



**VŠEOBECNÁ FAKULTNÍ  
NEMOCNICE V PRAZE**



**1. LÉKAŘSKÁ  
FAKULTA**  
Univerzita Karlova

# **Trikuspidální vady**

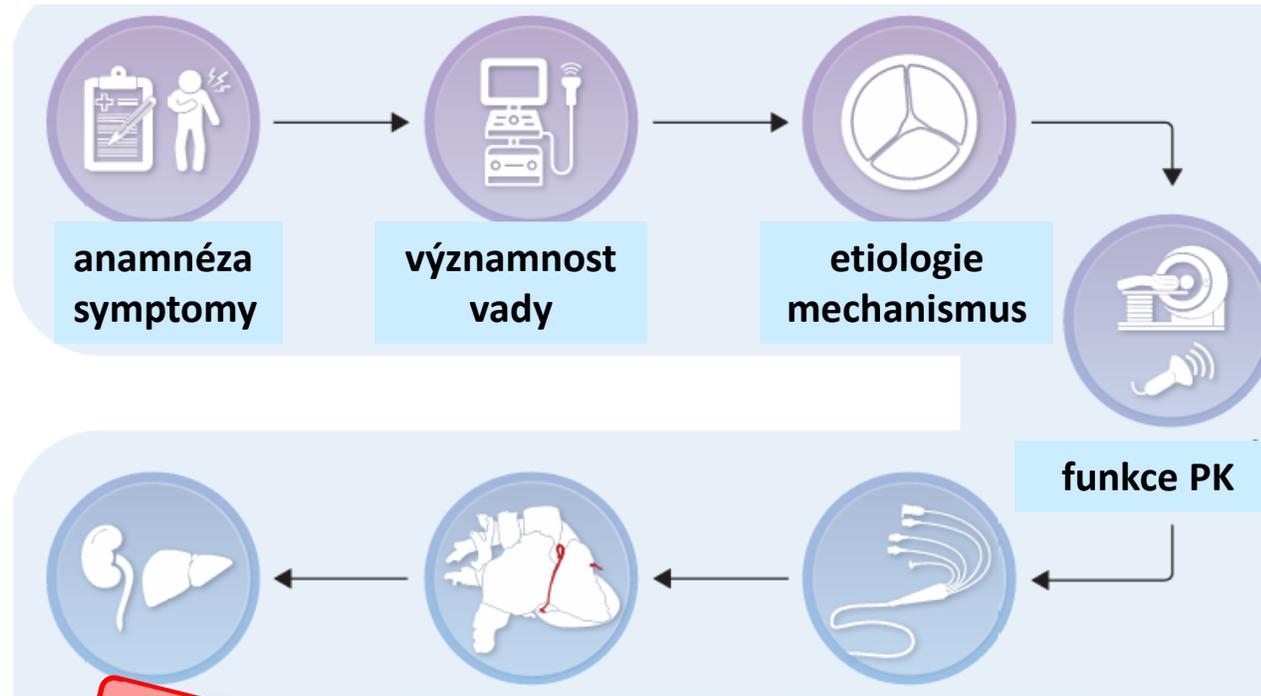
## **Současná doporučení ESC 2025**

**Zuzana Hlubocká**



KOMPLEXNÍ  
**KARDIO  
VASKULÁRNÍ**  
CENTRUM  
VFN Praha

