



**VŠEOBECNÁ FAKULTNÍ
NEMOCNICE V PRAZE**



**1. LÉKAŘSKÁ
FAKULTA**
Univerzita Karlova

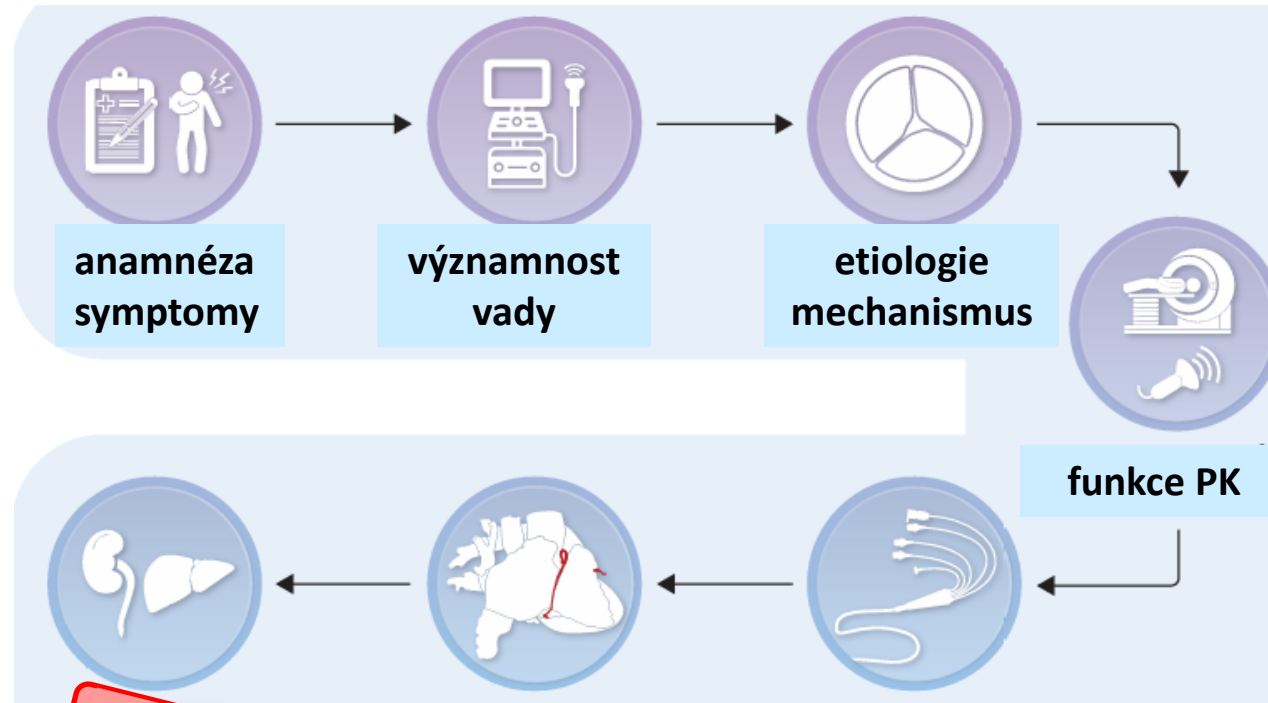
Do přinesla nová ESC doporučení 2025?

Trikuspidální vady

Zuzana Hlubocká



Trikuspidální regurgitace – postup step-by-step



Recommendations

New

Careful evaluation of TR aetiology, stage of the disease (i.e. degree of TR severity, RV and LV dysfunction, and PH), patient operative risk, and likelihood of recovery by a multidisciplinary Heart Team is recommended in patients with severe TR prior to intervention.

Class

Level

I

C

Zobrazovací metody u TR

- **Echokardiografie**

- kvantifikace, etiologie a mechanismus TR
- Velikost, objem a funkce PK

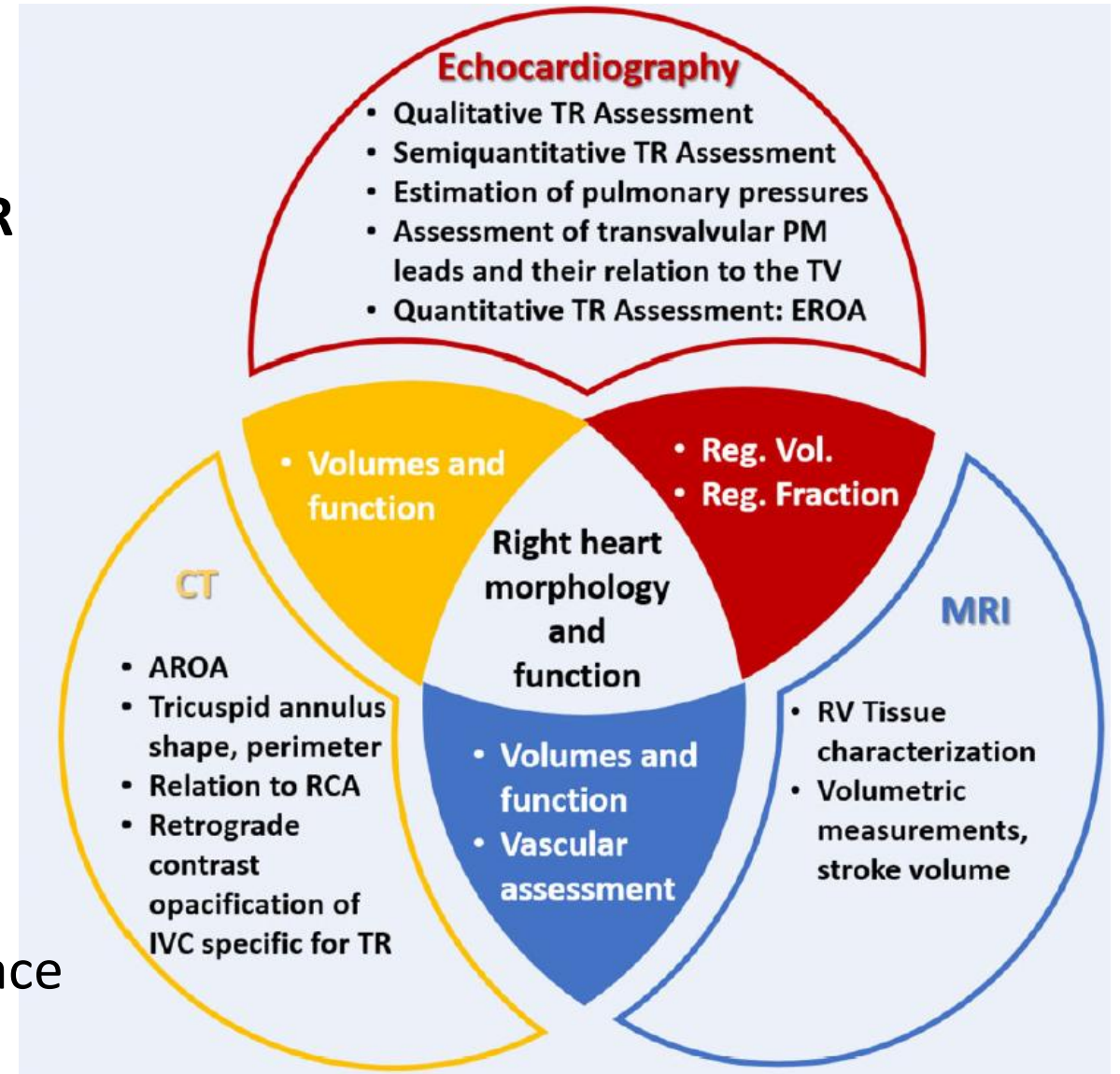
- **MRI srdce**

- objemy a funkce pravé komory
- kvantifikace TR

- **CT srdce**

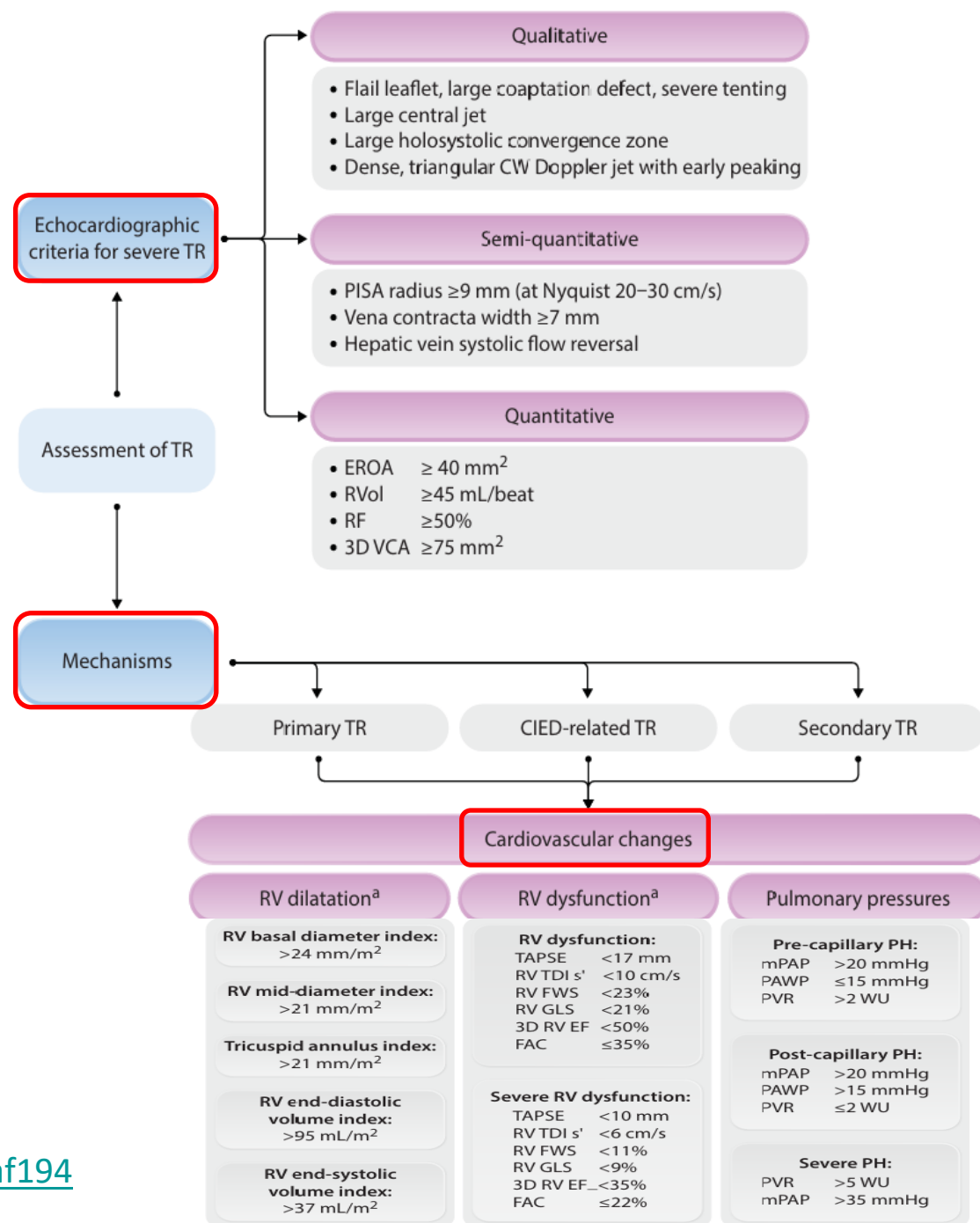
- morfologie anulu, plánování intervencí
- objemy a funkce PK

+ **Katetrizační vyšetření** – pravostranná katetrizace



Echokg hodnocení trikuspidální regurgitace

- **Kvantifikace** významnosti regurgitace
- Hodnocení etiologie/**mechanismu** vady
- Posouzení **důsledků** vady na pravé srdce



