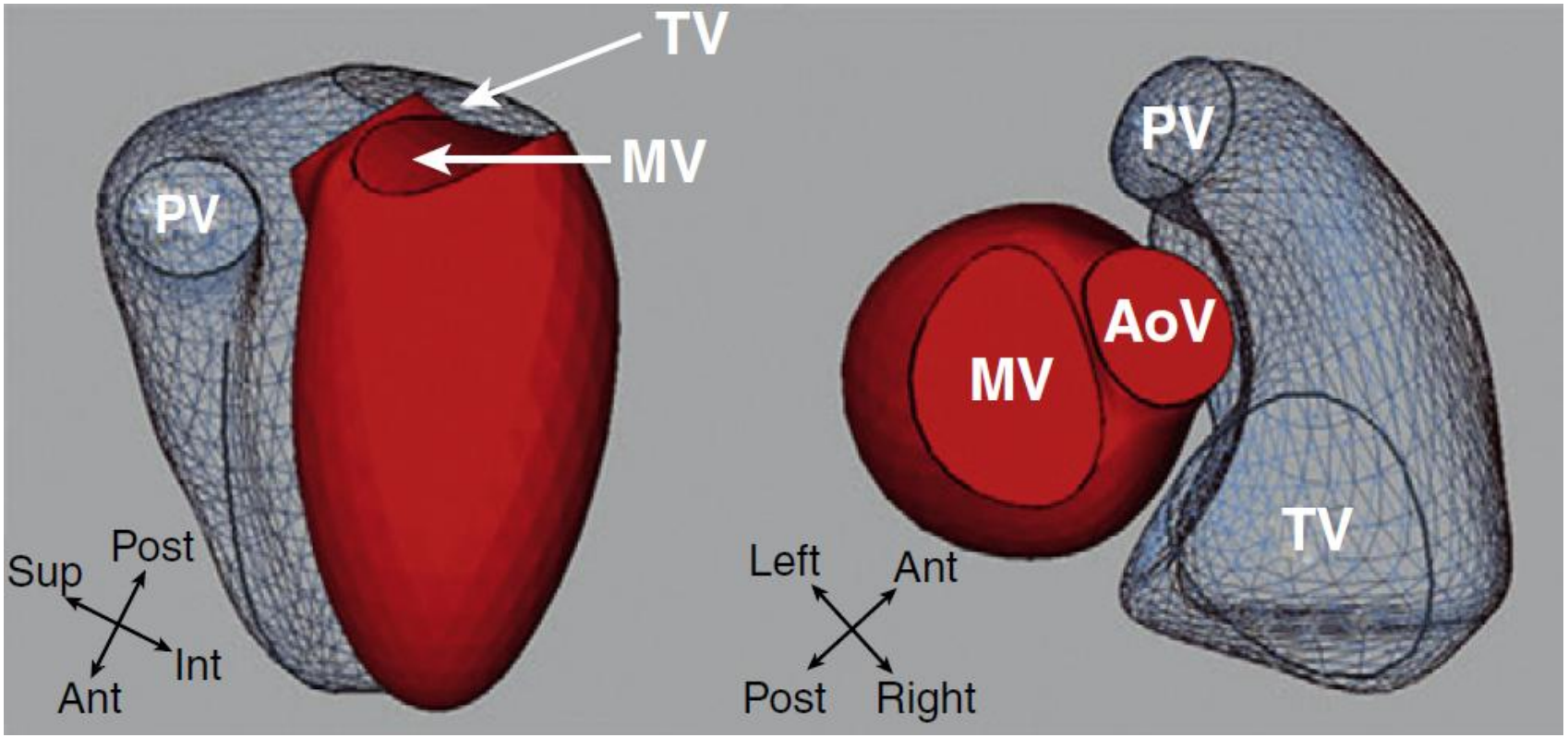


Anderson RH. Wilcox´s Surgical Anatomy 2013

Komplexní tvar PK

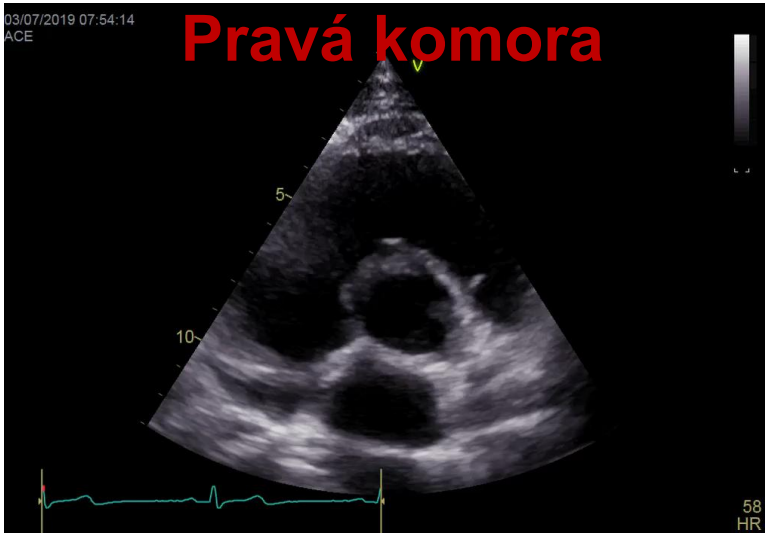
Parasternání projekce méně spolehlivé

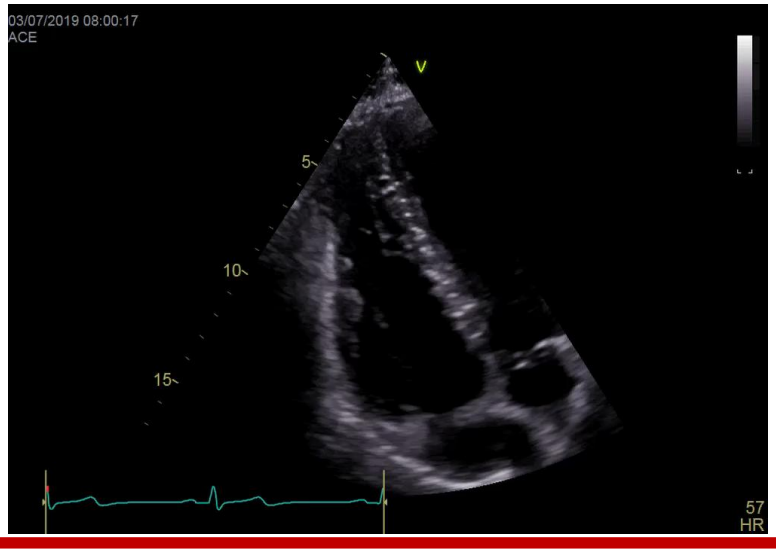
Apikální a subkostální preferenčně

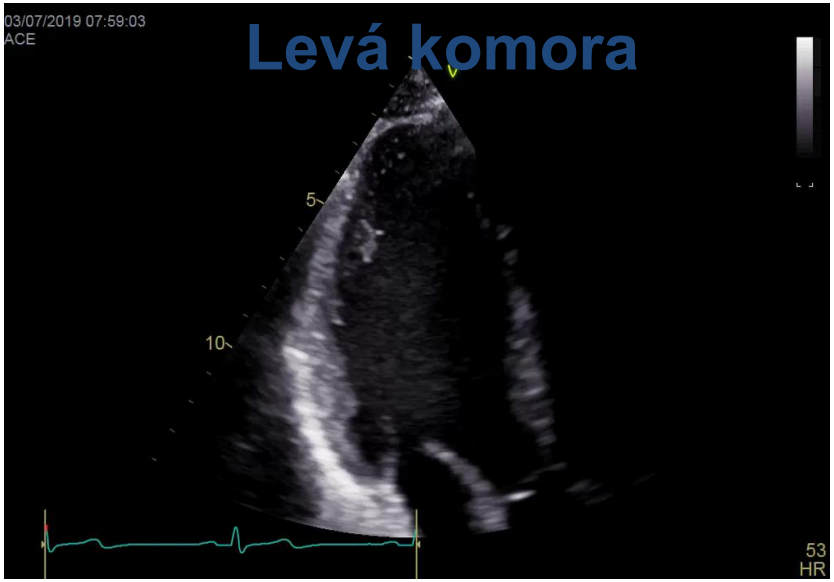


Catherine Otto. Textbook of clinical echocardiography 2013

Komplexní tvar PK

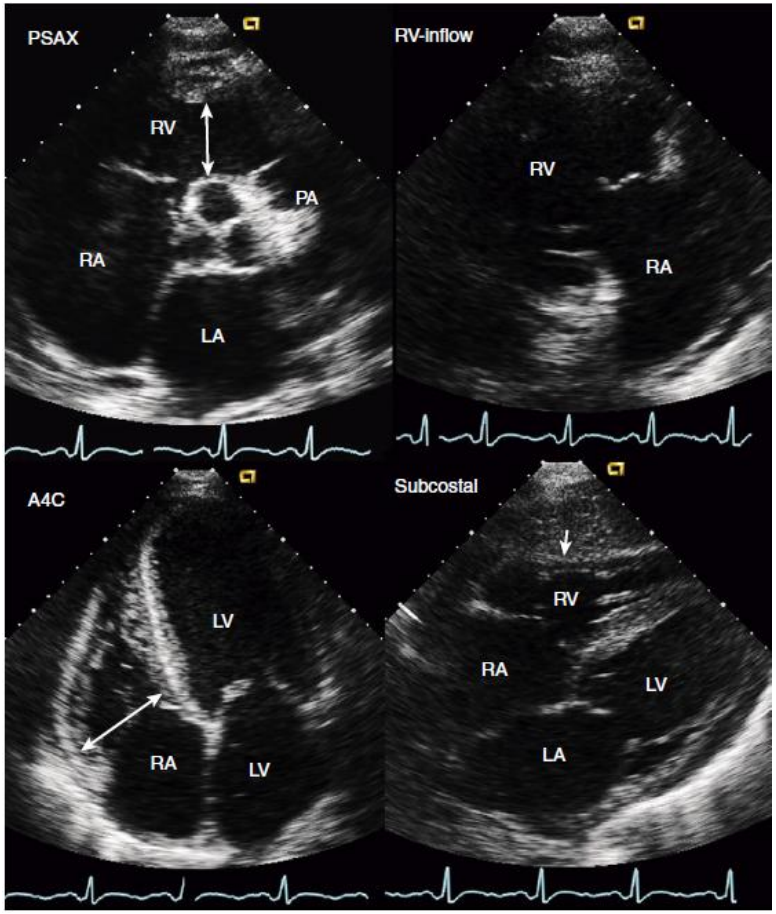






Minimalistický přístup

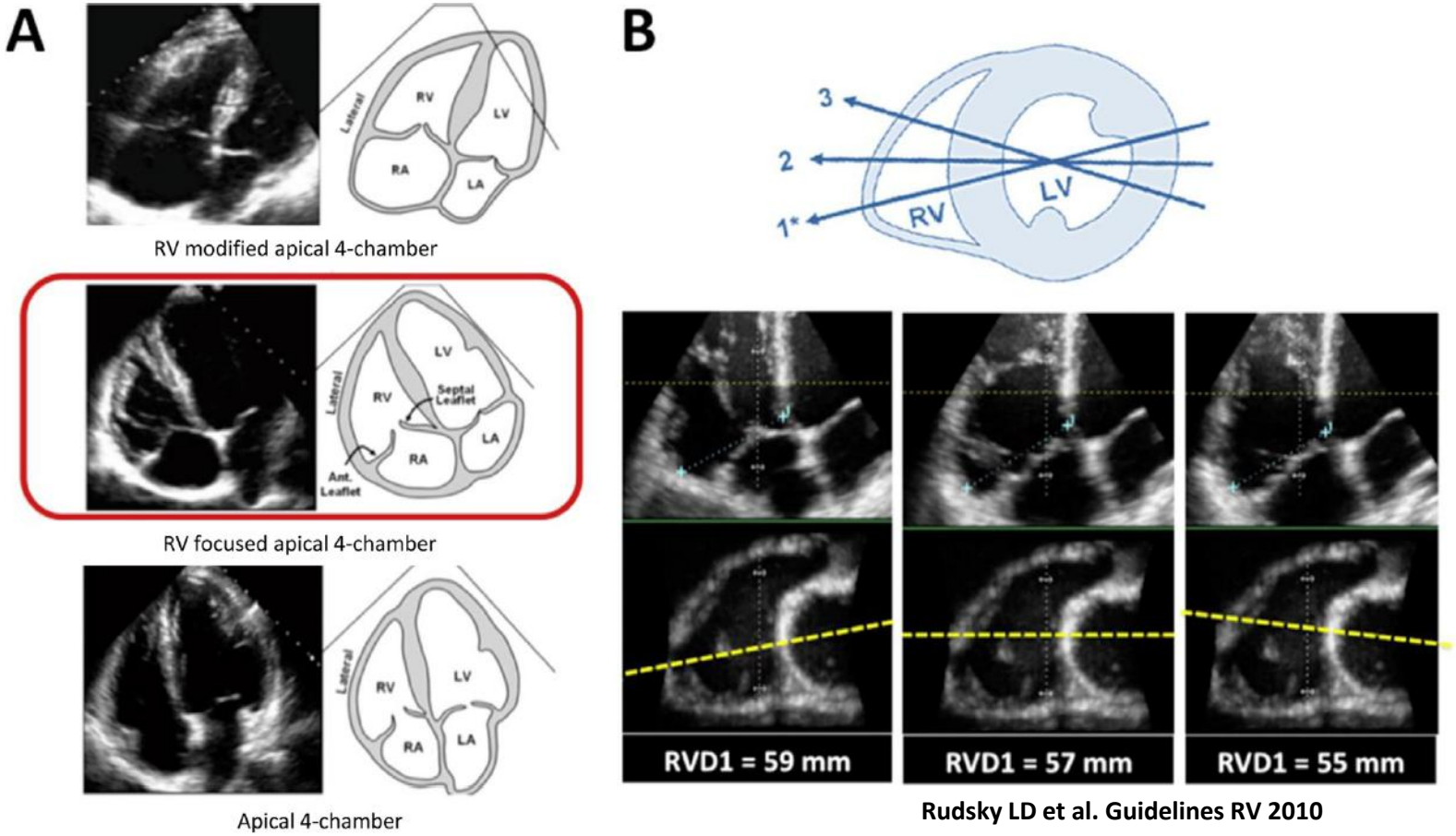
- **Alespoň 4 projekce**



Catherine Otto. Textbook of clinical echocardiography 2013

Zobrazení PK z apikální projekce

- **Preferována – hlavní pro hodnocení PK (vtoková č.)**