# 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

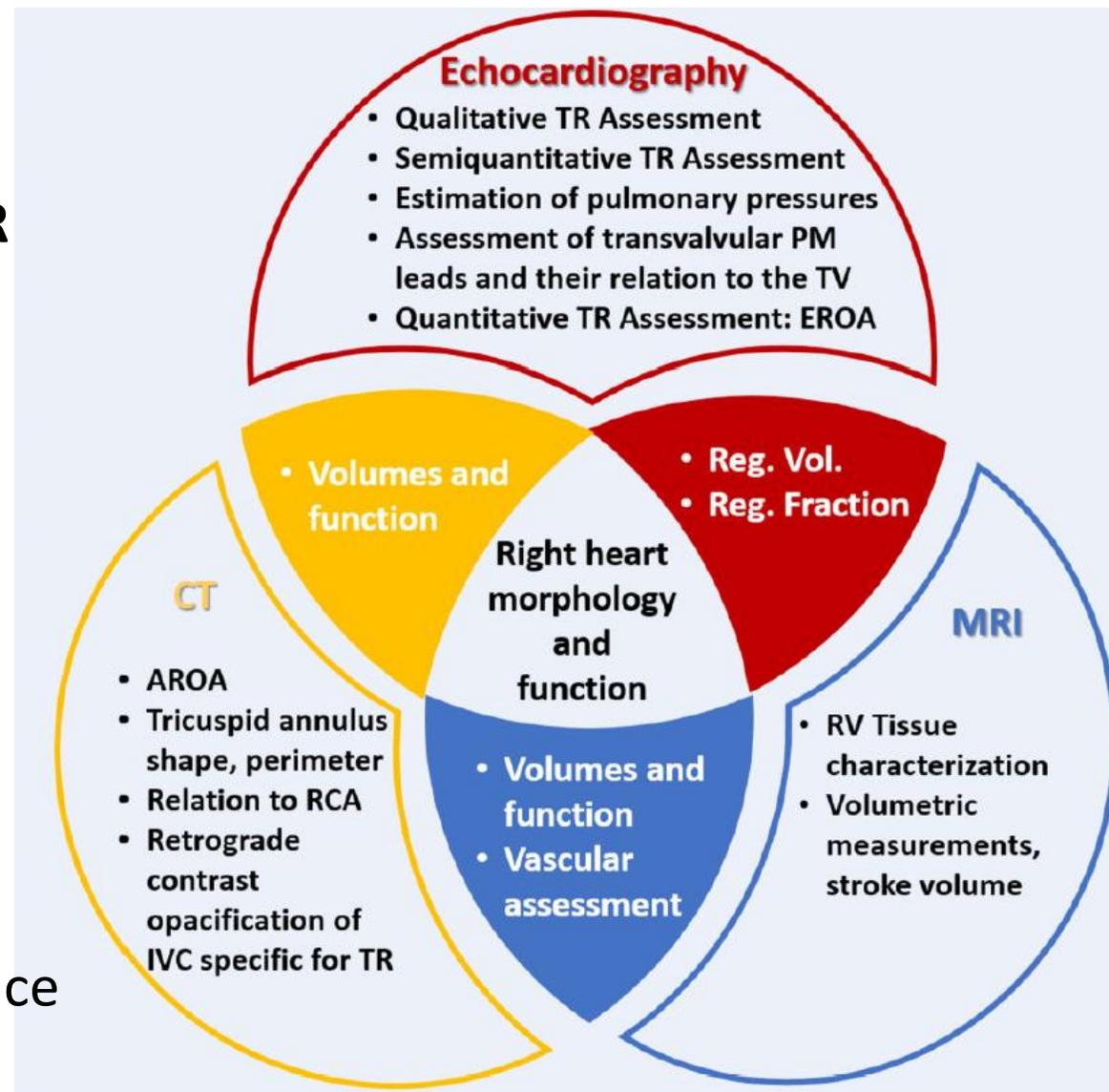
- **MRI srdce**

- objemy a funkce pravé komory
- kvantifikace TR

- **CT srdce**

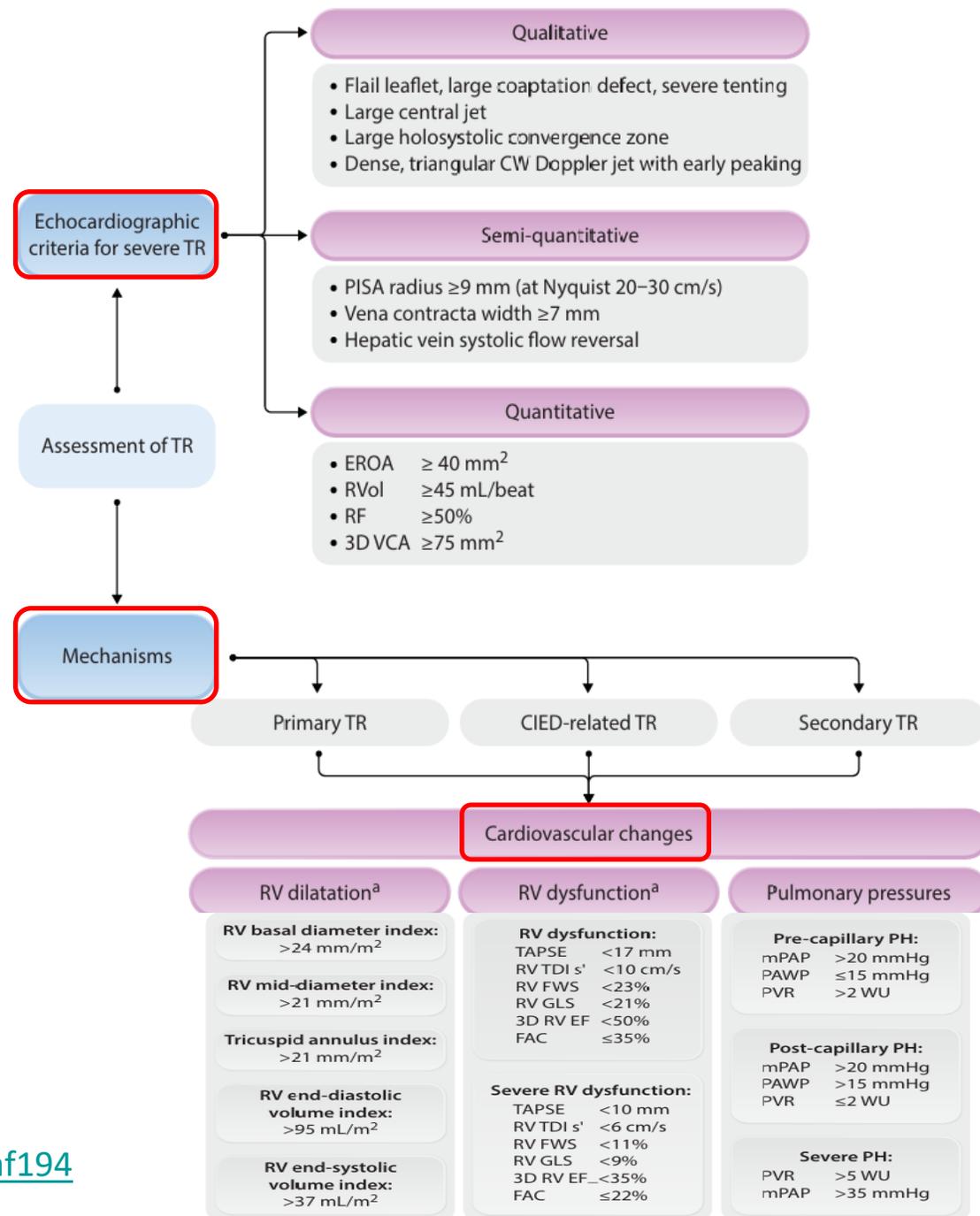
- morfologie anulu, plánování intervencí
- objemy a funkce PK