Kvantifikace trikuspidální regurgitace

EACVI/ESC a ASE guidelines

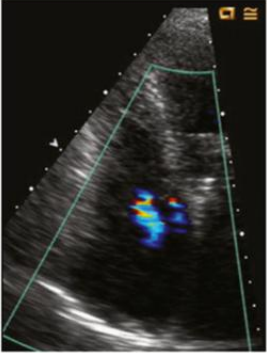
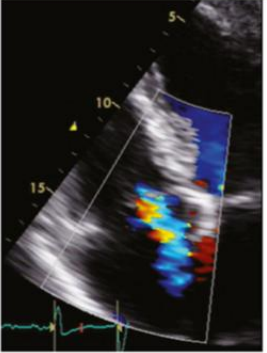
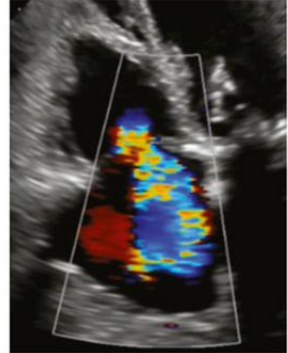
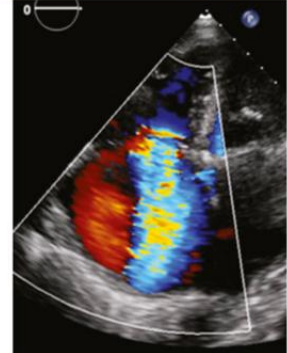
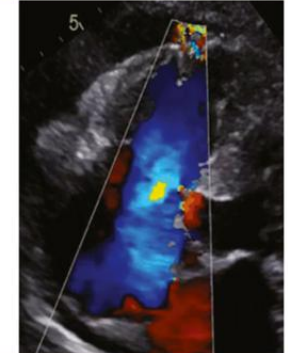
Parameters	Mild	Moderate	Severe
Qualitative			
TV morphology	Mildly abnormal leaflets (e.g. mild rheumatic thickening, limited prolapse)	Moderately abnormal leaflets (e.g. moderate thickening or prolapse)	Severe valve lesions (e.g. Flail leaflet, ruptured papillary muscle, severe retraction, large perforation or vegetation)
Interventricular septal motion	Normal	Typically normal	Paradoxical/ volume overload pattern
Color flow TR jet [Note: not recommended for sole grading of severity]	Small RA penetration or not holosystolic	Moderate RA penetration or large penetration and late systolic	Deep RA penetration and holosystolic jet
Flow convergence zone	Not visible, transient or small	Intermediate in size and duration	Large throughout systole
CW signal TR jet	Faint/parabolic or partial contour	Dense, variable contour	Dense, triangular with early peaking contour (peak <2 m/s in very severe TR)
IVC diameter	Normal	2.1 -2.5 cm	>2.5 cm
Semi-quantitative			
Color flow jet area (cm ²) [Central Jet] ^a	<5	5-10	> 10
Color jet area:RA area (%)	10-20	10-33	>33
Vena contracta (cm)	<0.3	<0.6	≥ 0.7
PISA Radius (cm) ^b	≤0.5	0.6-0.9	> 0.9
Hepatic vein flow	Systolic dominance	Systolic blunting ^c	Systolic flow reversal
Tricuspid inflow	E-wave < 1 m/sec or A-wave dominant	Variable	E-wave ≥1.0 m/sec
Quantitative			
EROA (mm ²) [by PISA]	<20	20-39 ^d	≥40
EROA (mm ²) [by 3D]	Unknown	Unknown	>75
Regurgitant volume(mL) [by PISA]	<30	30-45 ^d	≥45
RV and RA size	Usually normal	Usually normal or mild dilatation	Usually dilated ^e

Lancellotti P. Eur Heart J Cardiovasc Imaging 2022; 23: e171-232

Hahn R.T., Eur Heart J Cardiovasc Imaging 2017, 18: 1342-43



Rozšířené schéma kvantifikace TR

Parameters	MILD	MODERATE	Těžká regurgitace		
			SEVERE	MASSIVE	TORRENTIAL
Vena Contracta width (biplane average)	<3 mm	3-6.9 mm	7 mm - 13 mm	14-20 mm	≥21 mm
EROA by PISA	<20 mm ²	20-39 mm ²	40-59 mm ²	60-79 mm ²	≥80 mm ²
3D Vena Contracta Area or Quantitative Doppler EROA	-	-	75-94 mm ²	95-114 mm ²	≥115 mm ²
Example:					

Rebecca T. Hahn et al. *J Am Coll Cardiol Img* 2019; 12:469-490.

Echokg parametry významné trikuspidální regurgitace

Qualitative

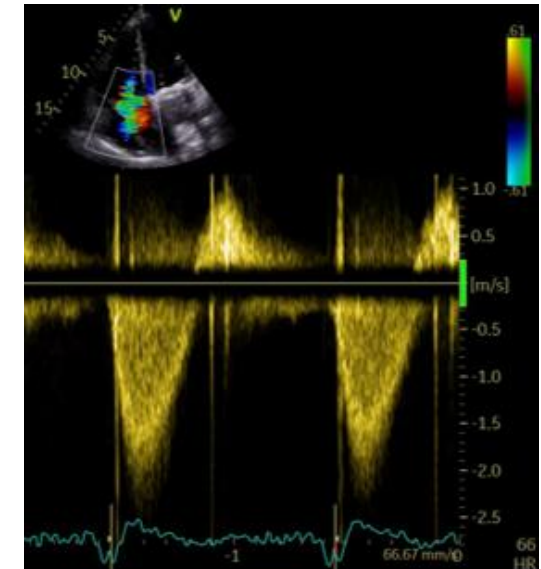
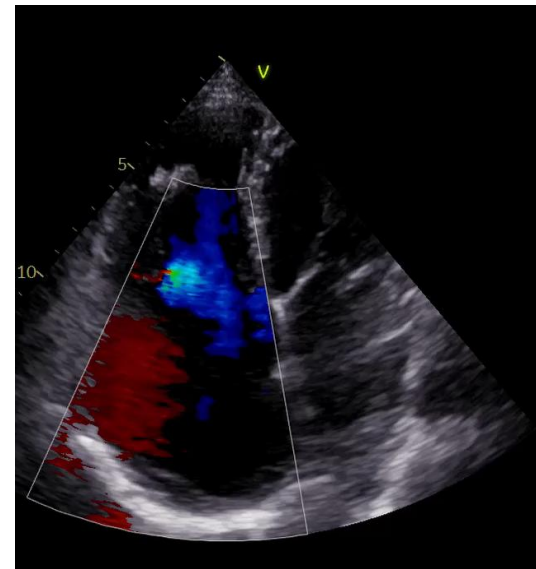
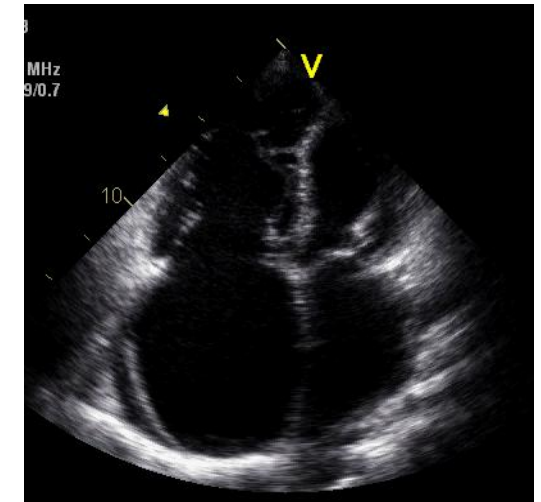
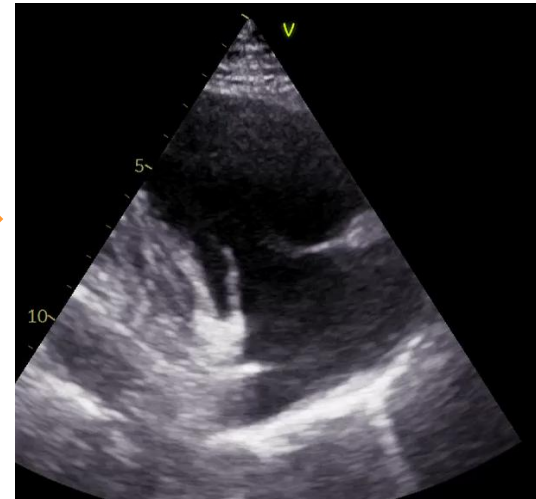
- Flail leaflet, large coaptation defect, severe tenting
- Large central jet
- Large holosystolic convergence zone
- Dense, triangular CW Doppler jet with early peaking

Semi-quantitative

- PISA radius ≥ 9 mm (at Nyquist 20–30 cm/s)
- Vena contracta width ≥ 7 mm
- Hepatic vein systolic flow reversal