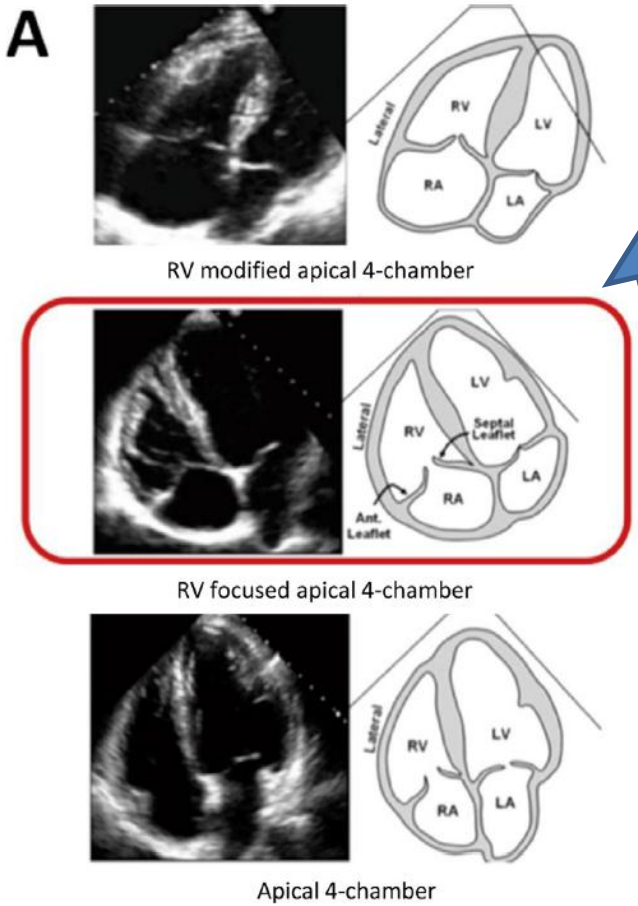


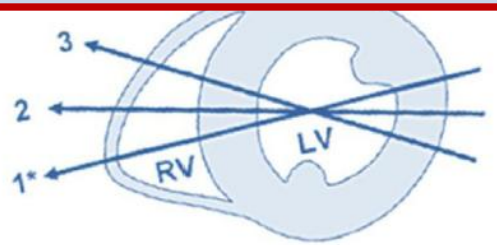
Rudsky LD et al. Guidelines RV 2010

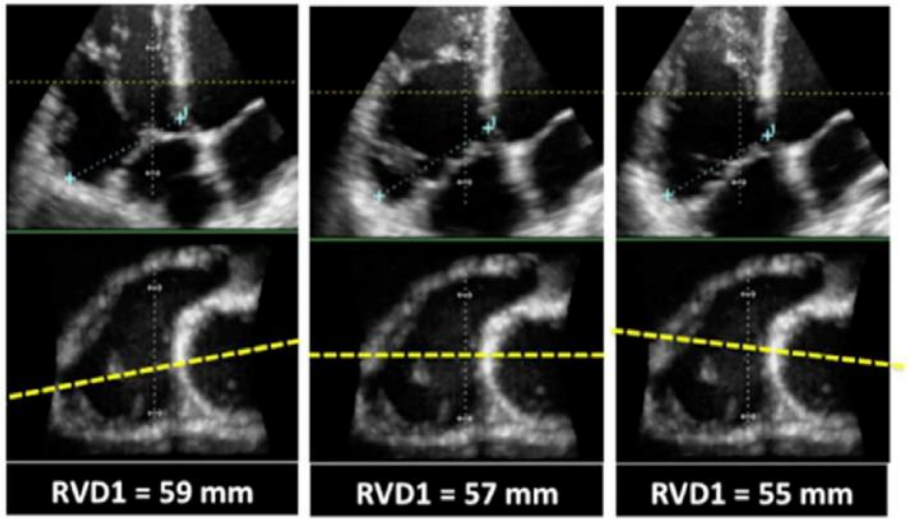
Zobrazení PK z apikální projekce

- **Vtoková část PK**

Sonda od srdečního hrotu
!zkrácení!
LK je stále v centru obrazu
NE 5-dutina



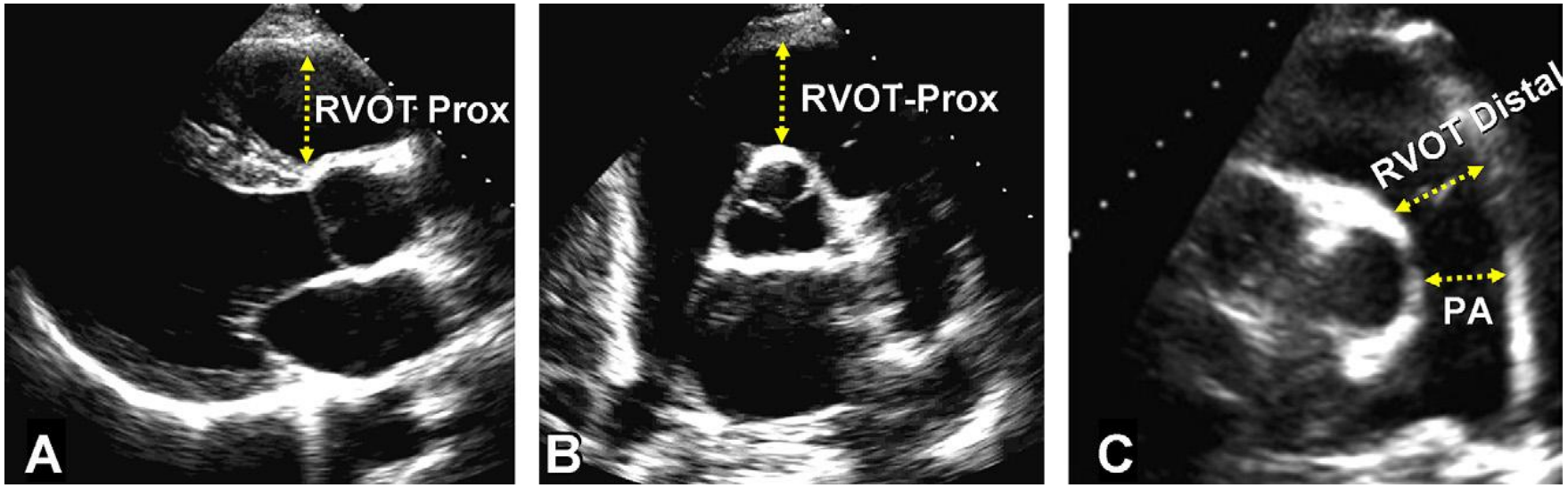




Rudsky LD et al. Guidelines RV 2010

Zobrazení RVOT (infundibula)

- **Parasternální (PLAX, PSAX)**



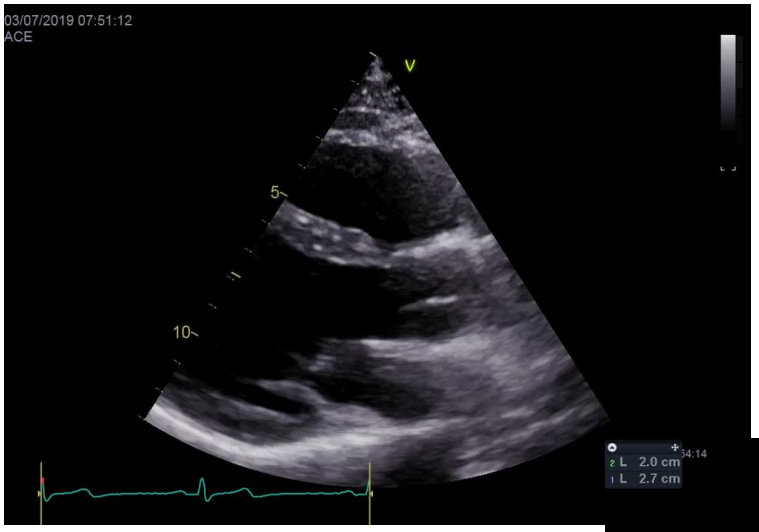
Moderator band – pulmonální chlopeň
Mírně opožděná kontrakce za PK

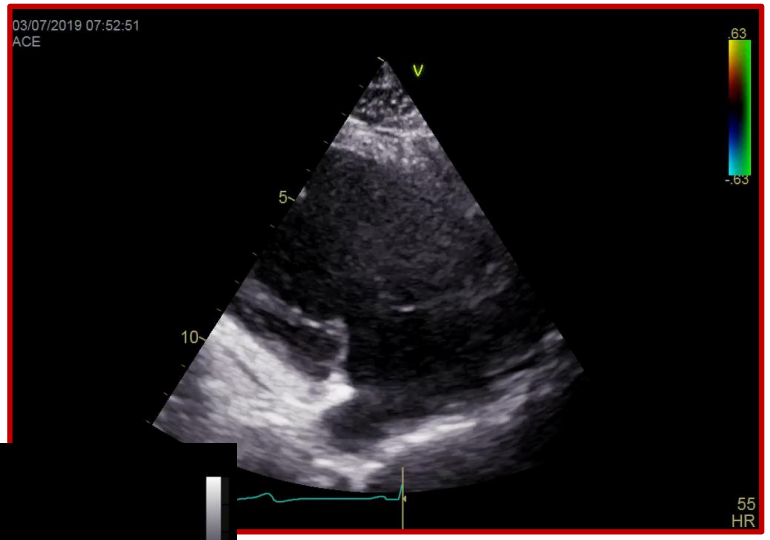
- **Patologie u vrozených vad**
- **Arytmogenní kardiomyopatie**
- **tamponáda**