+ **Katetrizační vyšetření** – pravostranná katetrizace



# Echokg hodnocení trikuspidální regurgitace

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



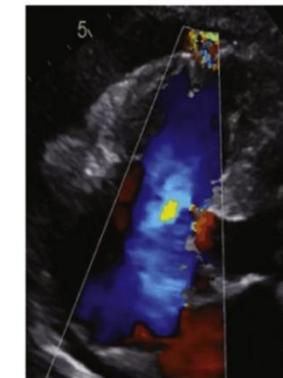
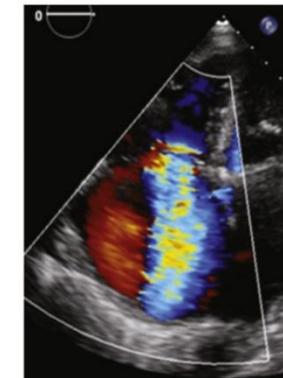
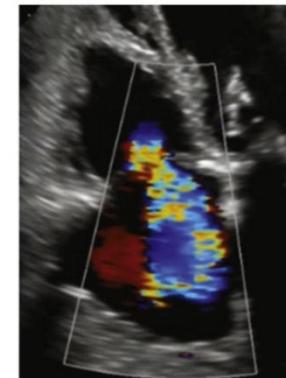
# Kvantifikace trikuspidální regurgitace