Quantitative

- EROA ≥ 40 mm²
- RVol ≥ 45 mL/beat
- RF $\geq 50\%$
- 3D VCA ≥ 75 mm²



Kvantifikace trikuspidální regurgitace

Qualitative

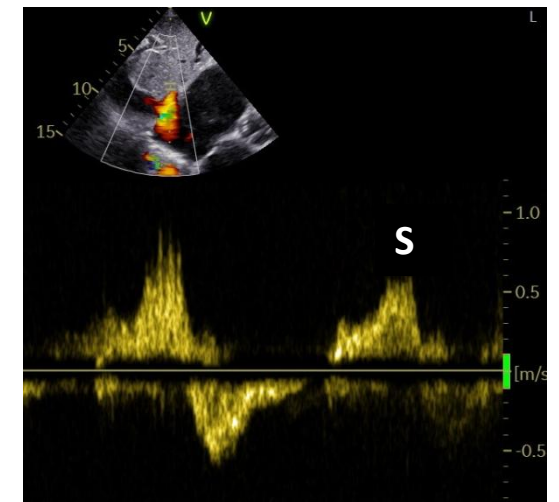
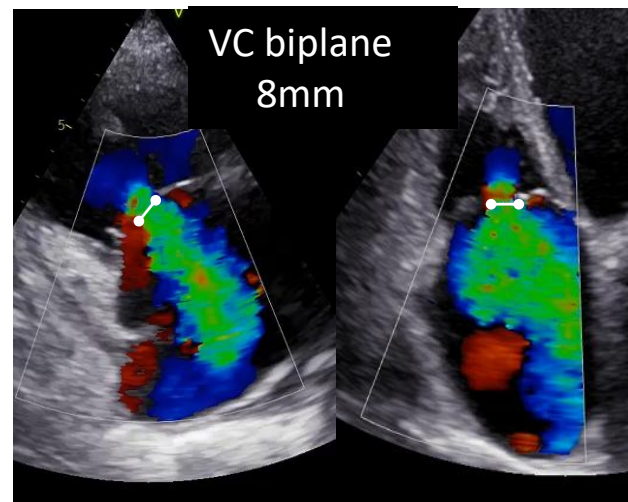
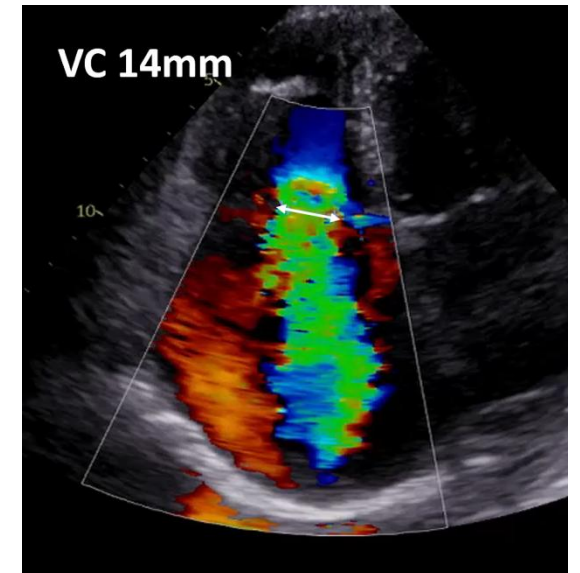
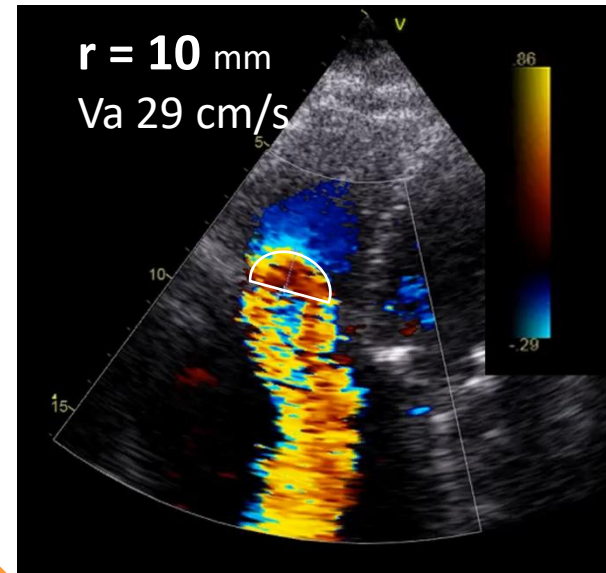
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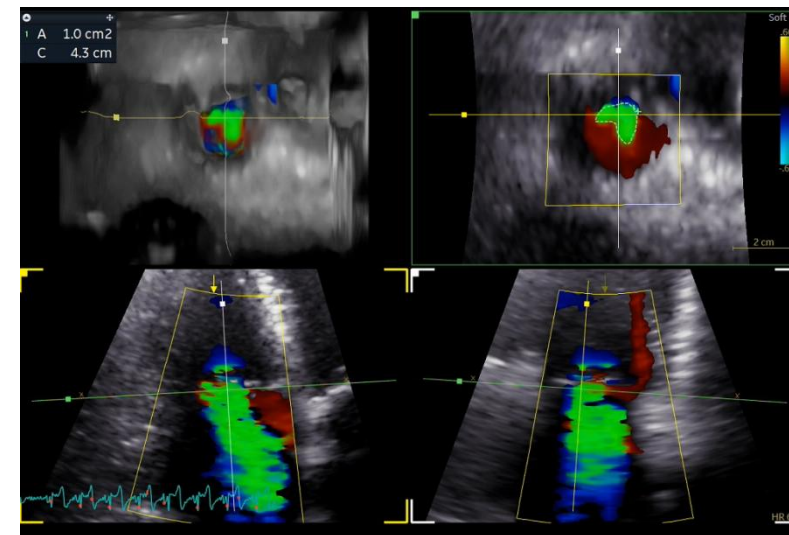
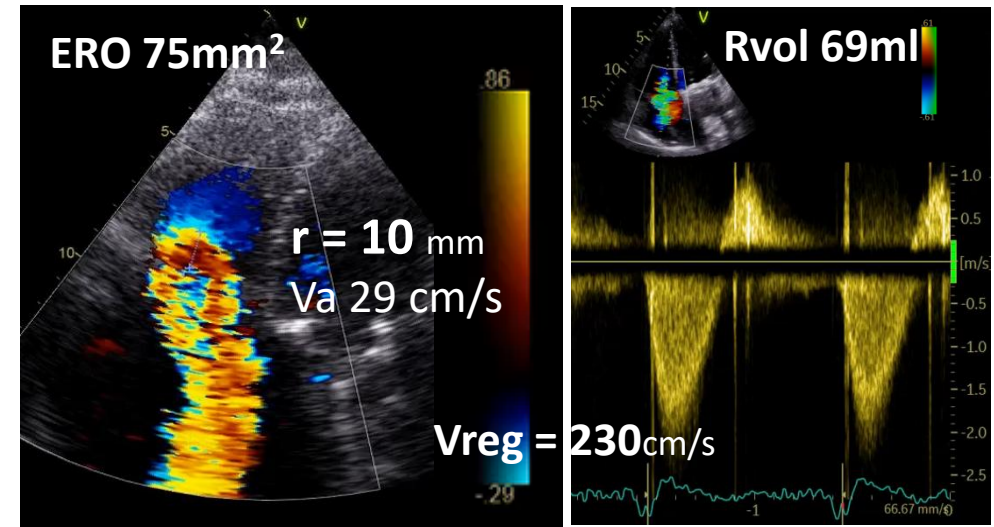
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Hodnocení mechanismu TR

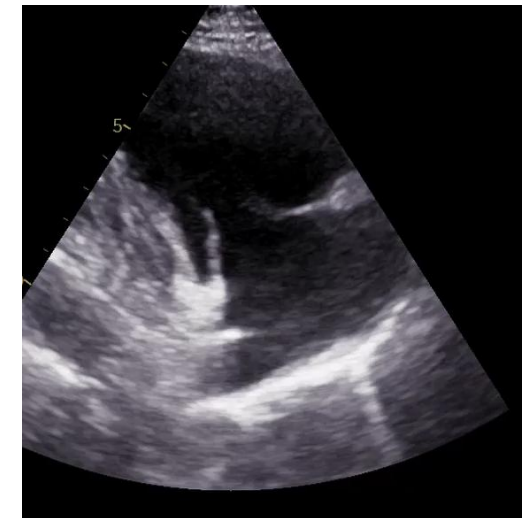
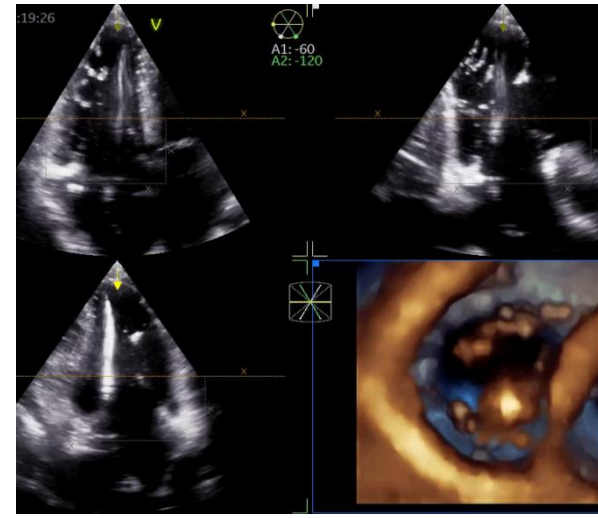
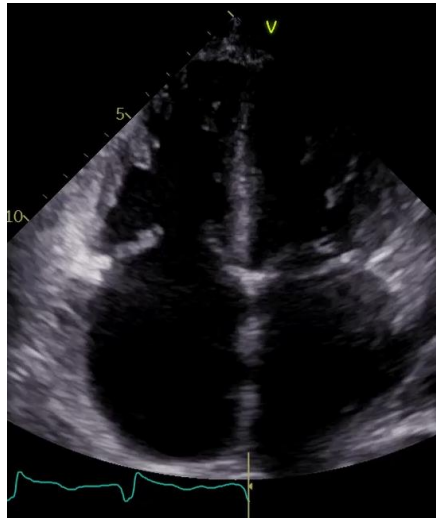
Sekundární/funkční (88%)

CIED TR

Primární/organická (8%)

Atriální

Ventrikulární



Fibrilace síní

Plicní hypertenze

- při vadách a onem. levého srdce
- arteriální
- plicní nemoci, embolie

Ebsteinova anomálie

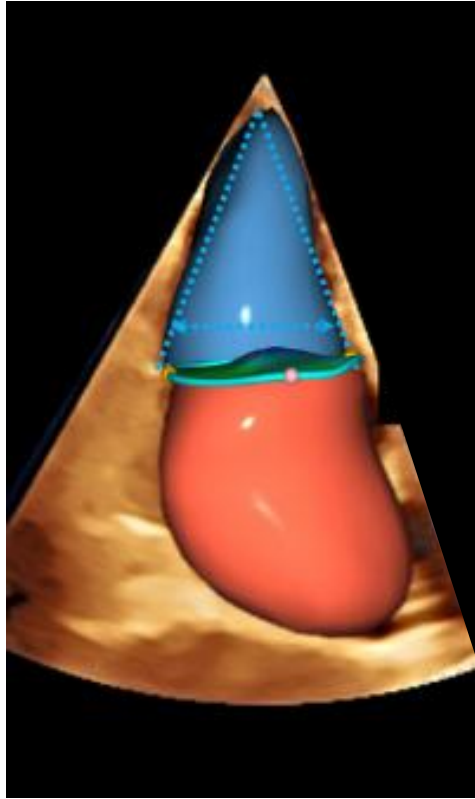
Infekční endokarditida

Prolaps

Karcinoid, trauma

Atriální sekundární TR

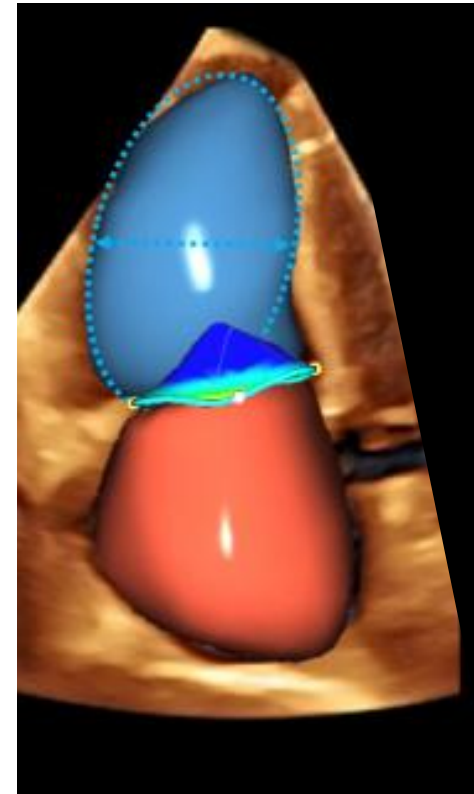
- ✓ **kónická PK**
dilatace bazálně
- ✓ **dilatace anulu**
bez význ. tetheringu
- ✓ **dilatace síně**
dominuje



- x **bez těžší plicní hypertenze**
- x **bez význ. dilatace/dysfunkce PK, LK**
- x **bez onem. levého srdce**

Ventrikulární sekundární TR

- ✓ **sférická PK**
dilatace a
prodloužení PK
- ✓ **tethering cípů**
menší dilatace anulu
- ✓ **dilatace PK**
proporčně k síni



- ✓ **plicní hypertenze**
- ✓ **dilatace/dysfunkce PK, LK**
- ✓ **onemocnění levého srdce**

Hodnocení důsledků TR na pravé srdce

Cardiovascular changes

RV dilatation^a

RV basal diameter index:
>24 mm/m²

RV mid-diameter index:
>21 mm/m²

Tricuspid annulus index:
>21 mm/m²

RV end-diastolic
volume index:
>95 mL/m²

RV end-systolic
volume index:
>37 mL/m²

RV dysfunction^a

RV dysfunction:

TAPSE <17 mm
RV TDI s' <10 cm/s
RV FWS <23%
RV GLS <21%
3D RV EF <50%
FAC ≤35%

Severe RV dysfunction:

TAPSE <10 mm
RV TDI s' <6 cm/s
RV FWS <11%
RV GLS <9%
3D RV EF <35%
FAC ≤22%

Pulmonary pressures

Pre-capillary PH:

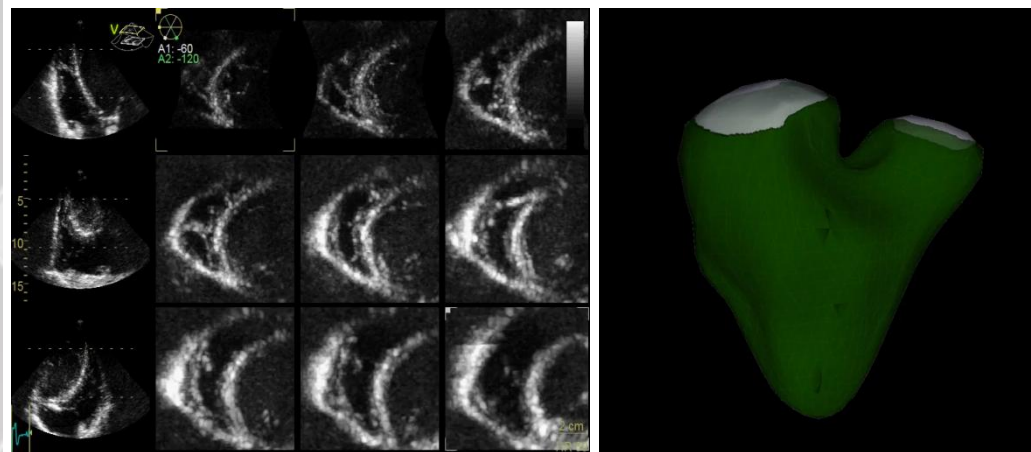
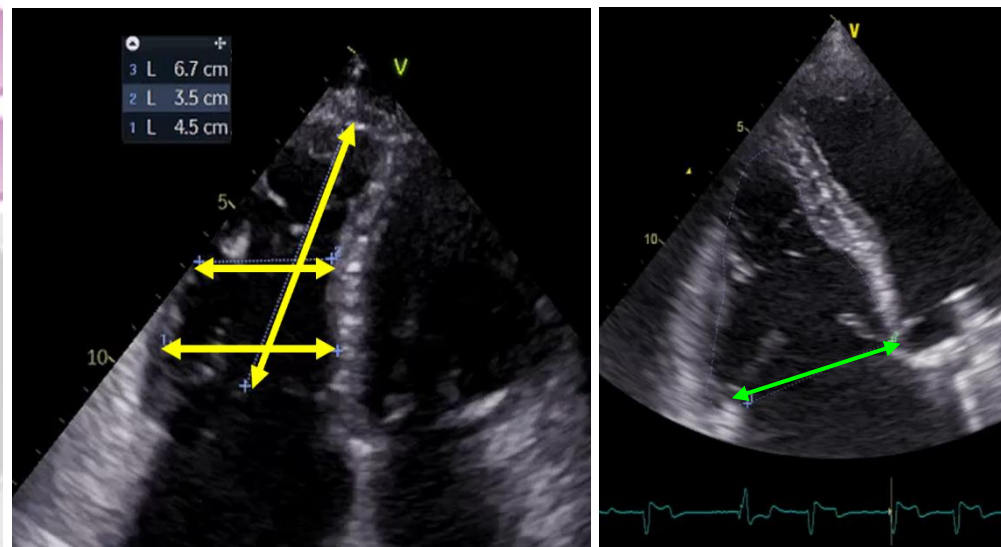
mPAP >20 mmHg
PAWP ≤15 mmHg
PVR >2 WU

Post-capillary PH:

mPAP >20 mmHg
PAWP >15 mmHg
PVR ≤2 WU

Severe PH:

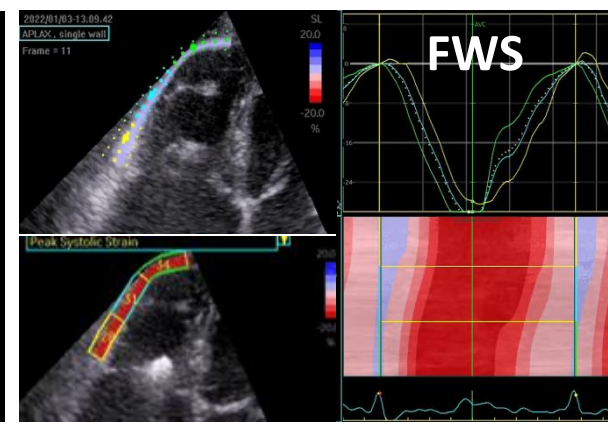
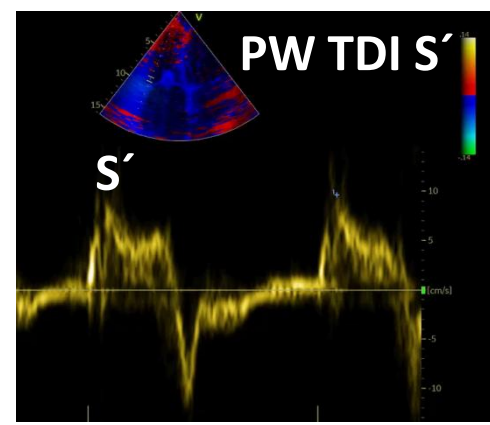
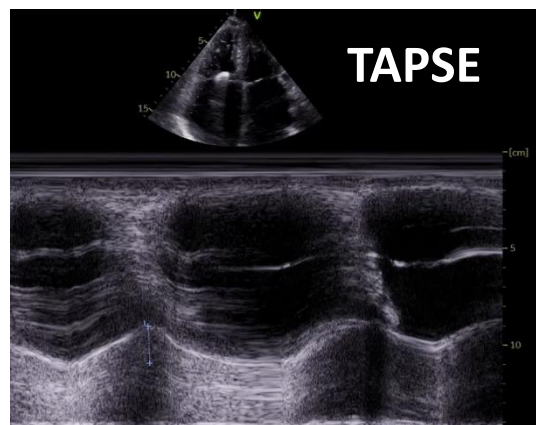
PVR >5 WU
mPAP >35 mmHg



Hodnocení funkce pravé komory

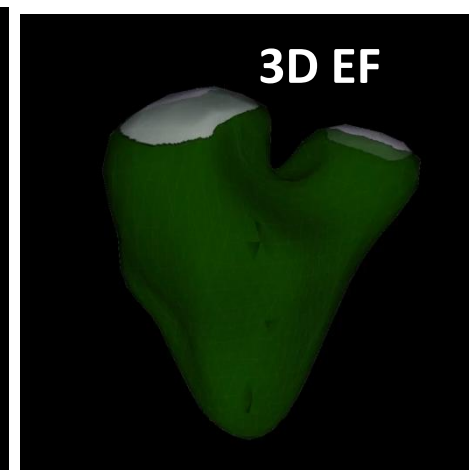
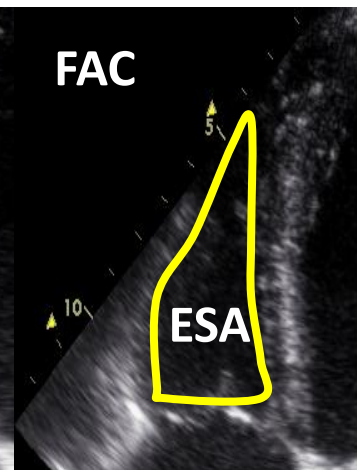
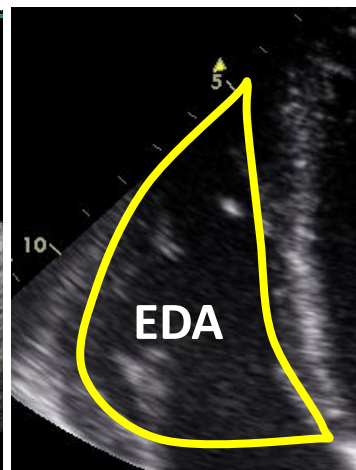
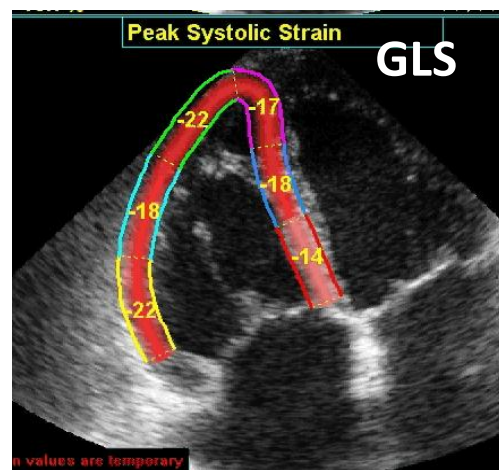
RV dysfunction:

TAPSE	<17 mm
RV TDI s'	<10 cm/s
RV FWS	<23%
RV GLS	<21%
3D RV EF	<50%
FAC	≤35%



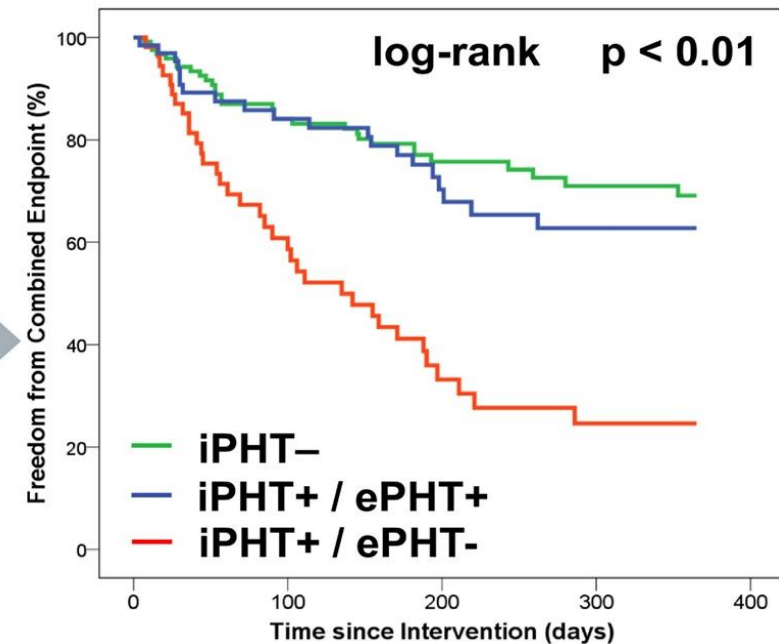
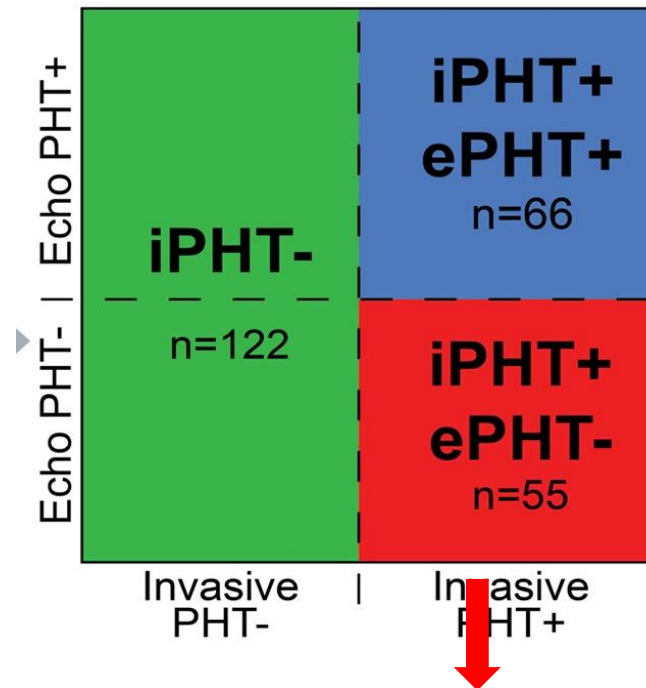
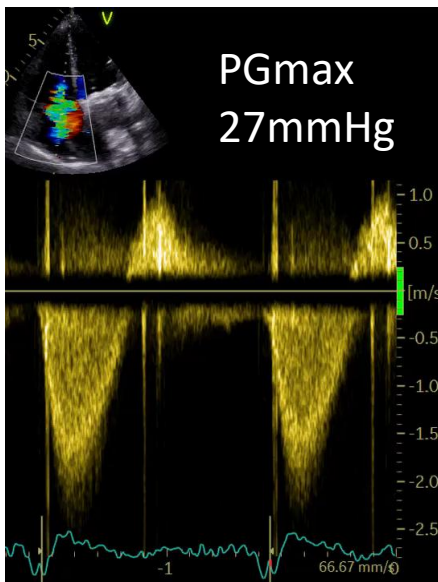
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Plicní hypertenze u nemocných s významnou TR

- 243 pacientů s významnou TR, plicní hypertenze echokg a pravostrannou katetrizací
- jen 55% pacientů s invazivně PASP > 50mmHg mělo echokg plicní hypertenzi (PASP > 50mmHg)
- iPHT+/ePHT- mají nejhorší prognózu



**Echokg hodnocení plicní hypertenze má u významné TR omezený význam
Pravostranná srdeční katetrizace – nezbytná před indikací k výkonu na TR**