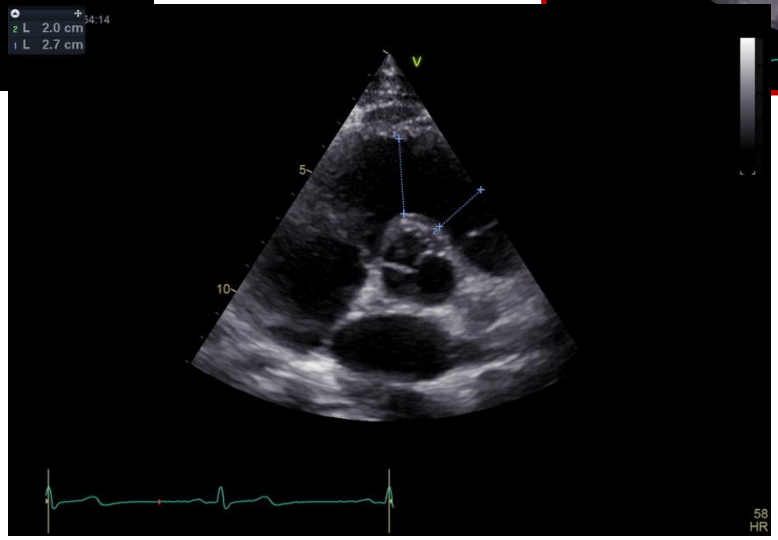
Rudsky LD et al. Guidelines RV 2010

Základní projekce na PK

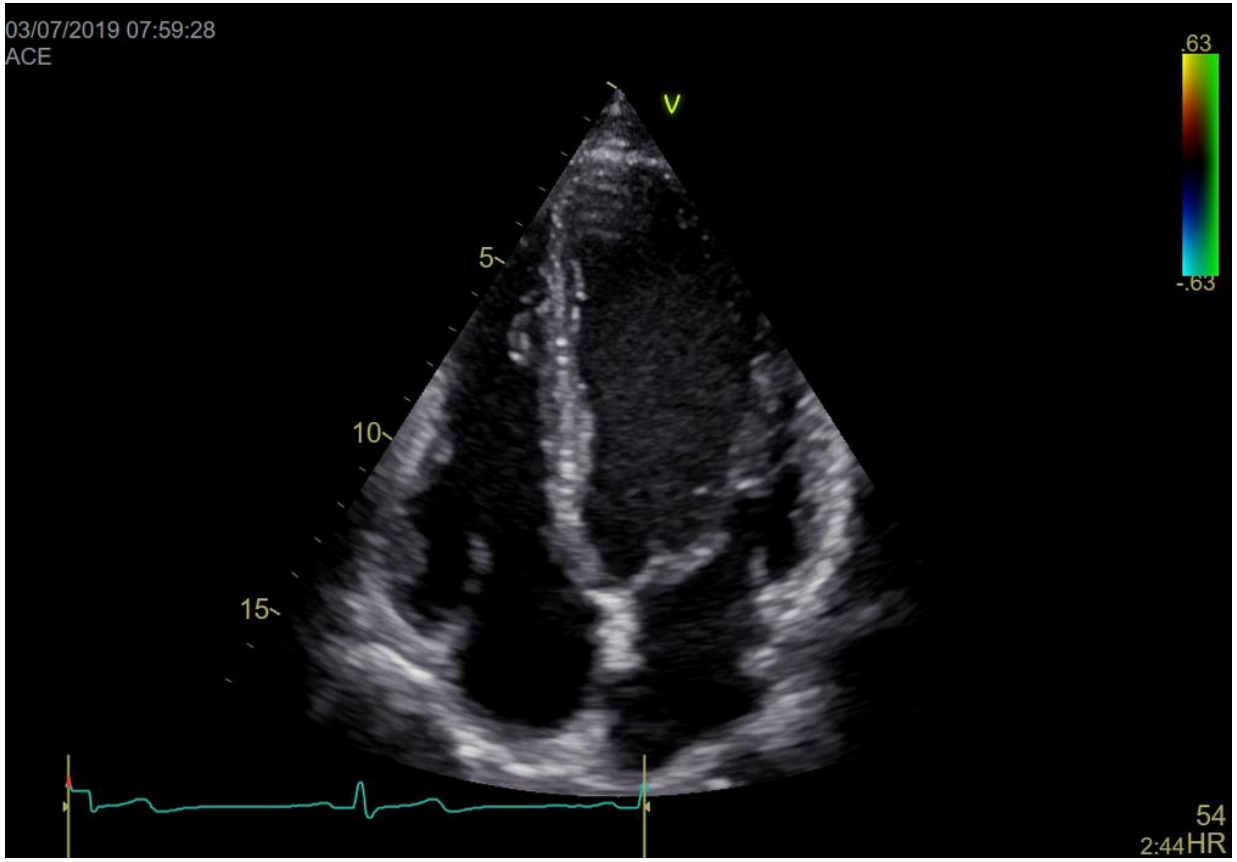
- **Parasternální (PLAX, PSAX, RV inflow)**







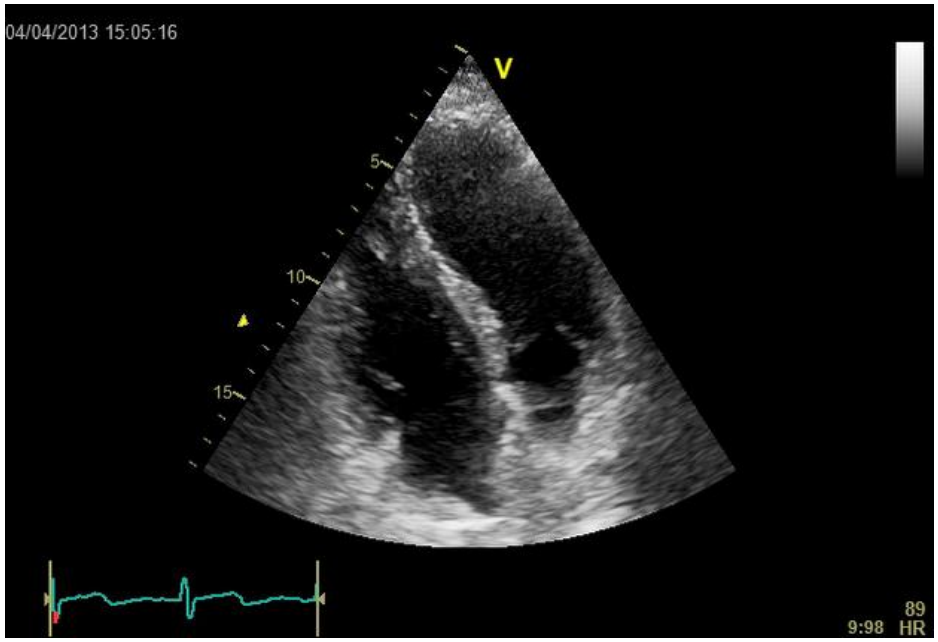
Velikost PK semikvantitativně



≤ 2/3 velikosti levé komory
Hrot tvoří levá komora

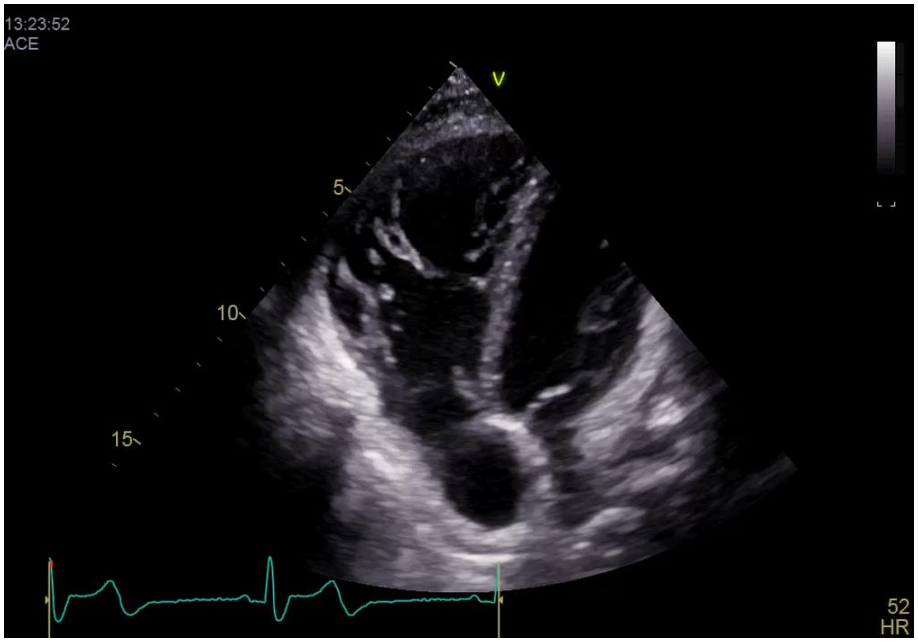
Dilatace pravé komory

Akutní cor pulmonale
Dilatace + dysfunkce



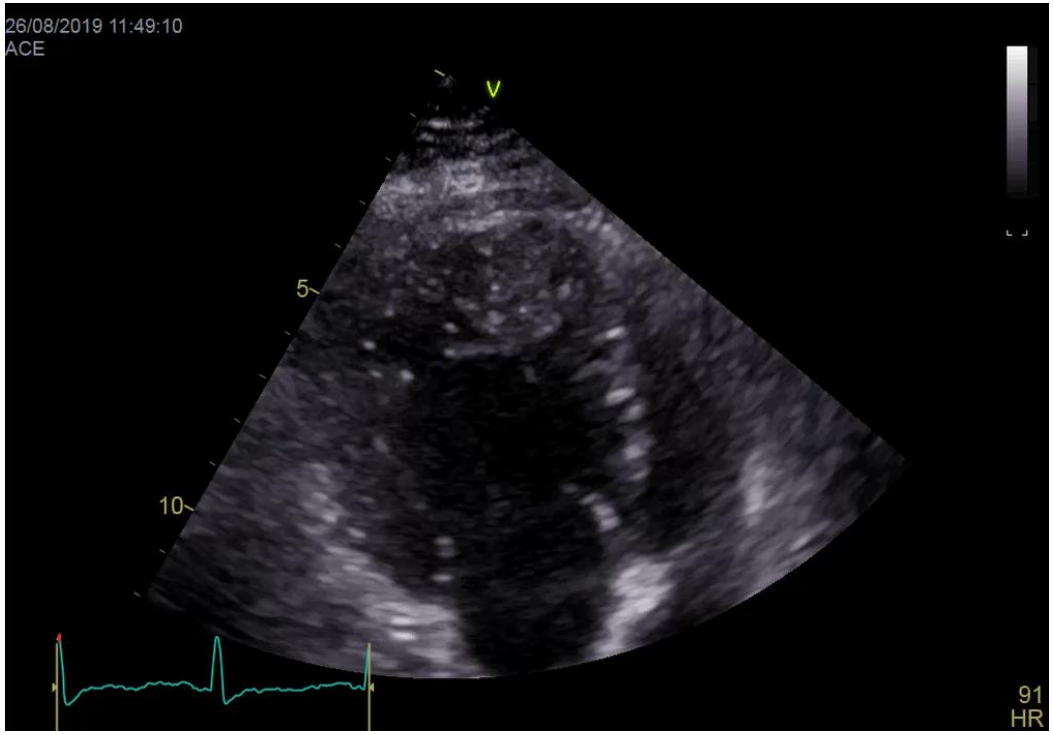
Akutní tlakové přetížení PK

Fallotova tetralogie
Významná PR – jen dilatace



Chronické objemové přetížení PK

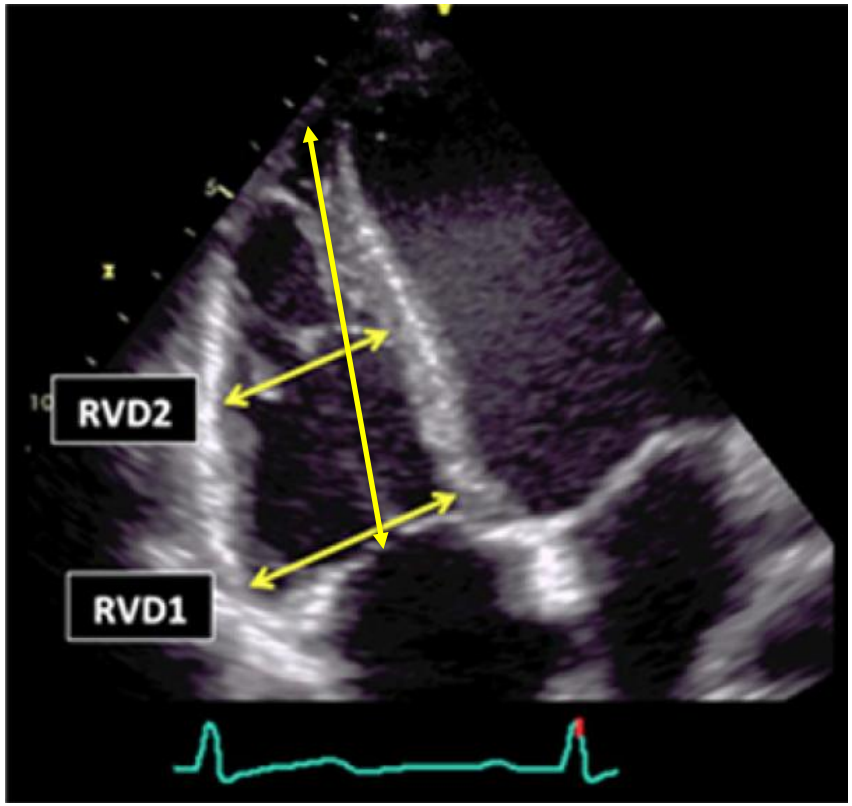
Hypertrofie, dilatace PK



Chronické tlakové přetížení PK

Linární měření PK

- Apikální 4-D zaměřená (focused) na PK
- RVD1 ≤ 41 mm
- RVD2 ≤ 35 mm
- RVD3 ≤ 83 mm