## EAE a ASE guidelines

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

## Rozšířená klasifikace TR

Variable	Severe	Massive	Torrential
VC (biplane)	7–13 mm	14–20 mm	≥21 mm
EROA (PISA)	40–59 mm <sup>2</sup>	60–79 mm <sup>2</sup>	≥80 mm <sup>2</sup>
3D VCA or quantitative EROA <sup>a</sup>	75–94 mm <sup>2</sup>	95–114 mm <sup>2</sup>	≥115 mm <sup>2</sup>



Zoghbi WA et al., JASE 2017;30

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

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

# Echokg parametry významné trikuspidální regurgitace

## Qualitative

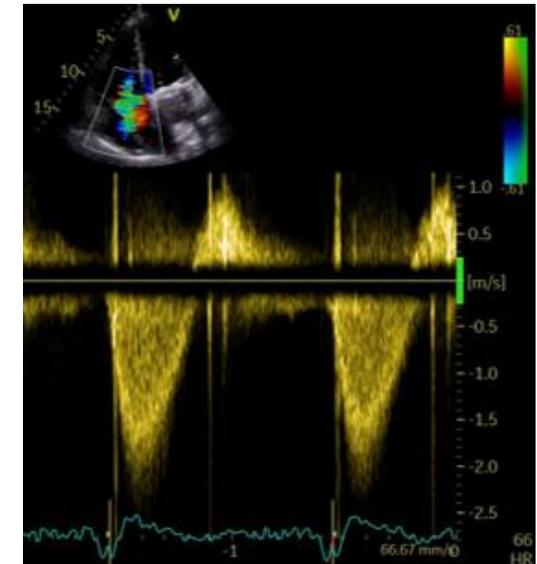
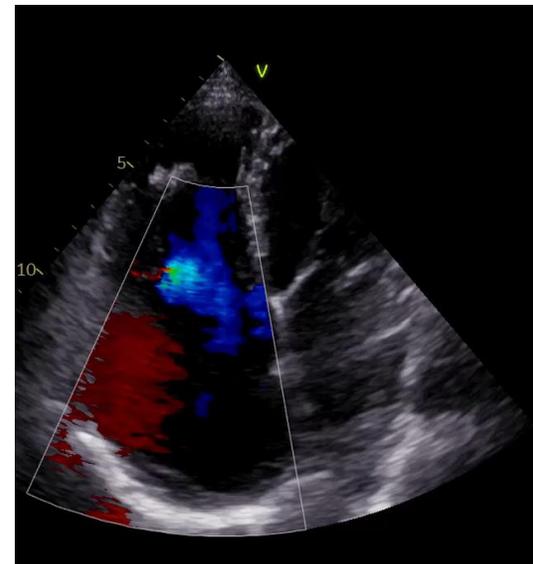
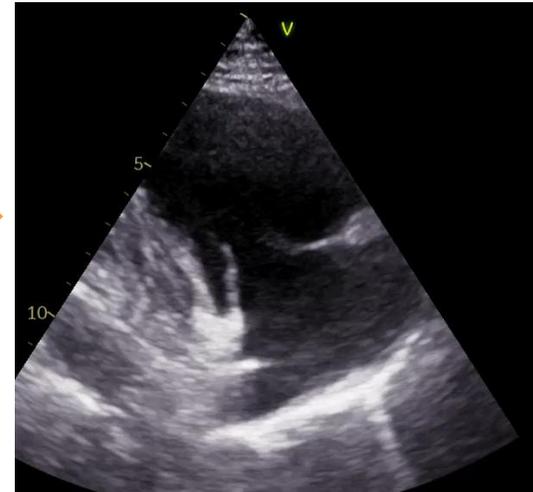
- Flail leaflet, large coaptation defect, severe tenting
- Large central jet
- Large holosystolic convergence zone
- Dense, triangular CW Doppler jet with early peaking

## Semi-quantitative

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

## Quantitative

- EROA  $\geq 40$  mm<sup>2</sup>
- RVol  $\geq 45$  mL/beat
- RF  $\geq 50\%$
- 3D VCA  $\geq 75$  mm<sup>2</sup>