Hodnocení plicní hypertenze

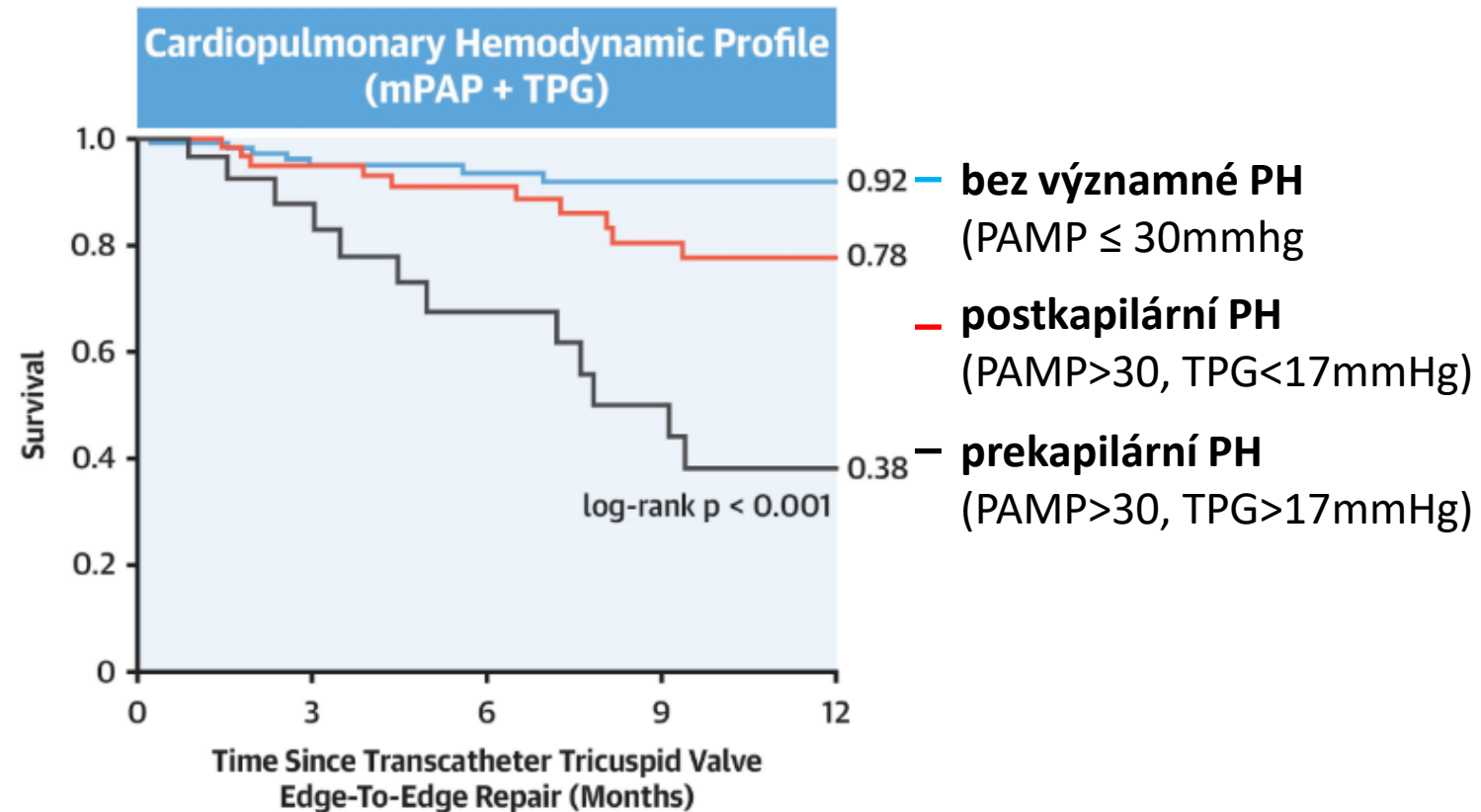
⇒ Pravostranná katetrizace doporučena u významné TR zvažované k intervenci

Pulmonary pressures

Pre-capillary PH:
 mPAP >20 mmHg
 PAWP ≤15 mmHg
 PVR >2 WU

Post-capillary PH:
 mPAP >20 mmHg
 PAWP >15 mmHg
 PVR ≤2 WU

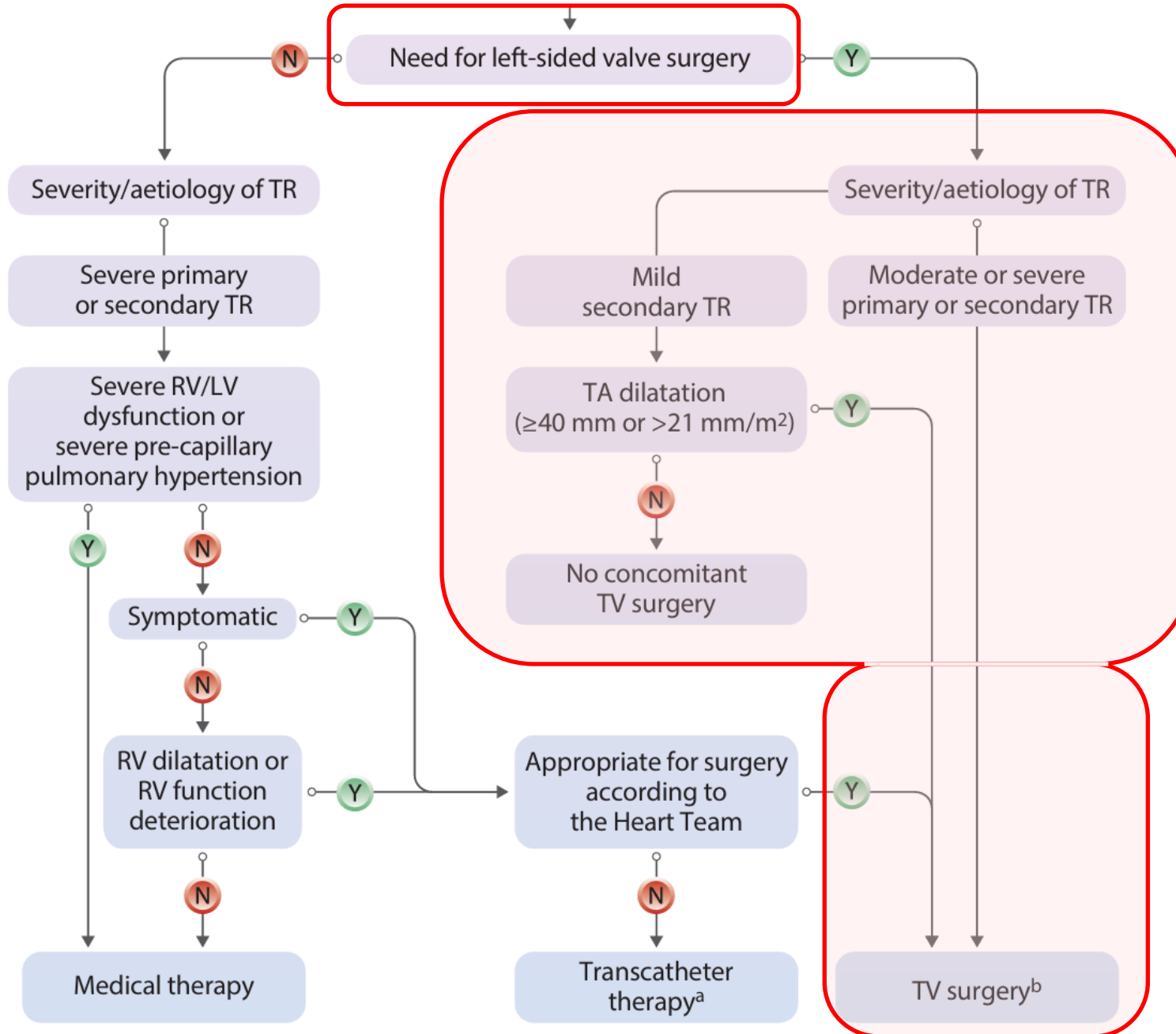
Severe PH:
 PVR >5 WU
 mPAP >35 mmHg





No. at risk:

No PH	128	81	70	51	41
Post-Cap PH	71	52	43	28	24
Pre-Cap PH	30	18	11	8	6

Indikace k intervenci u pacientů s TR



Indikace k intervenci TR – nemocní indikovaní k operaci levostranné vady

Recommendations	Class	Level
Patients with tricuspid regurgitation and left-sided valvular heart disease requiring surgery		
Concomitant TV surgery is recommended in patients with <u>severe primary or secondary TR</u> .	I	B
Concomitant <u>TV repair</u> should be considered in patients with <u>moderate primary or secondary TR</u> , to avoid progression of TR and RV remodelling. 	IIa	B
Concomitant TV repair may be considered in selected patients with <u>mild secondary TR and tricuspid annulus dilatation</u> (≥ 40 mm or > 21 mm/m ²), to avoid progression of TR and RV remodelling. 	IIb	B



TR u nemocných s významnou levostrannou vadou

Randomized Controlled Trial > N Engl J Med. 2022 Jan 27;386(4):327-339.

doi: 10.1056/NEJMoa2115961. Epub 2021 Nov 13.

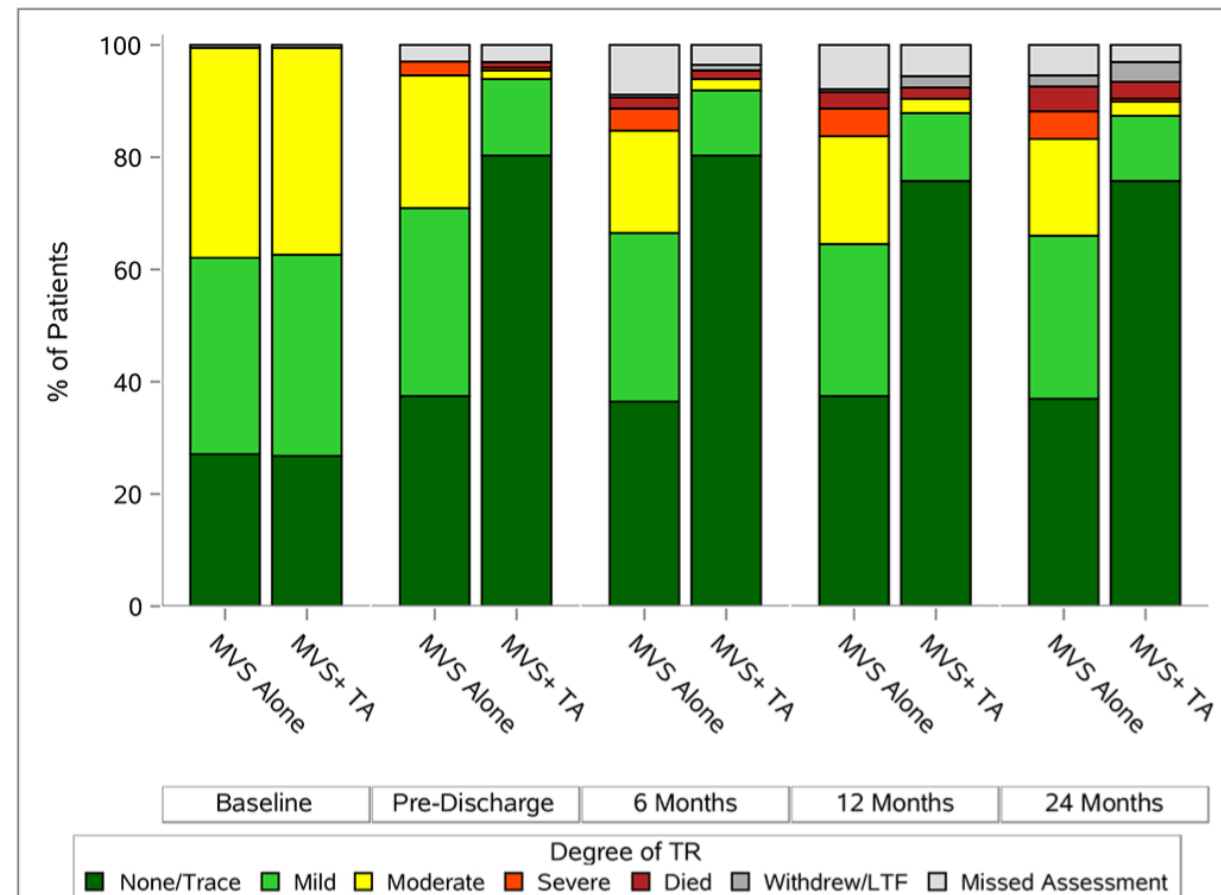
Concomitant Tricuspid Repair in Patients with Degenerative Mitral Regurgitation