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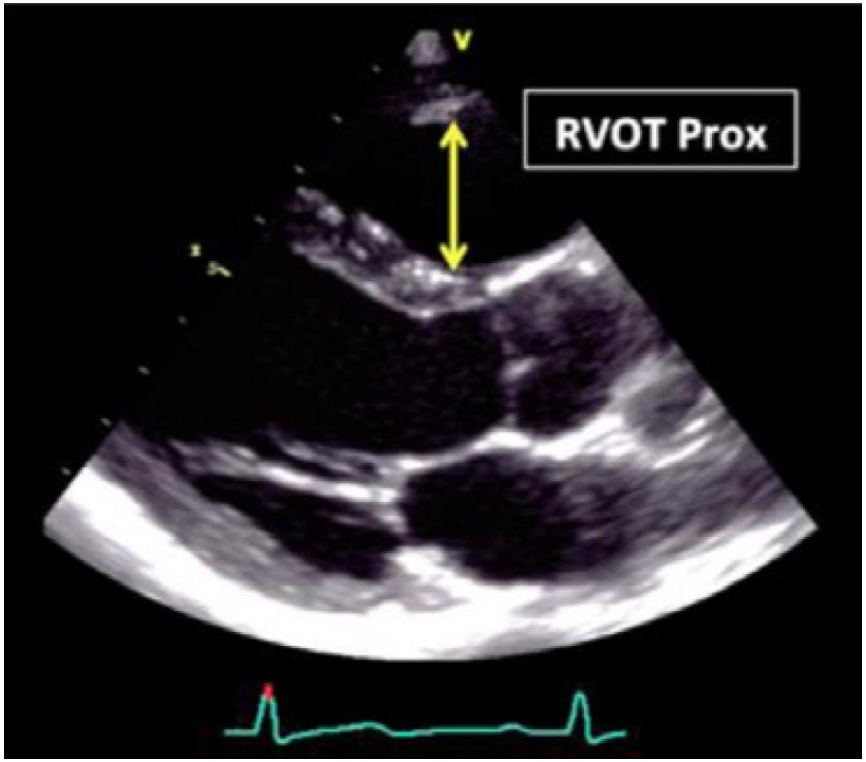
Lineární měření PK

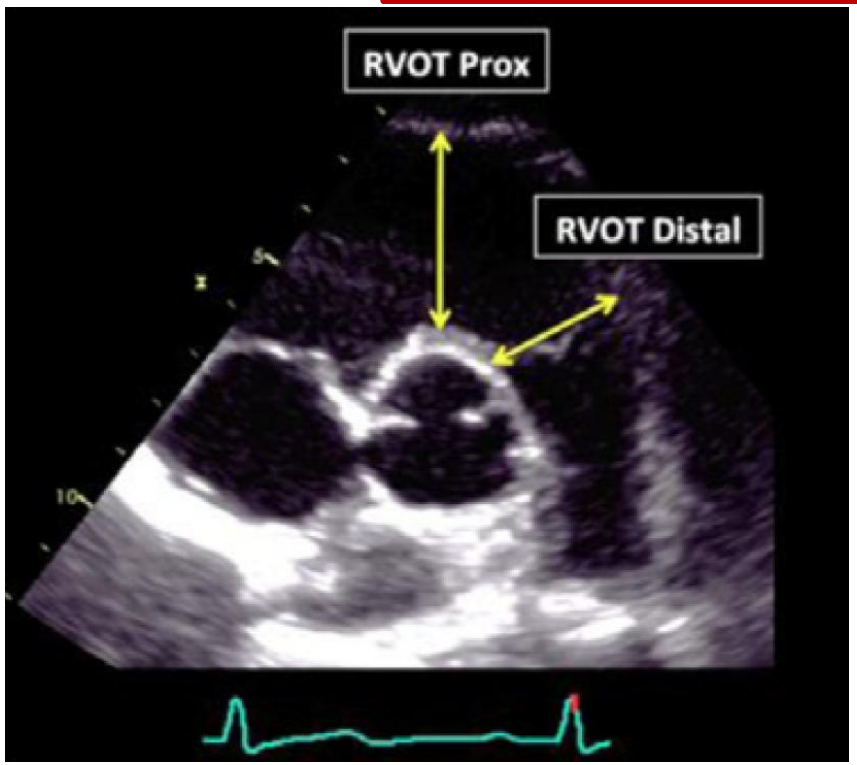
- RVOT proximal ≤ 35 mm
- RVOT distal ≤ 27 mm