# Kvantifikace trikuspidální regurgitace

## Qualitative

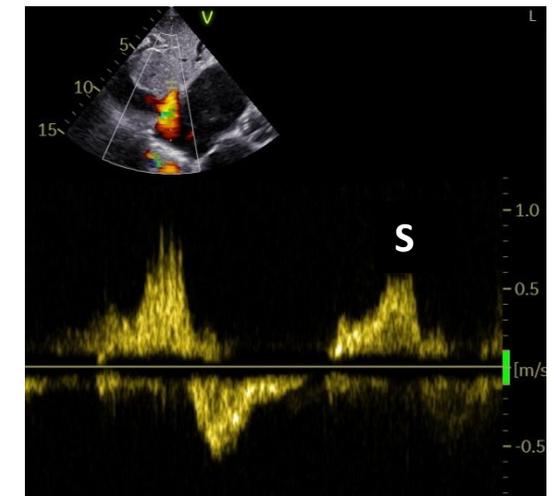
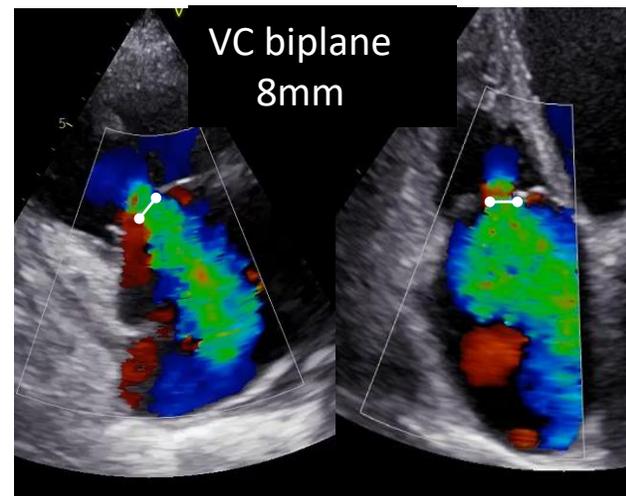
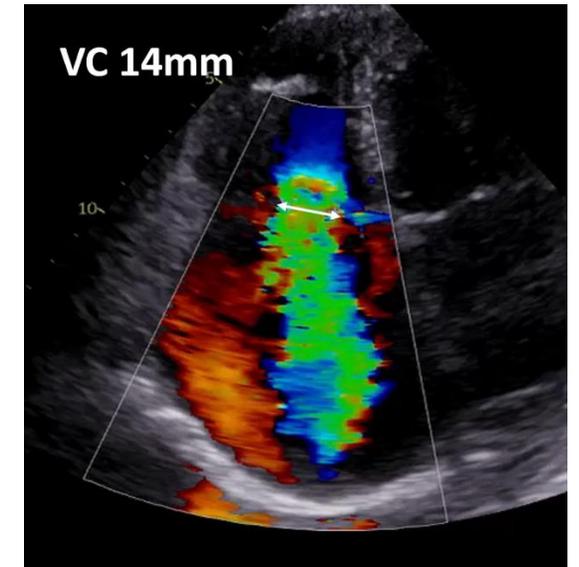
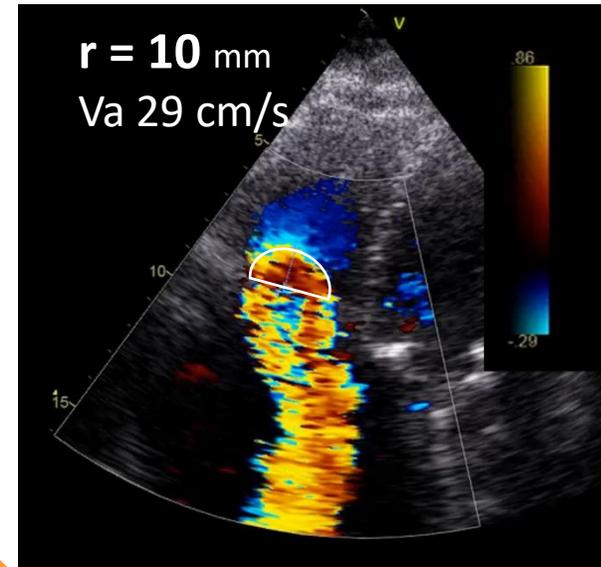