All Patients	MVS Alone (N=203)	MVS + TA (N=198)	Relative Risk (95% CI)	P-value
Primary Endpoint				
Imputed - % (95% CI)	10.2 (6.0, 14.5)	3.9 (1.1, 6.7)	0.37 (0.16, 0.86)	0.02
Observed	20/188 (10.6)	7/185 (3.8)	0.35 (0.15, 0.81)	-
Died within 2 Years	9/199 (4.5)	6/190 (3.2)	0.69 (0.25, 1.88)	-
TV Operation within 2 Years	0/190 (0.0)	0/184 (0.0)	-	-
Progression of TR at 2 Years	11/179 (6.1)	1/179 (0.6)	0.09 (0.01, 0.69)	-

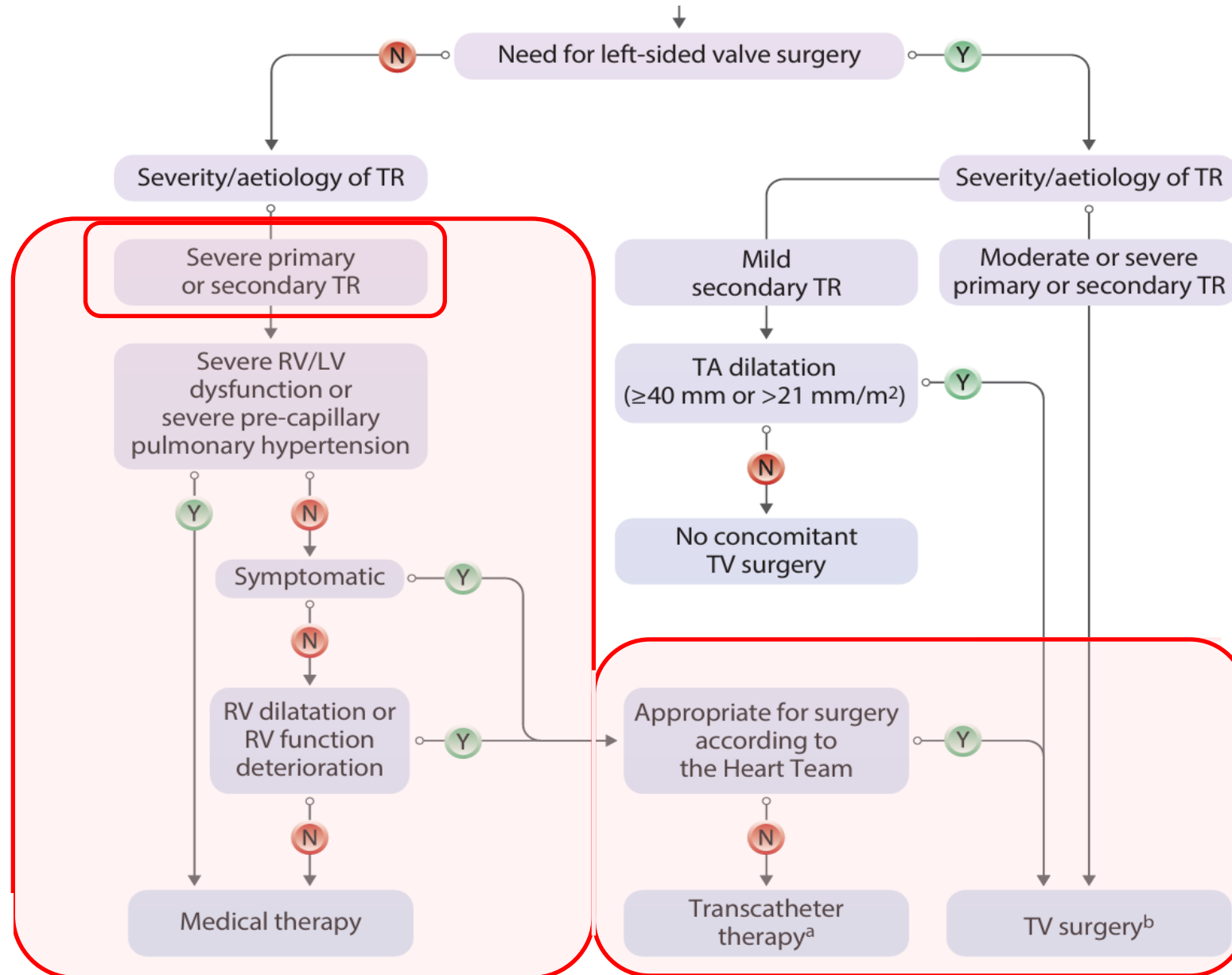
Gammie et al., NEJM 2022

Ailawadi et al., J Thorac Cardiovasc Surg 2000

- k progresi TR docházelo u střední TR, ne u lehké TR
- Trikuspidální anuloplastika spojená s častou implantací trvalé KS (14% vs. 2,5%)



Indikace k intervenci u pacientů s TR



Indikace k operaci u významné izolované TR

Recommendations	Class	Level
Patients with severe tricuspid regurgitation without left-sided valvular heart disease requiring surgery		
TV surgery is recommended in <u>symptomatic</u> patients with <u>severe primary TR</u> without severe RV dysfunction or severe PH.	I	C
TV surgery should be considered in <u>asymptomatic</u> patients with <u>severe primary TR</u> who have <u>RV dilatation/RV function deterioration</u> , but <u>without severe LV/RV dysfunction or severe PH</u> .	IIa	C
TV surgery should be considered in patients with <u>severe secondary TR</u> who are symptomatic or have <u>RV dilatation/RV function deterioration</u> , but <u>without severe LV/RV dysfunction or PH</u> .	IIa	B



Indikace ke katetrizační intervenci trikuspidální regurgitace

Recommendations	Class	Level
Patients with severe tricuspid regurgitation without left-sided valvular heart disease requiring surgery		
Transcatheter TV treatment should be considered to improve quality of life and RV remodelling in <u>high-risk patients with symptomatic severe TR despite optimal medical therapy in the absence of severe RV dysfunction or pre-capillary PH.</u>	Ila	A



Podpořeno výsledky 3 randomizovaných studií (Triluminate, Tri.Fr, Triscend), multicentrických registrů a dalších studií

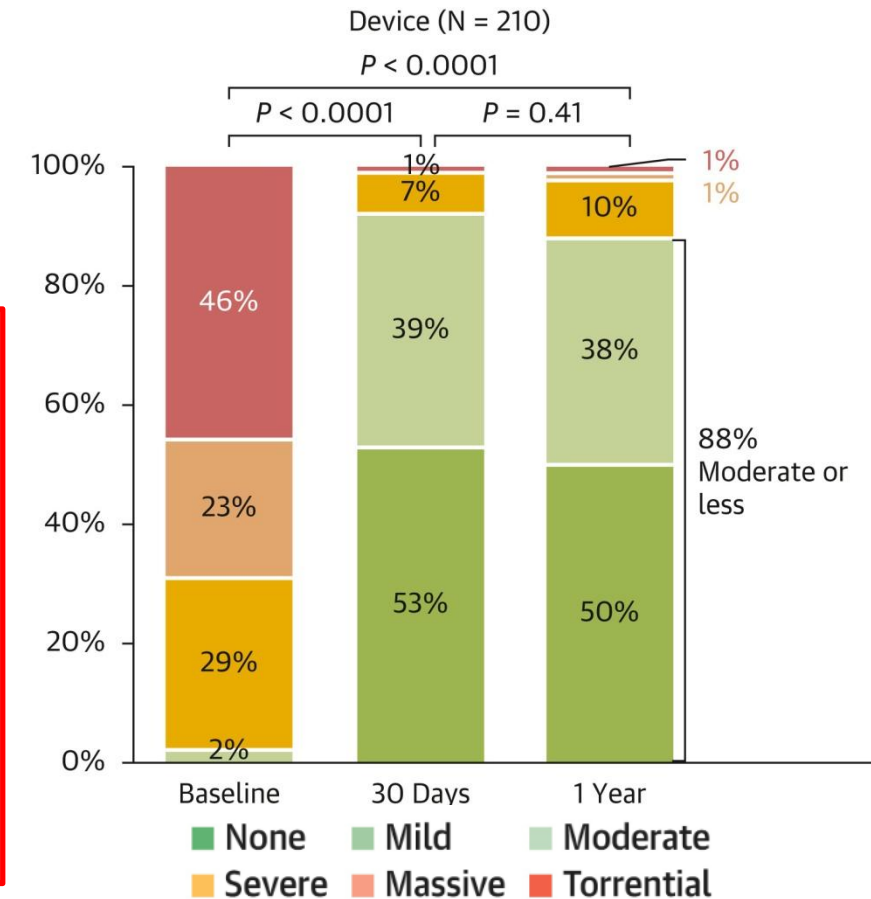
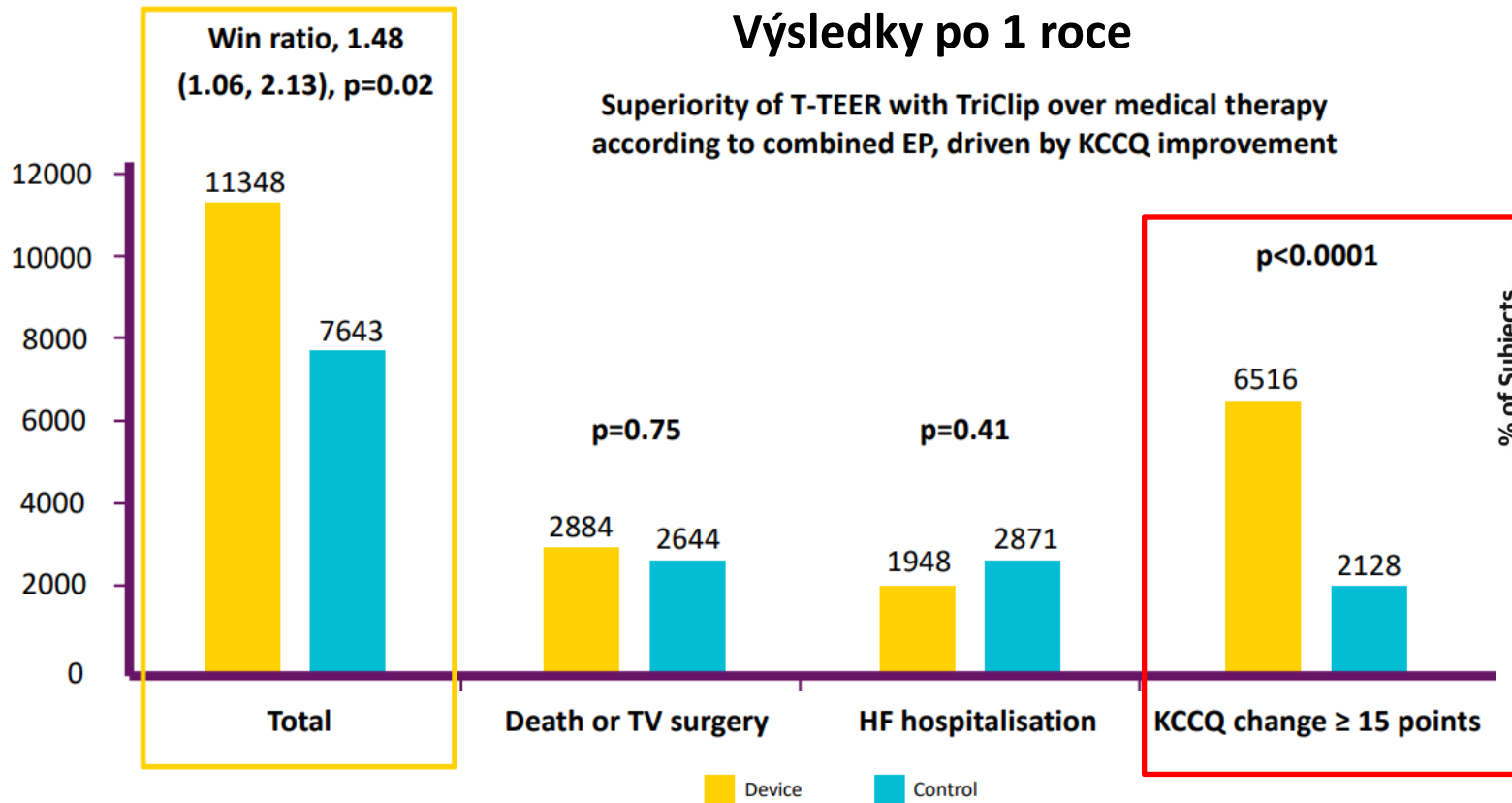