ARVC

Velká ≥ 19 mm/m²
≥ 21 mm/m²

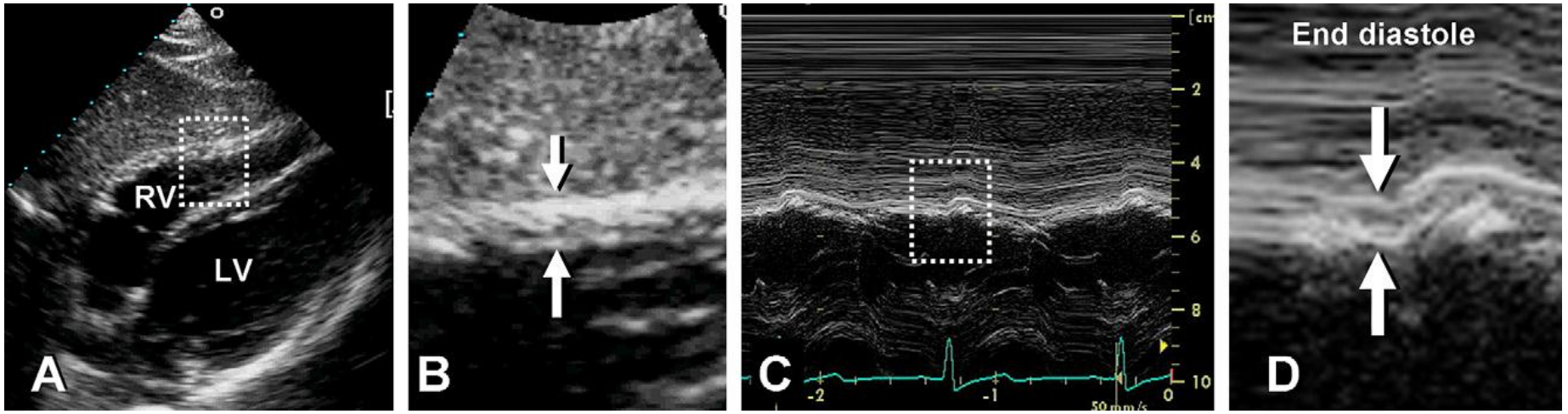
Malá ≥ 16 mm/m²
≥ 18 mm/m²



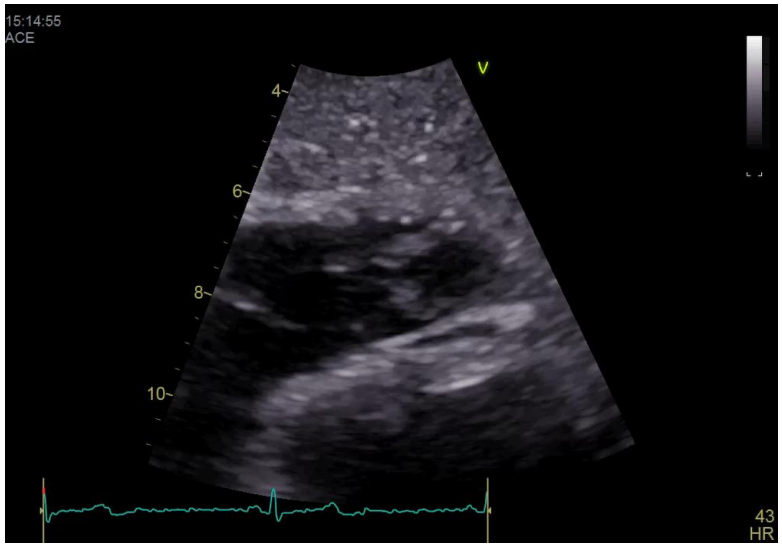


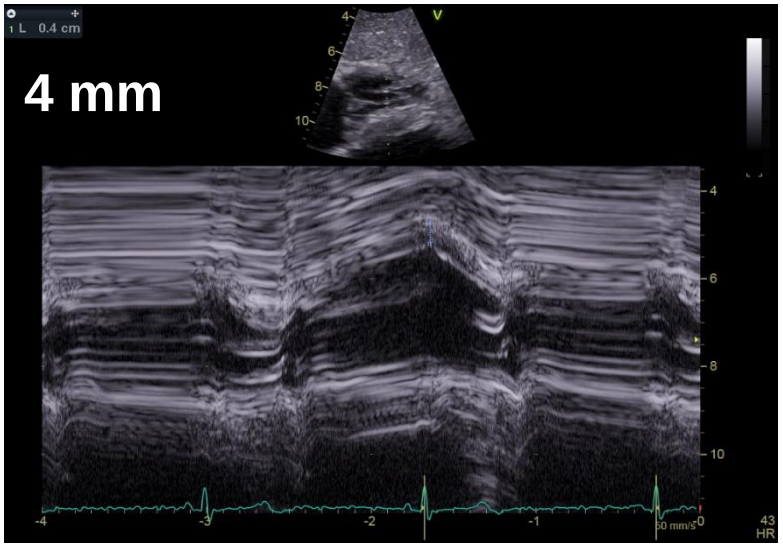
Rudsky LD et al. Guidelines RV 2010

Subcostální (subxiphoidální) projekce

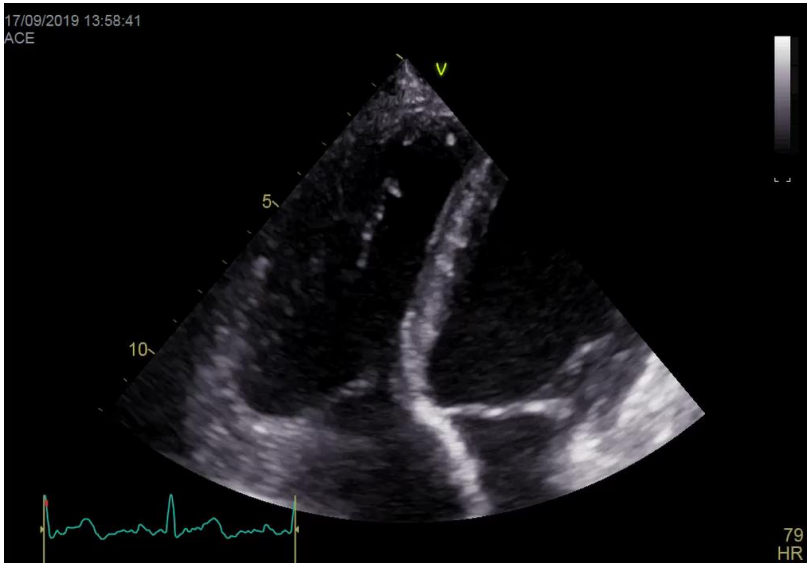


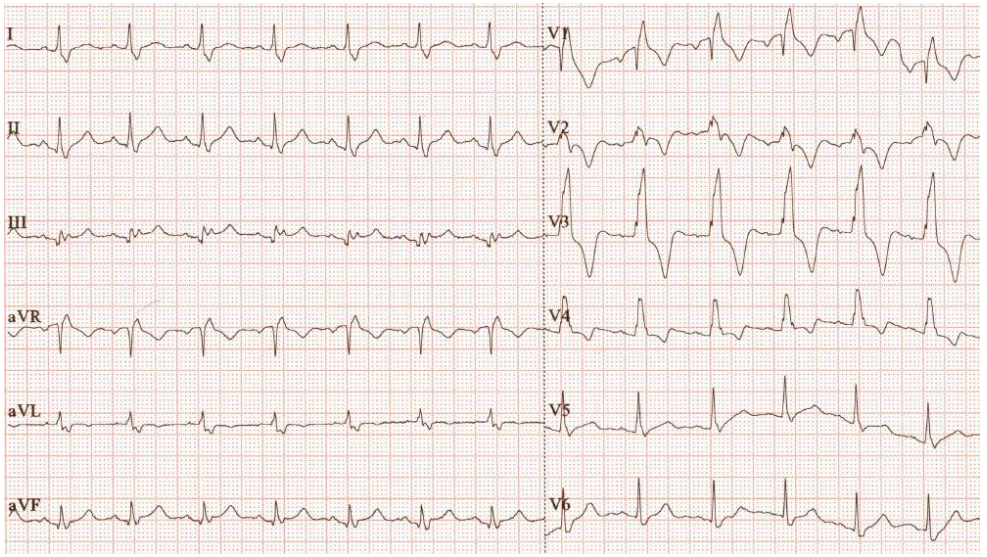
Rudsky LD et al. Guidelines RV 2010

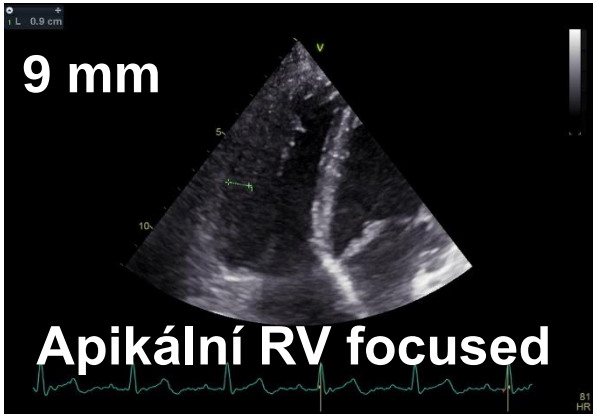


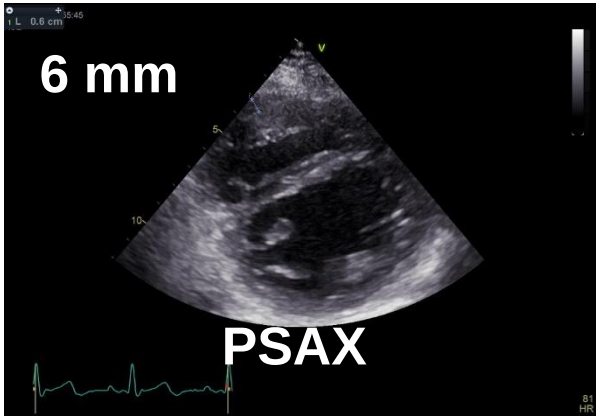


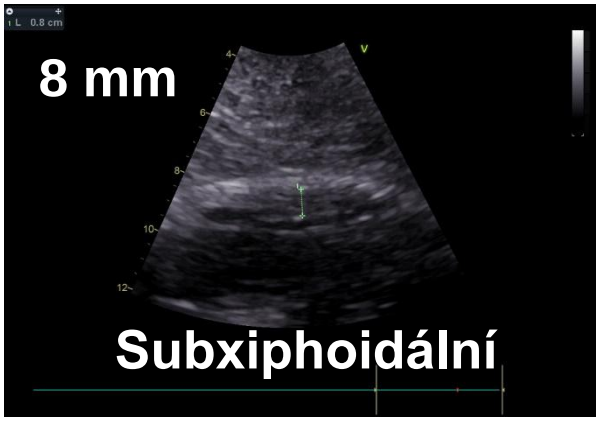
Šíře volné stěny PK







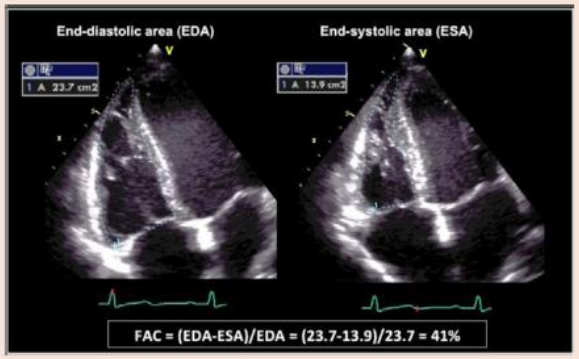




Hodnocení funkce PK

RV global systolic function

FAC



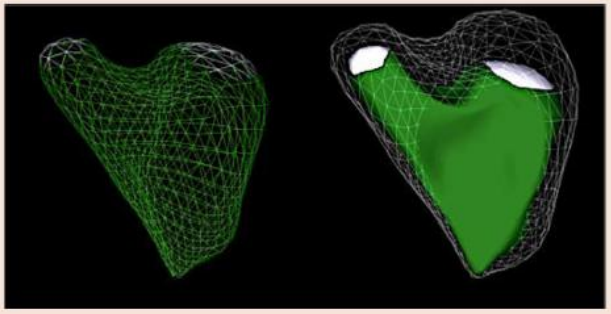
RV FAC in RV-focused apical four-chamber view:
RV FAC (%) = 100 × (EDA − ESA)/EDA

- Established prognostic value
- Reflects both longitudinal and radial components of RV contraction
- Correlates with RV EF by CMR

- Neglects the contribution of RV outflow tract to overall systolic function
- Only fair inter-observer reproducibility

FAC < 35% (49±7)
EDAi ♂ 5-12.6 cm²/m²
♀ 4.5-11.5 cm²/m²

EF



Fractional RV volume change by 3D TTE:
RV EF (%) = 100 × (EDV − ESV)/EDV

- Includes RV outflow tract contribution to overall function
- Correlates with RV EF by CMR

- Dependent on adequate image quality
- Load dependency
- Requires offline analysis and experience
- Prognostic value not established

EF < 45% (58±6.5)
EDVi ♂ 35-87 ml/m²
♀ 32-74 ml/m²

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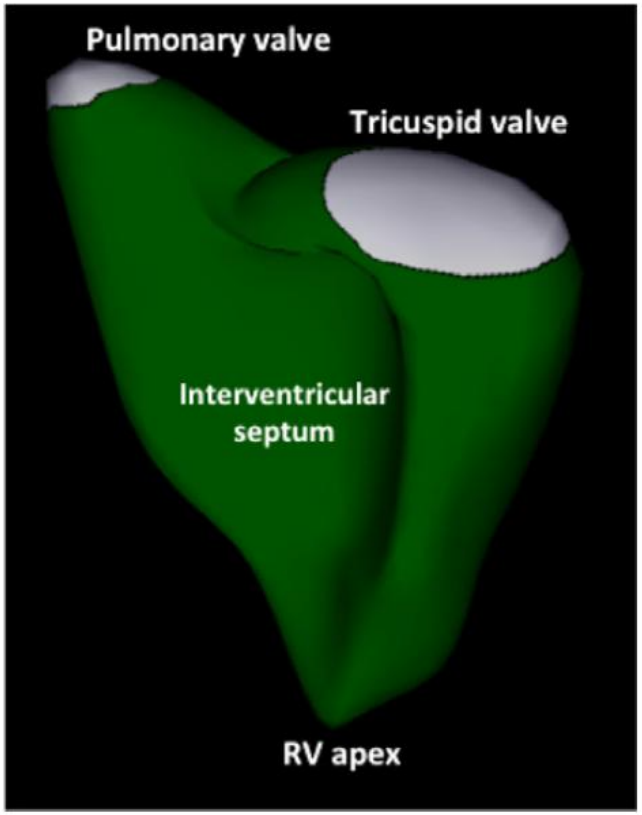
3D ECHO – volumetrie PK

3DE RV volumes



- Dedicated multibeat 3D acquisition, with minimal depth and sector angle (for a temporal resolution > 20–25 volumes/sec) that encompasses entire RV cavity
- Automatically identified timing of end-diastole and end-systole should be verified
- Myocardial trabeculae and moderator band should be included in the cavity

- **EDVi ≤ 87 ml/m2 (muži)**
- **EDVi ≤ 74 ml/m2 (ženy)**

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Volumetrie PK

- **Problém vyšetřitelnosti (PK těsně pod sternem)**
- **Časová náročnost**
- **Podhodnocení objemů (proti CMR)**

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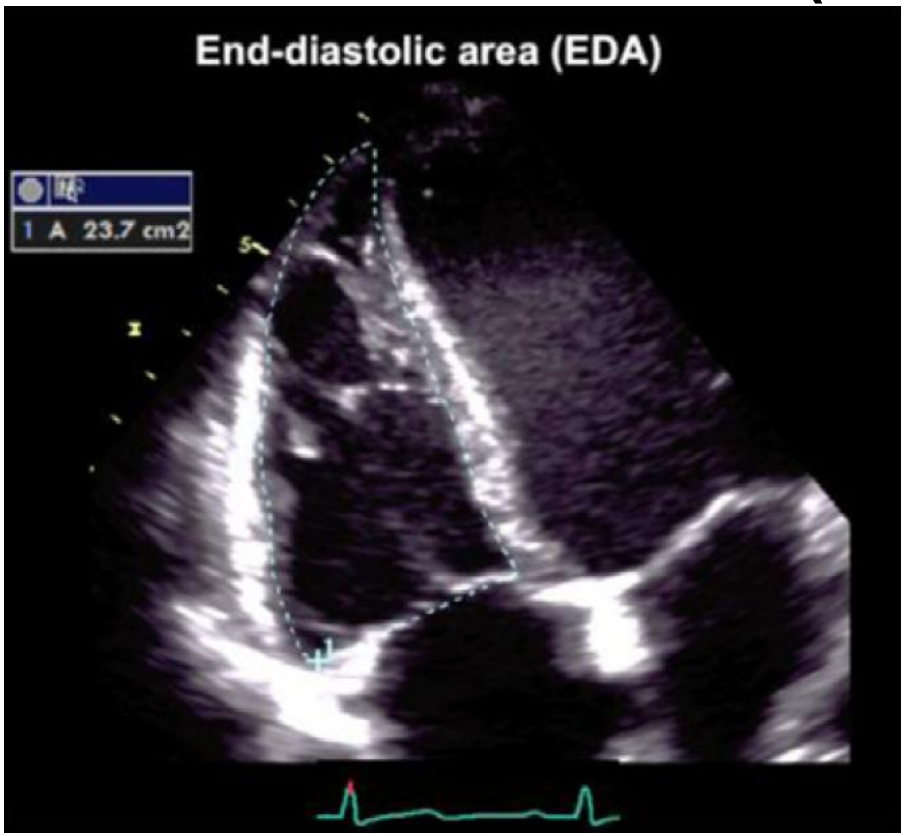
Fractional area change

- EDA ≤ 24 cm2 či ≤ 12.6 cm2/m2 (muži)
- EDA ≤ 20 cm2 či ≤ 11.5 cm2/m2 (ženy)



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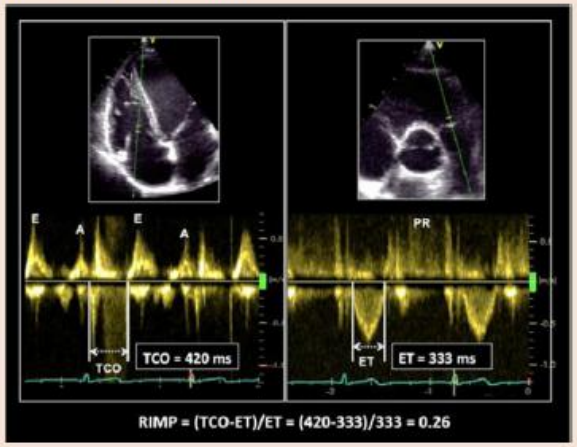
Hodnocení funkce PK

RV global function

Pulsed Doppler RIMP



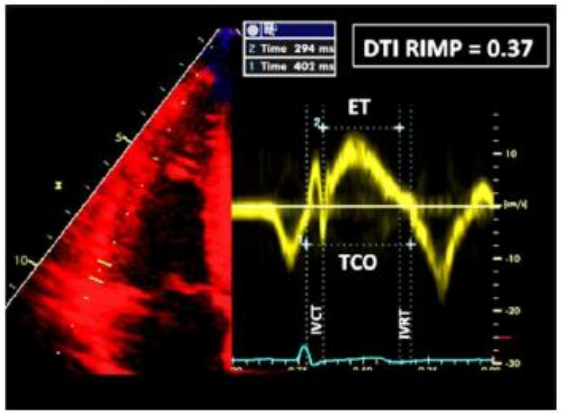
RIMP (Tei index) by pulsed Doppler:
RIMP = (TCO – ET)/ET

- Prognostic value
- Less affected by heart rate

- Requires matching for R-R intervals when measurements are performed on separate recordings
- Unreliable when RA pressure is elevated

RIMP by PW doppler > 0.43

Tissue Doppler RIMP



RIMP by tissue Doppler:
RIMP = (IVRT + IVCT)/ET =
(TCO – ET)/ET

- Less affected by heart rate
- Single-beat recording with no need for R-R interval matching

- Unreliable when RA pressure is elevated

RIMP by TDI doppler > 0.54

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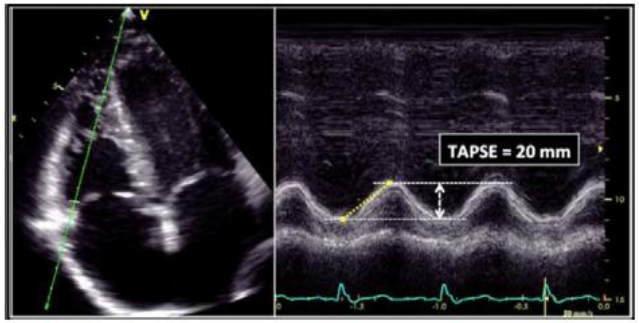
Hodnocení funkce PK

RV longitudinal systolic function

TAPSE



- Tricuspid annular longitudinal excursion by M-mode (mm), measured between end-diastole and peak systole
- Proper alignment of M-mode cursor with the direction of RV longitudinal excursion should be achieved from the apical approach.