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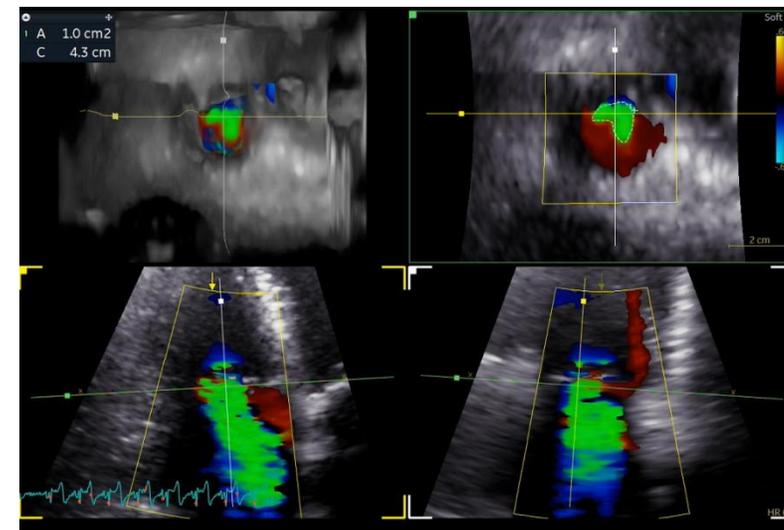
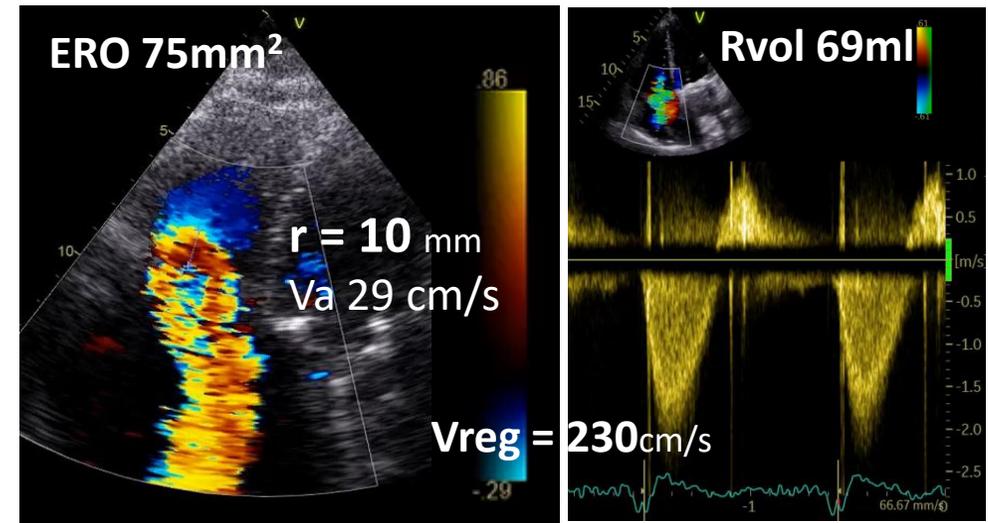
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# Hodnocení mechanismu TR