Eur Heart J, 2025, 00:0-102., <https://doi.org/10.1093/eurheartj/ehaf194>



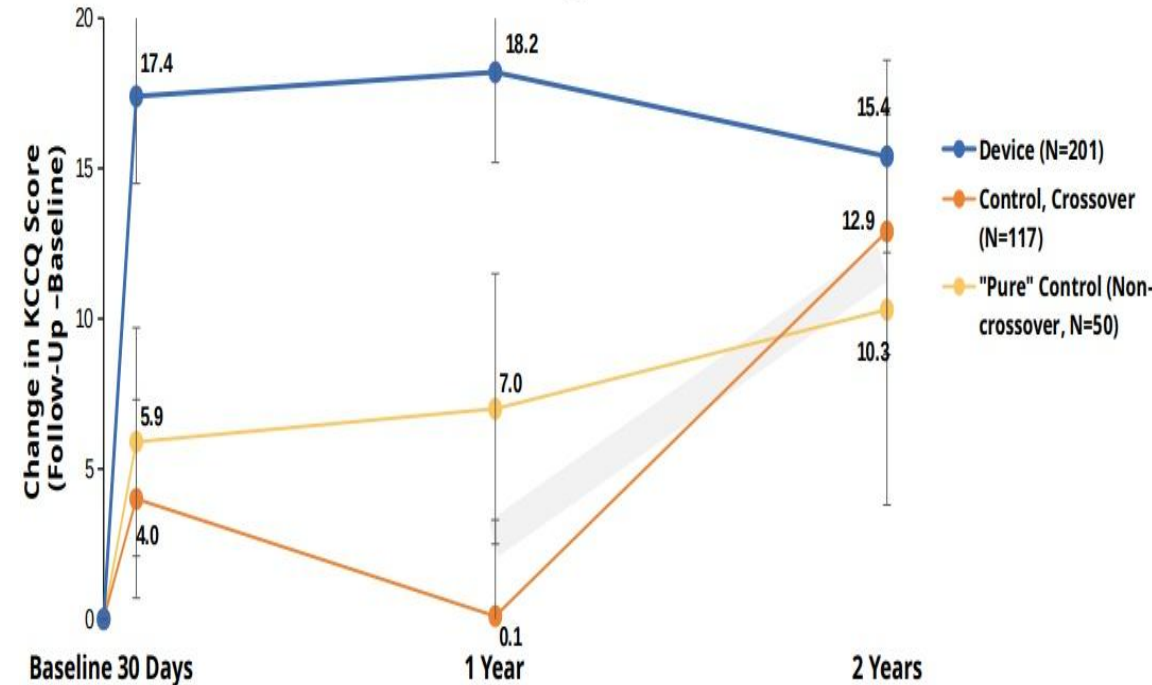
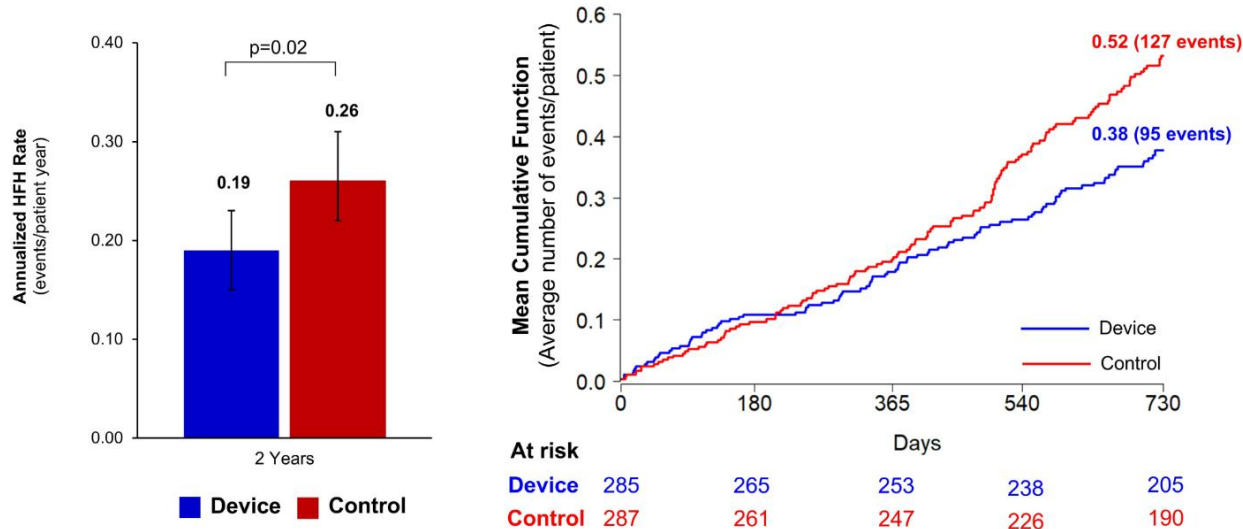
TRILUMINATE Pivotal Trial - TEER systémem TriClip

RCT, 350 symptomatických pacientů s TR $\geq 3+$, ve vysokém riziku chirurgie, s PASP < 60mmHg, randomizace k T-TEER versus medikam. léčba



TRILUMINATE – výsledky po 2 letech

Pokles hospitalizací pro srdeční selhání



28% relative risk reduction in HFH with TriClip device treatment
 HR 0.72 (two-sided 95%CI [0.53, 0.98])

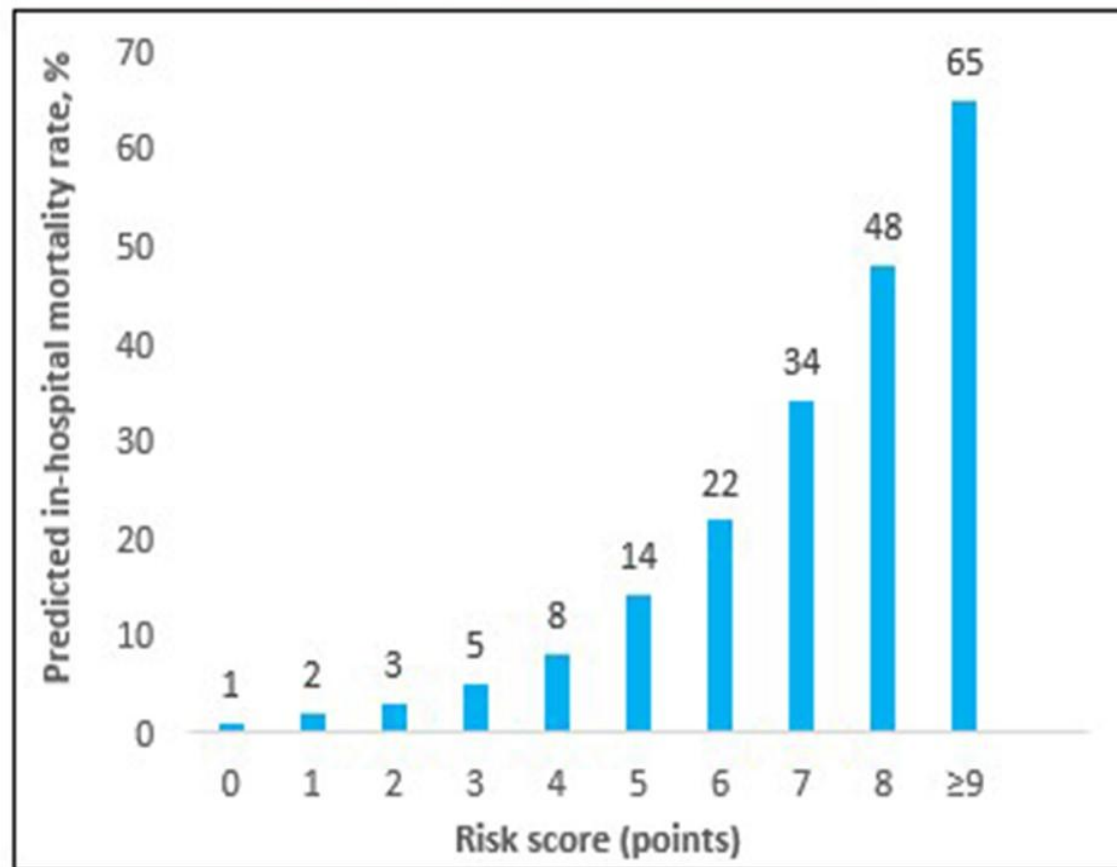
Crossover k T-TEER u 60% pacientů

Tri-Score – odhad časné mortality operace izolované TR

Rizikové faktory časné mortality po operaci izolované TR

Age \geq 70 years	1
NYHA functional class III-IV	1
Right sided heart failure signs	2
Daily dose of furosemide \geq 125 mg	2
Glomerular filtration rate $<$ 30mL/min	2
Elevated total bilirubin	2
LVEF $<$ 60%	1
Moderate/severe RV dysfunction	1
Total	12

Časná operační mortalita podle Tri-Score



Dreyfus G. EHJ 2022, 43 (7): 654–662



Tri-Score – odhad časné mortality operace izolované TR

TRI-SCORE CALCULATOR

Parameters

- Age \geq 70 years
- Female
- NYHA functional class III or IV
- Right-sided heart failure signs ⁽¹⁾
- Prior left-sided heart valve intervention
- Permanent pacemaker / defibrillator
- Atrial fibrillation / flutter
- Daily dose of furosemide \geq 125 mg
- Glomerular filtration rate $<$ 30 ml/min ⁽²⁾
- Elevated total bilirubin ⁽³⁾
- Left ventricular ejection fraction $<$ 60% ⁽⁴⁾
- Moderate/severe right ventricular dysfunction ⁽⁵⁾
 - Mechanism of tricuspid regurgitation
 - Secondary
 - Primary
 - Mixed

Prediction

TRI-SCORE

5/12

Predicted in-hospital mortality after isolated tricuspid valve surgery

14%

Risk

LOW

INTER

HIGH

<https://www.tri-score.com/>



TRIGISTRY – 2-leté přežívání podle typu intervence



TRIGISTRY: multicenter registry (33 centers, 10 countries)



2413 patients with severe isolated functional tricuspid regurgitation

Comparison of survival rates at 2 years between different treatment modalities according to TRI-SCORE categories (low, intermediate and high)

1217 patients conservatively managed

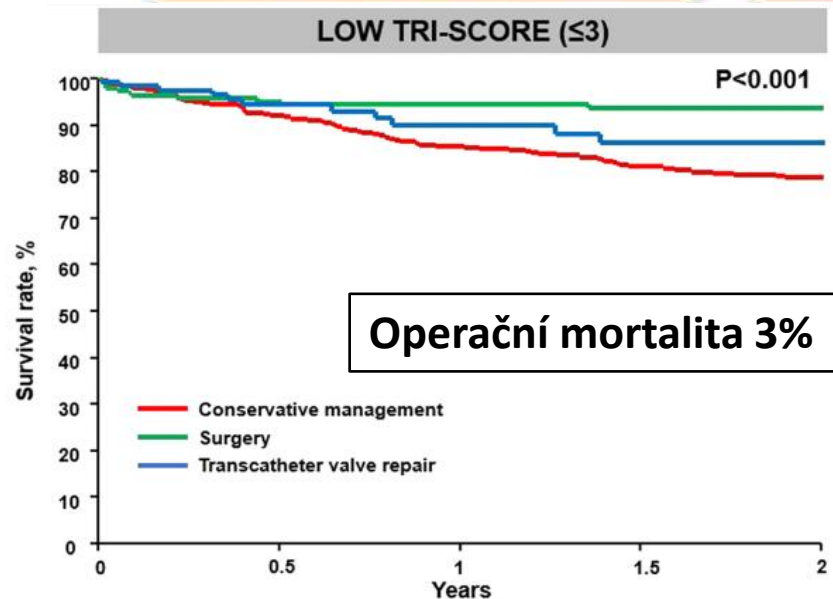
551 underwent isolated tricuspid valve surgery

645 underwent transcatheter valve repair

Low TRI-SCORE (≤ 3)