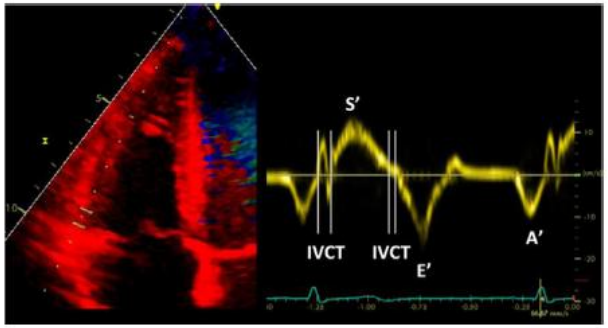
- Established prognostic value
- Validated against radionuclide EF

- Angle dependency
- Partially representative of RV global function*

TAPSE > 17 mm

24±3.5

Pulsed tissue Doppler S wave



- Peak systolic velocity of tricuspid annulus by pulsed-wave DTI (cm/sec), obtained from the apical approach, in the view that achieves parallel alignment of Doppler beam with RV free wall longitudinal excursion

- Easy to perform
- Reproducible
- Validated against radionuclide EF
- Established prognostic value

- Angle dependent
- Not fully representative of RV global function, particularly after thoracotomy, pulmonary thromboendarterectomy or heart transplantation

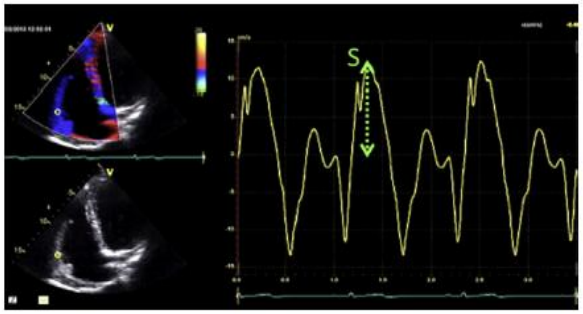
S waveTDI < 9.5 cm/s

14.1±2.3

Lang MR et al. Chamber quantification 2015

Hodnocení funkce PK

Color tissue Doppler S wave



- Peak systolic velocity of tricuspid annulus by color DTI (cm/sec)

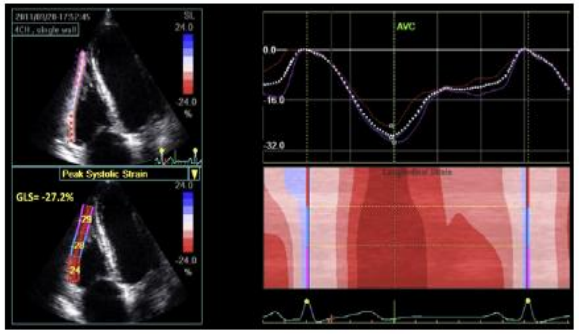
< 6.0 cm/s

9.7±1.85

- Sampling is performed after image acquisition
- Allows multisite sampling on the same beat

- Angle dependent
- Not fully representative of RV global function, particularly after thoracotomy, pulmonary thrombendarterectomy or heart transplantation
- Lower absolute values and reference ranges than pulsed DTI S′ wave
- Requires offline analysis

GLS



- Peak value of 2D longitudinal speckle tracking derived strain, averaged over the three segments of the RV free wall in RV-focused apical four-chamber view (%)

- Angle independent
- Established prognostic value

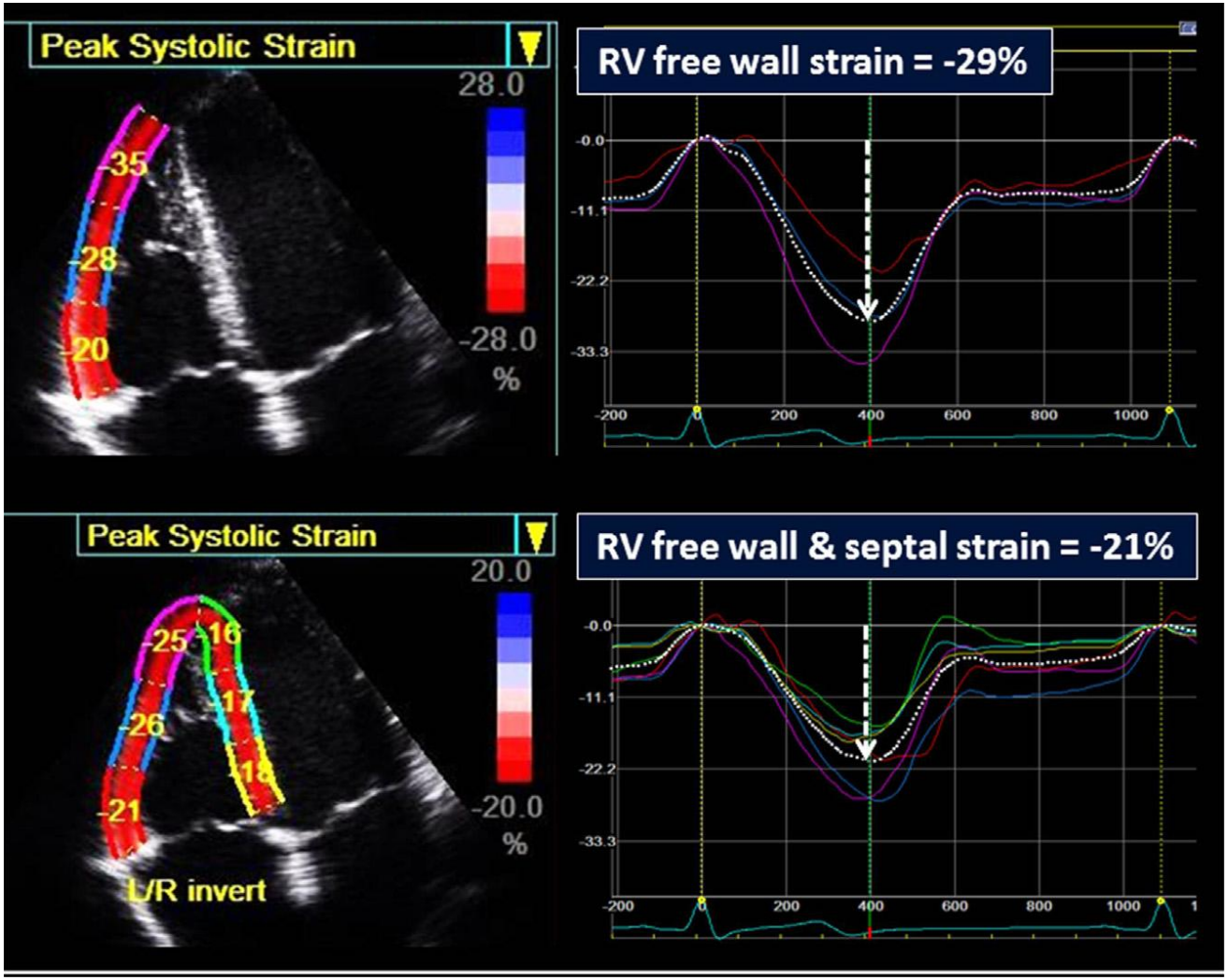
- Vendor dependent

Long. strain (GLS) > 20%

29±4

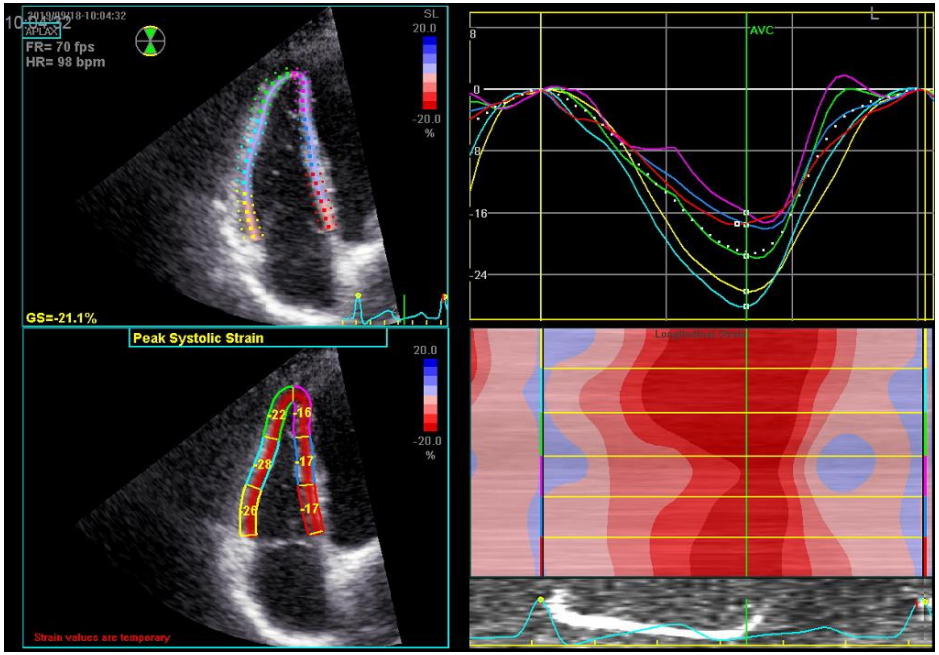
Lang MR et al. Chamber quantification 2015

RV longitudinální strain

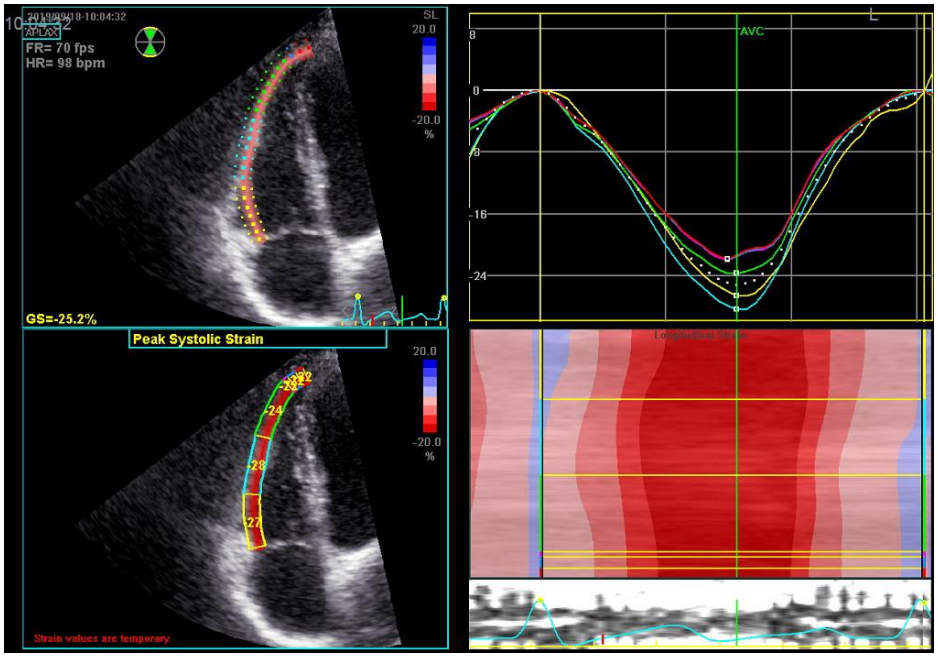


Lang MR et al. Chamber quantification 2015

Longitudinální strain PK



21.1%



25.2%

Normální parametry funkce PK

Table 10 Normal values for parameters of RV function

Parameter	Mean ± SD	Abnormality threshold
TAPSE (mm)	24 ± 3.5	<17
Pulsed Doppler S wave (cm/sec)	14.1 ± 2.3	<9.5
Color Doppler S wave (cm/sec)	9.7 ± 1.85	<6.0
RV fractional area change (%)	49 ± 7	<35
RV free wall 2D strain* (%)	−29 ± 4.5	>−20 (<20 in magnitude with the negative sign)
RV 3D EF (%)	58 ± 6.5	<45
Pulsed Doppler MPI	0.26 ± 0.085	>0.43
Tissue Doppler MPI	0.38 ± 0.08	>0.54
E wave deceleration time (msec)	180 ± 31	<119 or >242
E/A	1.4 ± 0.3	<0.8 or >2.0
e′/a′	1.18 ± 0.33	<0.52
e′	14.0 ± 3.1	<7.8
E/e′	4.0 ± 1.0	>6.0

Lang MR et al. Chamber quantification 2015

Funkce pravé komory po operaci vrození srdeční vady

Table 1 Pertinence of variables of right ventricular systolic function in patients with repaired congenital heart disease.