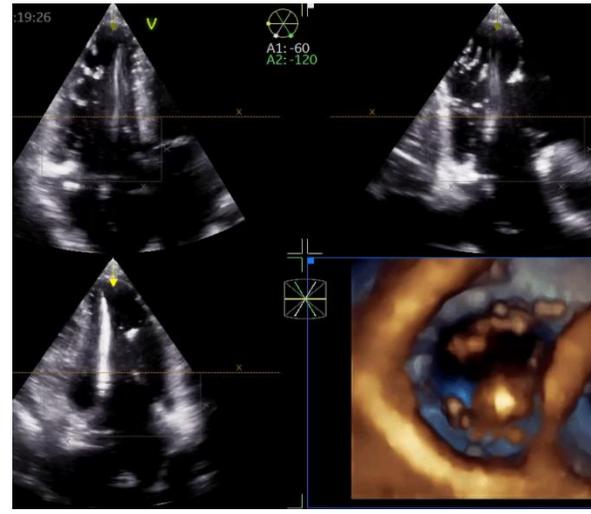
Sekundární/funkční (88%)

CIED TR

Primární/organická (8%)

Atriální

Ventrikulární



**Fibrilace síní**

**Plicní hypertenze**

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

**Ebsteinova anomálie**

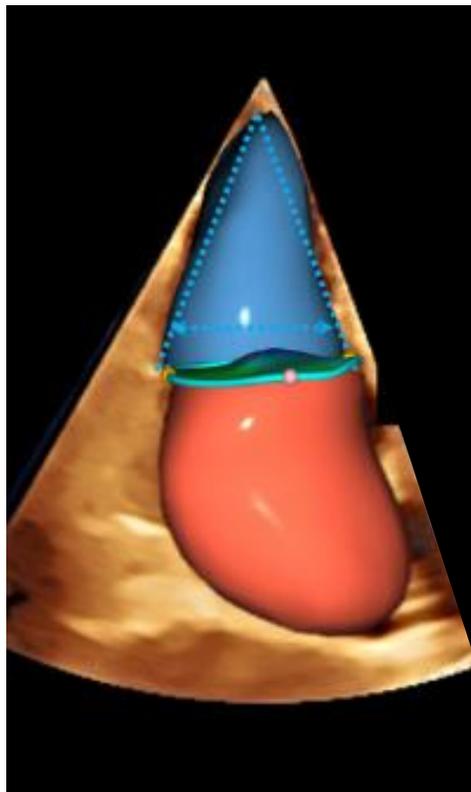
**Infekční endokarditida**

**Prolaps**

**Karcinoid, trauma**

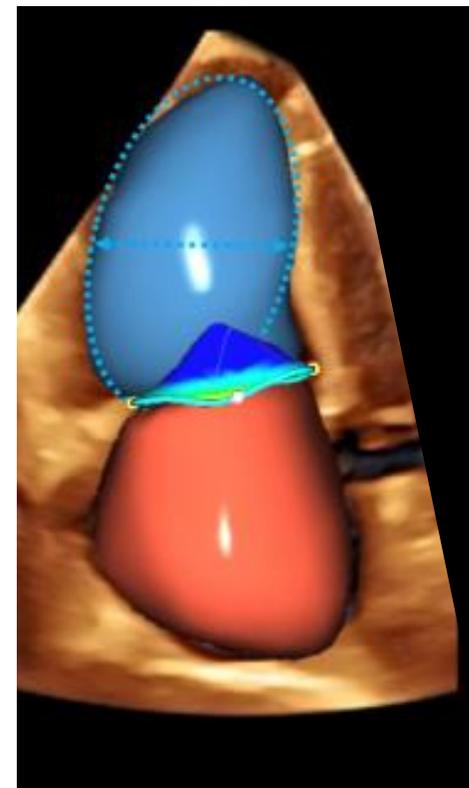
# Typy sekundární TR

**kónická PK**  
dilatace bazálně  
  
**dilatace anulu**  
  
**dilatace síně**



**sférická PK**  
dilatace a  
prodloužení PK

**tenting cípů**  
menší dilatace anulu  
  
dilatace síně



## Atriální sekundární TR

- bez významné plicní hypertenze
- typicky přítomna **fibrilace síní**

## Ventrikulární sekundární TR

- s plicní hypertenzí