Intermediate TRI-SCORE (4–5)

High TRI-SCORE (≥ 6)



Patients at risk			
	0	1	2
Conservative management	433	349	286
Surgery	183	139	119
Transcatheter valve repair	148	57	26

HIGH TRI-SCORE (≥ 6)



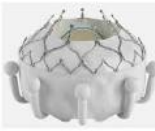
Chirurgická nebo katetrizační léčba má být indikována časně

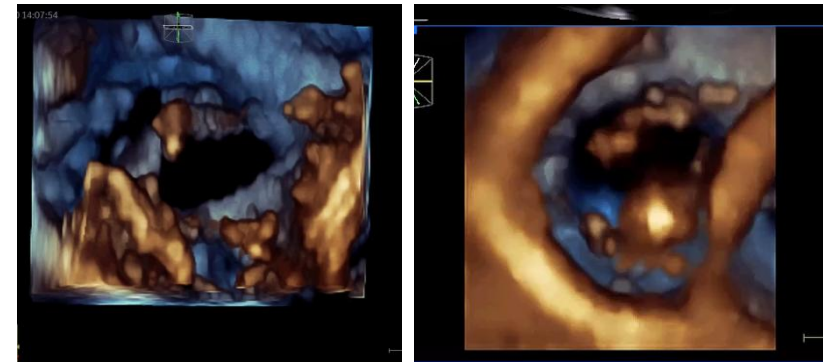
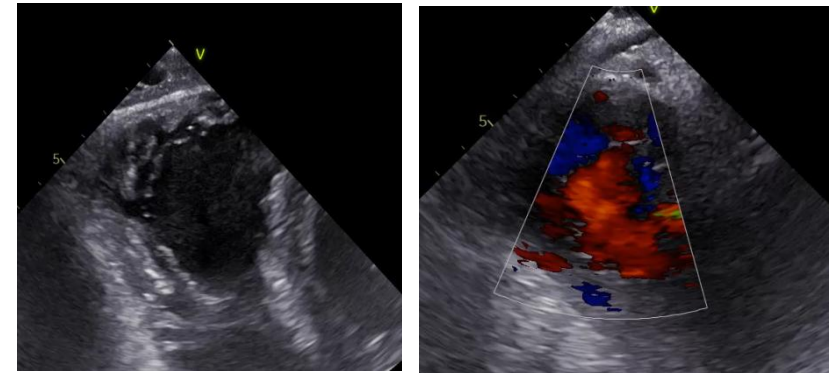
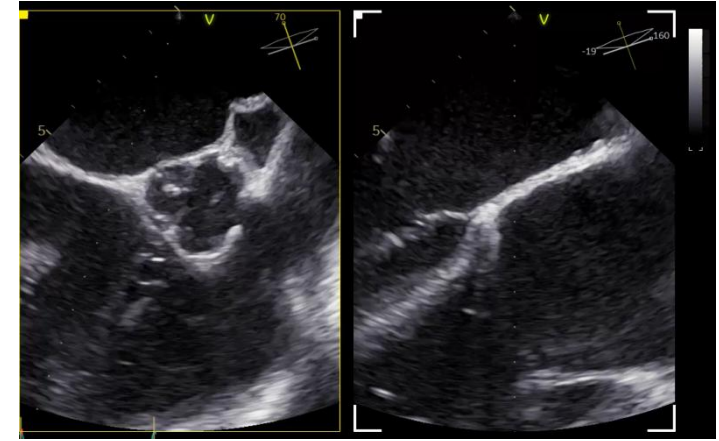
Zlepšení mortality zejména u nemocných s nízkým rizikem dle TRISCORE

Patients at risk			
	0	1	2
Conservative management	425	241	168
Surgery	183	106	80
Transcatheter valve repair	241	86	35

Anatomická vhodnost k intervenci

Table 3. Anatomical criteria for device selection.

Strategy	Favourable anatomy	Feasible anatomy	Unfavourable anatomy
T-TEER 	Small septolateral gap ≤ 7 mm ¹⁰ Anteroseptal jet location Confined prolapse or flail Trileaflet morphology	Septolateral coaptation gap >7 but ≤ 8.5 mm ⁶⁵ Posteroseptal jet location Non-trileaflet morphology Incidental CIED RV lead (i.e., without leaflet impingement)	Large septolateral coaptation gap >8.5 mm ⁶⁵ Leaflet thickening/shortening (rheumatic, carcinoid)/perforation Dense chordae with marked leaflet tethering Anteroposterior jet location Poor echocardiographic leaflet visualisation CIED RV lead leaflet impingement Unfavourable device angle of approach
Annuloplasty 	Annular dilatation as primary mechanism of TR Mild tethering (tethering height <0.76 cm, tenting area <1.63 cm ² , tenting volume [3D] <2.3 mL) ^{110,111} Central jet location Sufficient landing zone for anchoring	Moderate tethering (tethering height ≥ 0.76 cm but <1.0 cm, tenting area >1.63 but <2.5 cm ² , tenting volume [3D] ≥ 2.3 mL but ≤ 3.5 mL) ^{110,111} Incidental CIED RV lead (i.e., without leaflet impingement)	Excessive annular dilatation (exceeding device size) Severe tethering (tethering height >1.0 cm, tenting volume >3.5 mL). Poor echocardiographic annular visualisation ^{110,111} Annular proximity of RCA CIED RV lead leaflet impingement
Orthotopic valve implantation 	Previous surgical repair or bioprosthetic valve replacement Leaflet thickening/shortening (rheumatic, carcinoid) Incidental CIED RV lead (i.e., without leaflet impingement) Any leaflet morphology	Large coaptation gap CIED RV lead leaflet impingement	Excessive annular dilatation (exceeding device size) Unfavourable device angle of approach Severe right ventricular dysfunction



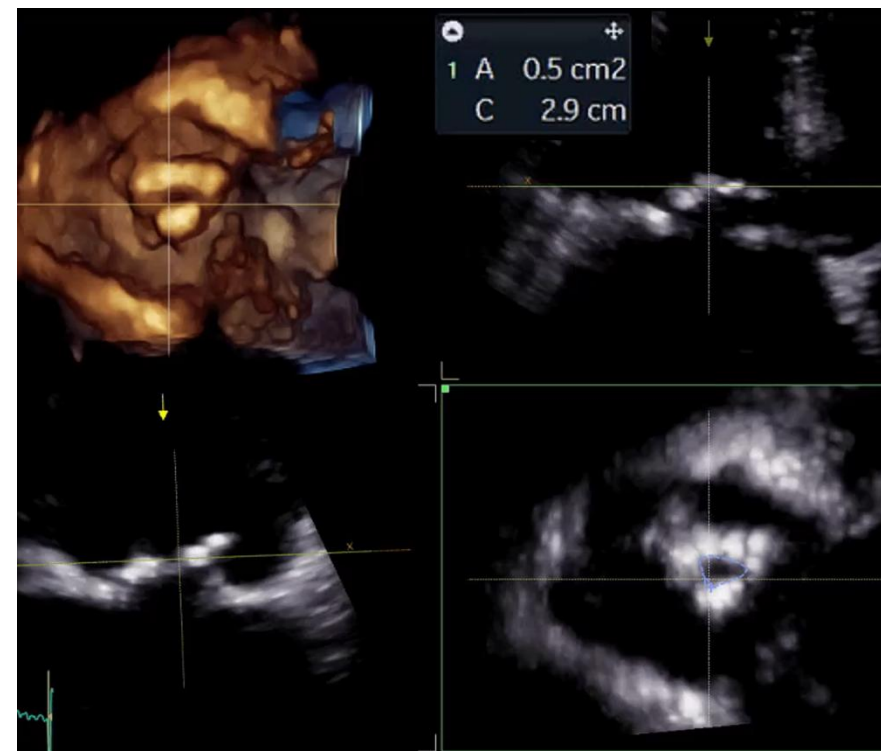
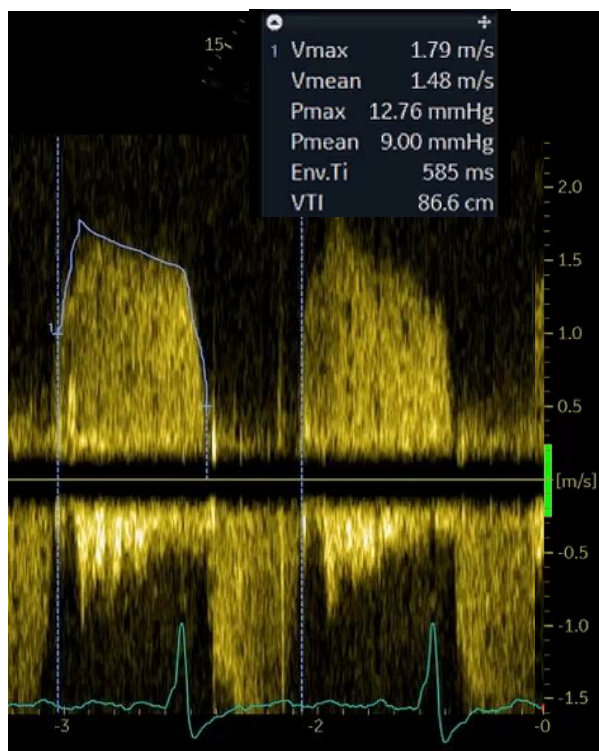
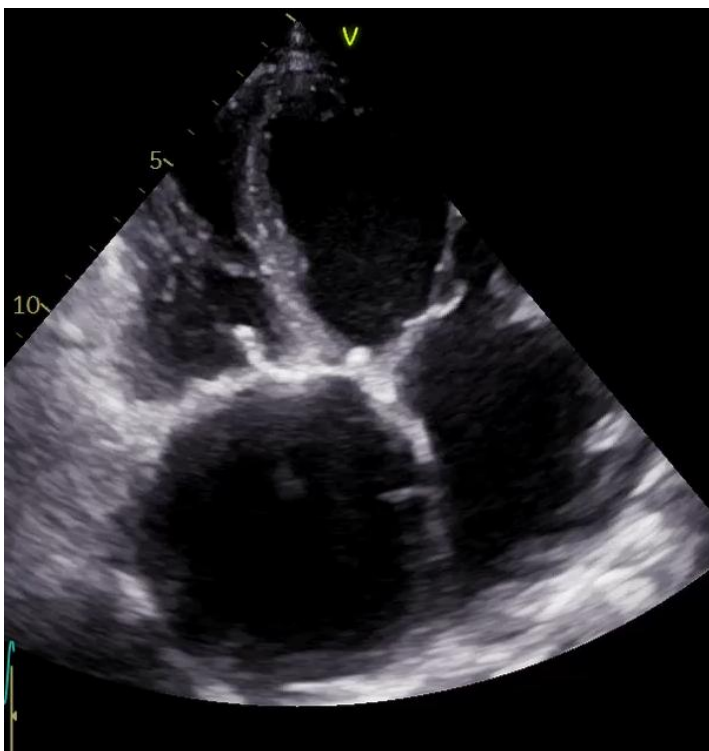
Trikuspidální stenóza

Etiologie - porevmatická, degenerace bioprotézy, vrozená, IE, tumor síně, karcinoid

Echokg kvantifikace vady - významná stenóza

$PG_{mean} \geq 5 \text{ mmHg}$, $PHT \geq 190 \text{ ms}$

3D planimetrie $< 1 \text{ cm}^2$



Trikuspidální stenóza

Recommendations on tricuspid stenosis		
Operace je doporučena <u>u symptomatické významné trikuspidální stenózy</u>	I	C
Operace je doporučena u pacientů s významnou trikuspidální stenózou podstupující operaci levostranné chlopně	I	C

- **Náhrada bioprotézou**, ev. plastika chlopně s implantací prstence
- Perkutánní balónková valvuloplastika
- Katetrizační ViV implantace – degenerovaná bioprotéza

Závěr

- Nové změny v doporučeních
- **Trikuspidální anuloplastika** je indikována **při operaci jednostranné vady u střední regurgitace (IIa)**, u lehké regurgitace s dilatací anulu jen u vybraných pacientů (IIb)
- **Katetrizační intervence** symptomatické významné TR je indikována u nemocných s **vysokým rizikem operace (IIa)**



Děkuji za pozornost.