	Feasibility	Reproducibility	Correlation with RVEF by MRI	Cut-off value for abnormal RV function
TAPSE, PSV	++	++	—	—
GLPSS	+	+	—	—
IVA	++	+	—	<1.8 m/s2
MPI		++	±	>0.28
RV FAC	+	+	+	<35%
RT3DE	+	+	++	<50%
3DKBR	++	+	++	<50%

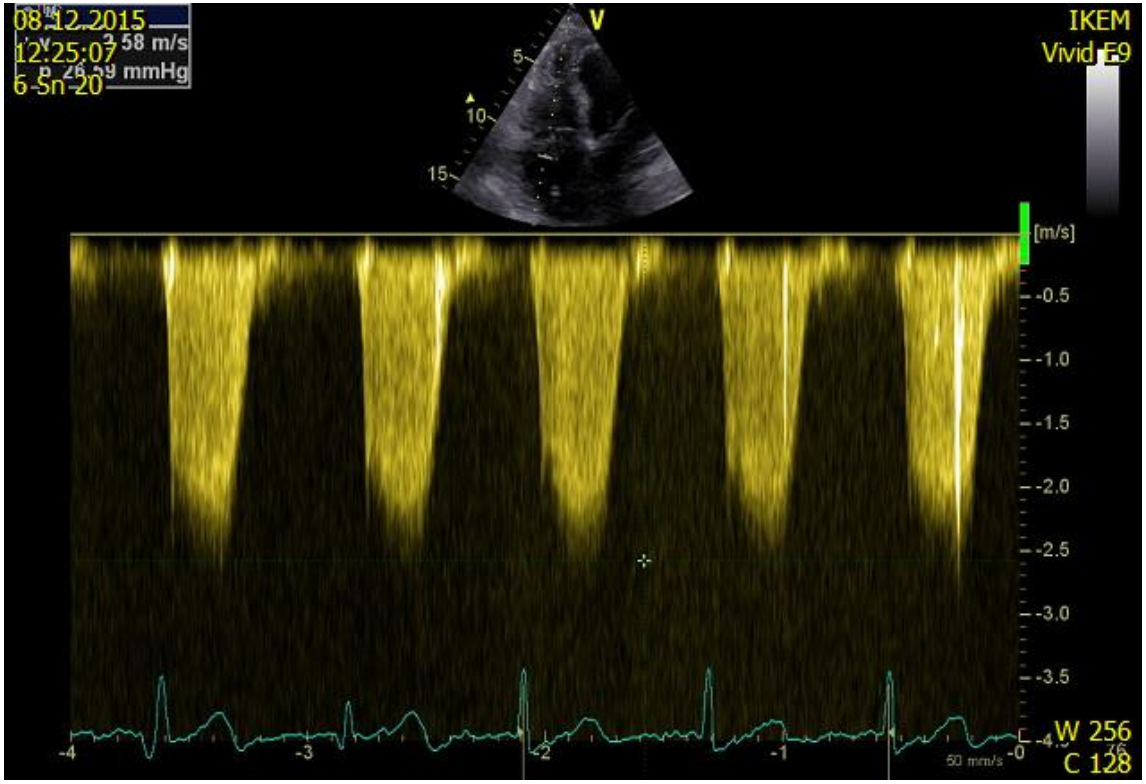
3DKBR: three-dimensional knowledge-based reconstruction; FAC: fractional area change; GLPSS: global longitudinal peak systolic strain of RV lateral wall; IVA: isovolumic acceleration time; MPI: myocardial performance index; MRI: magnetic resonance imaging; PSV: peak systolic velocity; RT3DE: real-time three-dimensional echocardiography; RV: right ventricular; RVEF: right ventricular ejection fraction; TAPSE: tricuspid annular plane systolic excursion.

Diala Khraiche, Nidhal Ben Moussa. Arch Cardiovasc Disease 2016

Odhad tlaku v pravé komoře

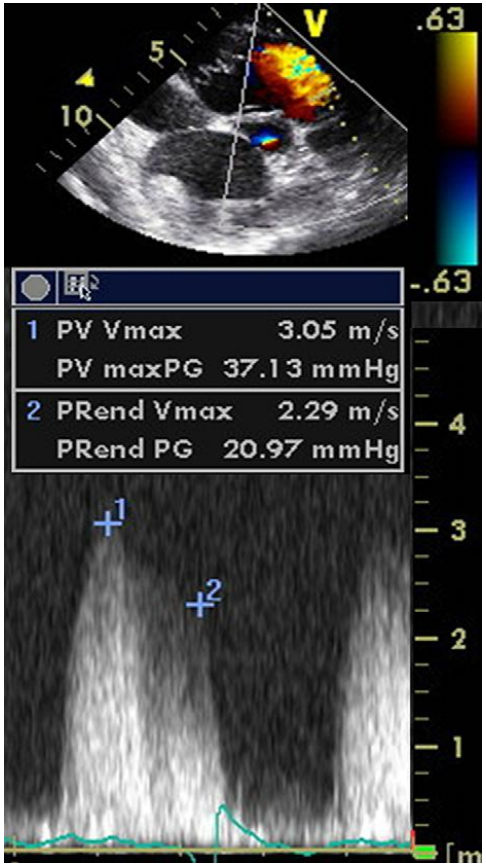
PG max na trikuspidální regurgitaci

Systolický tlak v plicnici



PG max pulm. Regurgitaci

Střední tlak v plicnici



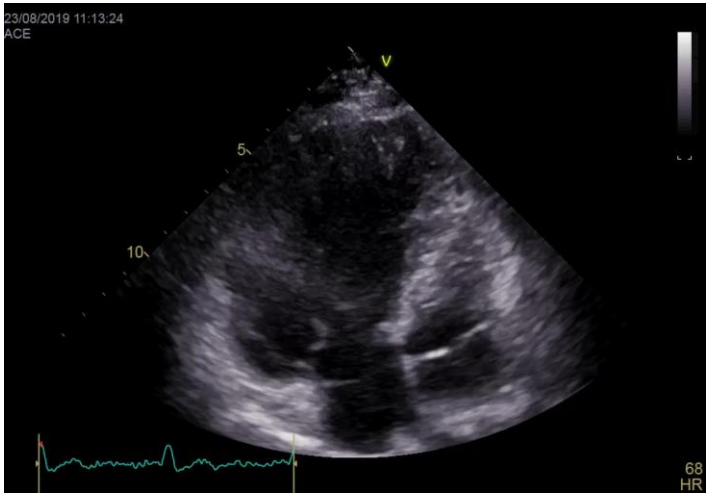
Rudsky LD et al. Guidelines RV 2010

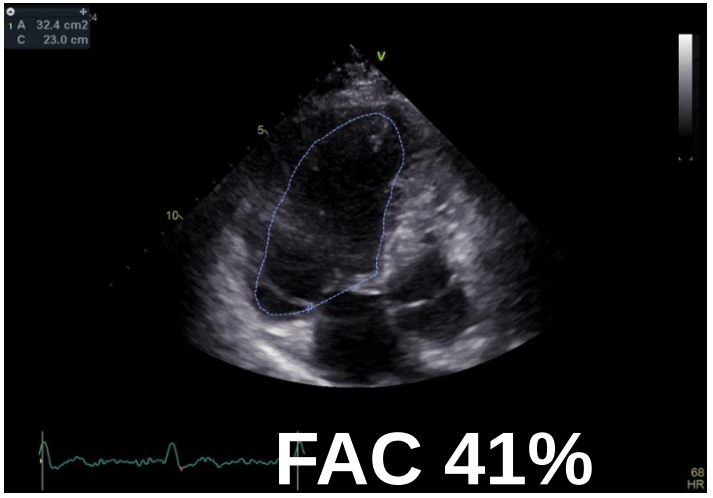
Odhad tlaku v pravé síni

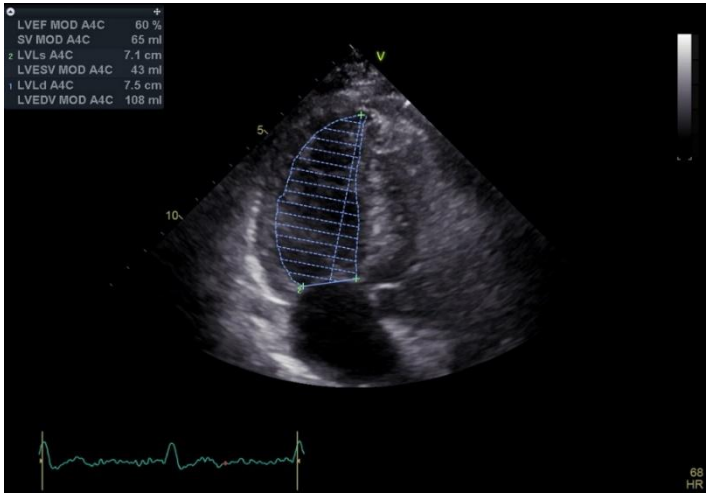
- DDŽ < 2.1 cm kolabující > 50% 0-5 mmHg
- DDŽ > 2.1 cm kolabující < 50% 10-15 mmHg

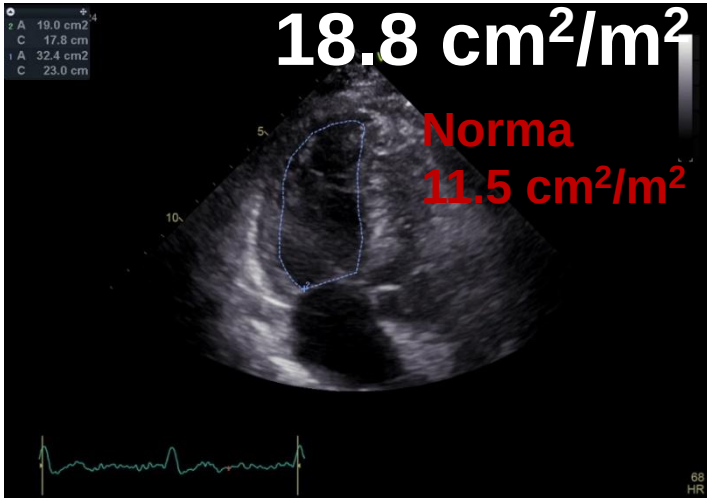
Lang MR et al. Chamber quantification 2015

Fallotova tetralogie, korekce v dětství, t.č. významná pulmonální regurgitace



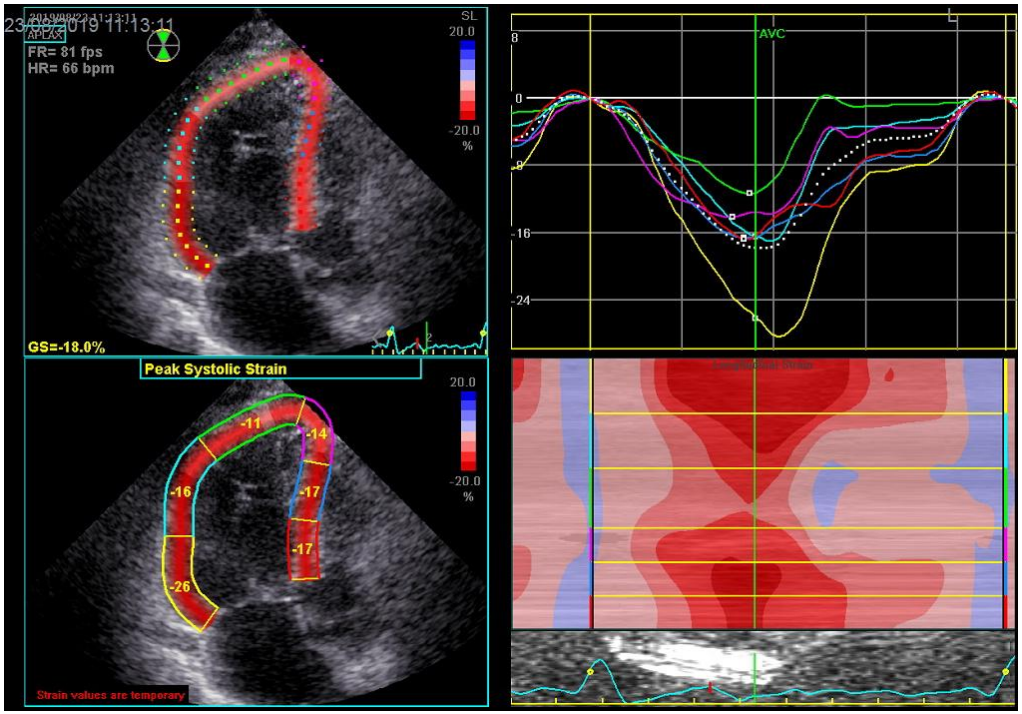






Fallotova tetralogie, korekce v dětství, t.č. významná pulmonální regurgitace

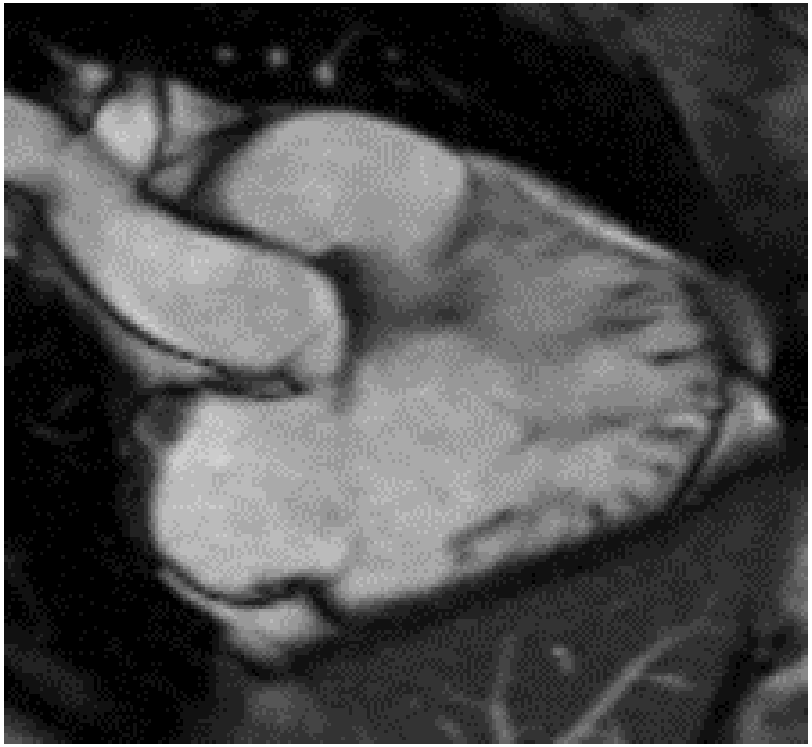
Longitudinální strain 18%



PK dilatovaná
PK s normální syst.funkcí

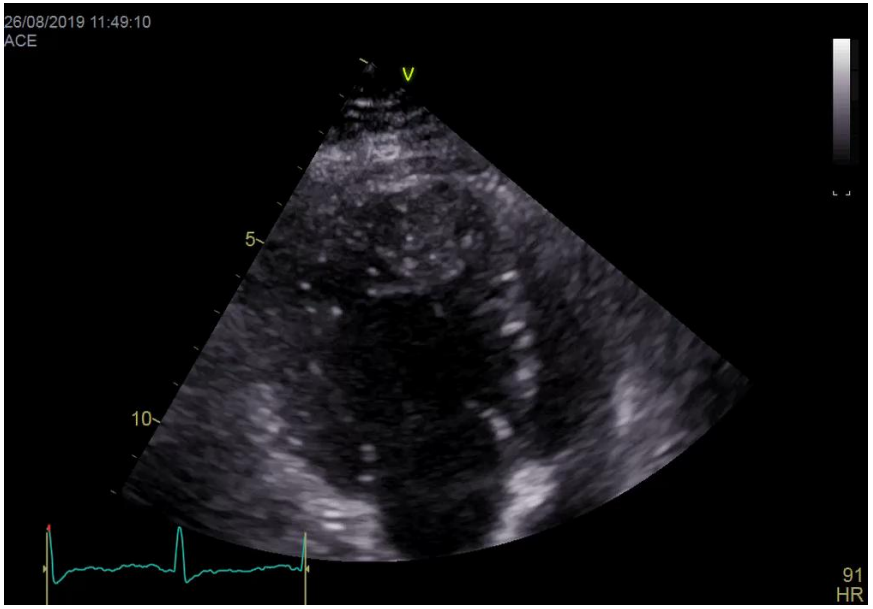
Fallotova tetralogie, korekce v dětství, t.č. významná pulmonální regurgitace

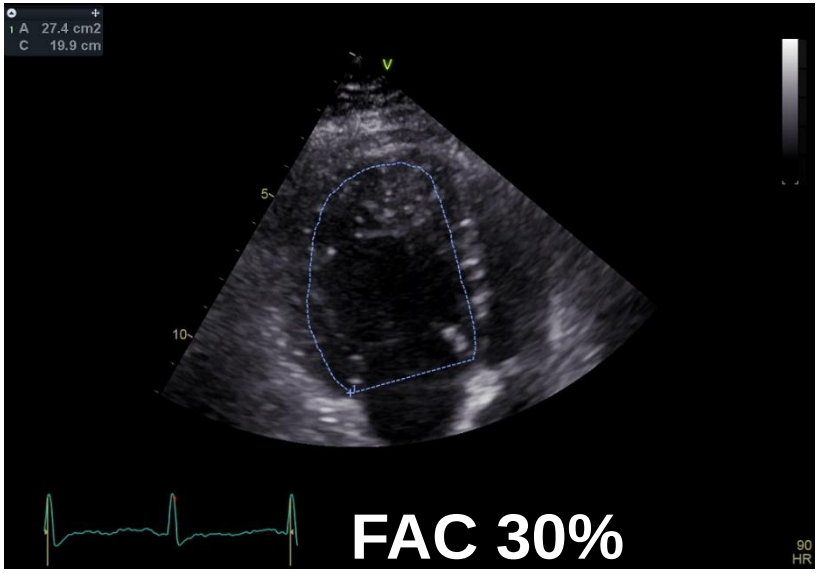
MRI EF PK 42% (49-73); EDVi 159 ml/m2 (67-111)

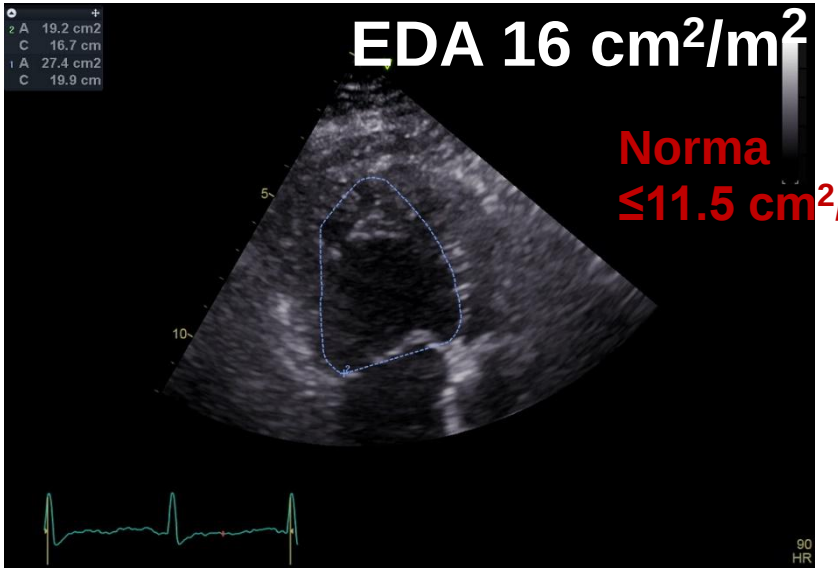


PK těžce dilatovaná
PK se sníženou syst.funkcí

TGA - Mustard



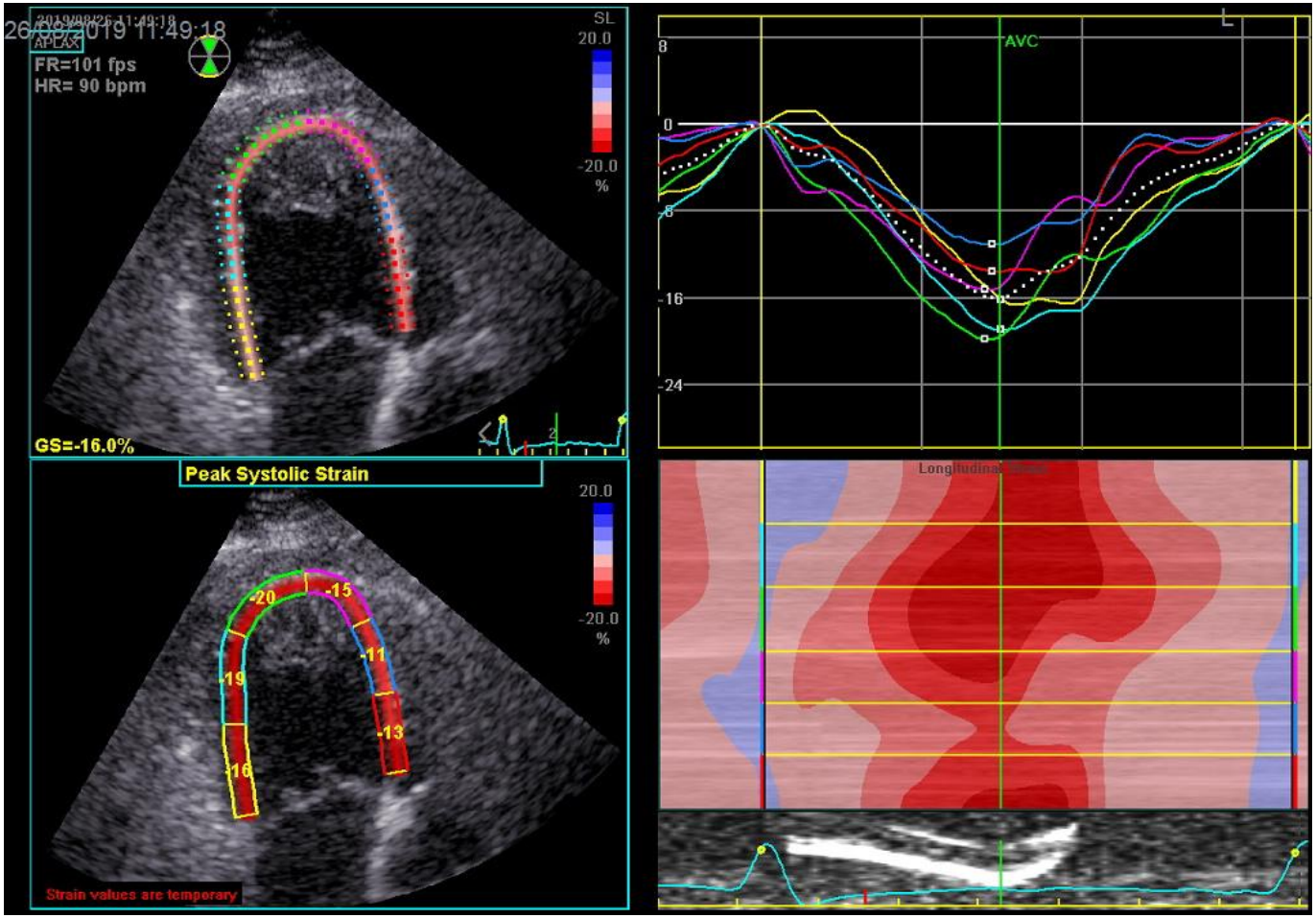




PK dilatovaná
PK se sníženou syst.funkcí

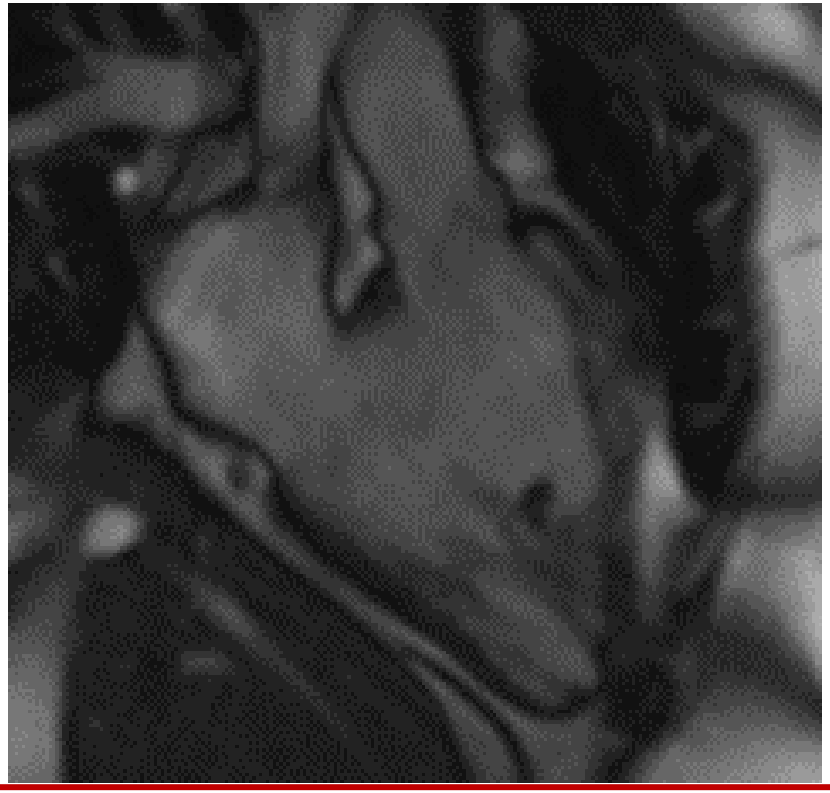
TGA - Mustard

Longitudinální strain 16%



TGA - Mustard

MRI EF PK 51% (49-73); EDVi 89 ml/m2 (67-111)



PK nedilatovaná
PK se normální ejekční frakcí

Děkuji za pozornost

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