# Hodnocení důsledků TR na pravé srdce

## Cardiovascular changes

### RV dilatation<sup>a</sup>

RV basal diameter index:  
>24 mm/m<sup>2</sup>

RV mid-diameter index:  
>21 mm/m<sup>2</sup>

Tricuspid annulus index:  
>21 mm/m<sup>2</sup>

RV end-diastolic  
volume index:  
>95 mL/m<sup>2</sup>

RV end-systolic  
volume index:  
>37 mL/m<sup>2</sup>

### RV dysfunction<sup>a</sup>

#### 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:

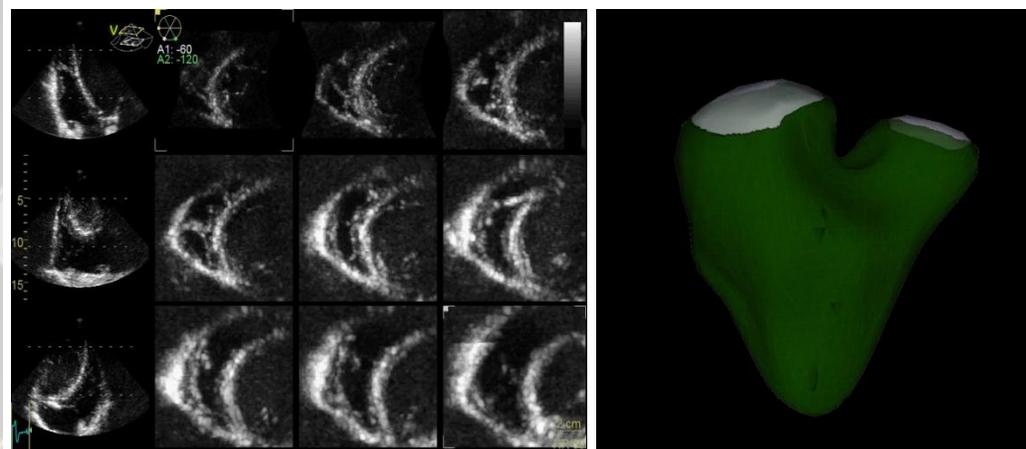
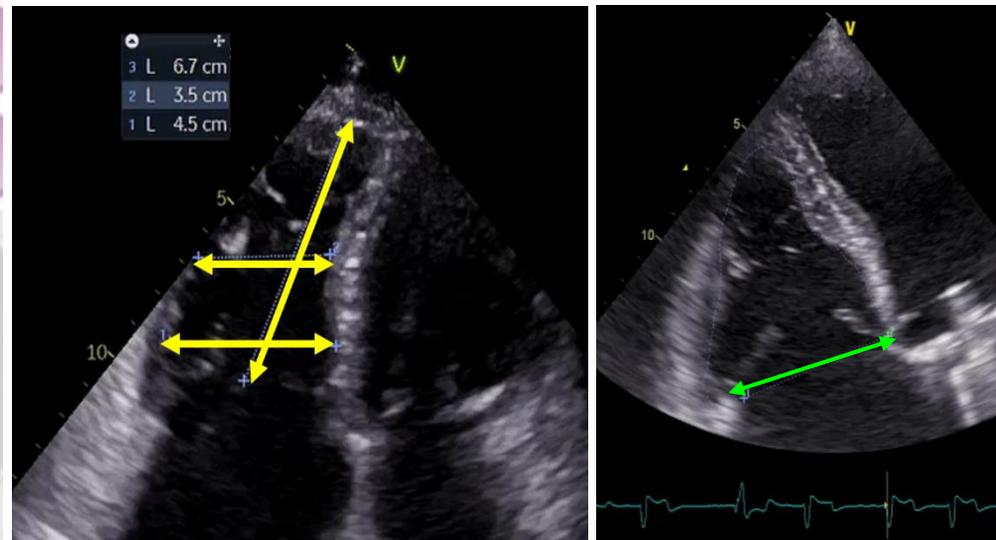
mPAP >20 mmHg  
PAWP ≤15 mmHg  
PVR >2 WU

#### Post-capillary PH:

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

#### Severe PH:

PVR >5 WU  
mPAP >35 mmHg



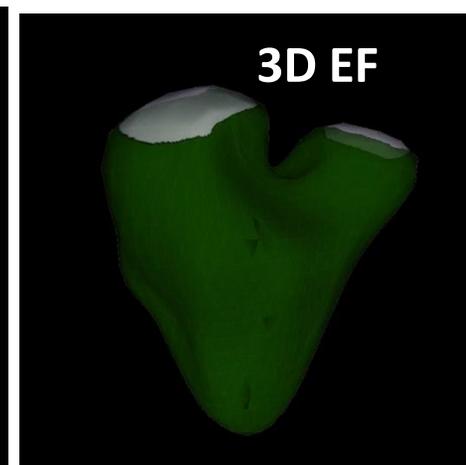
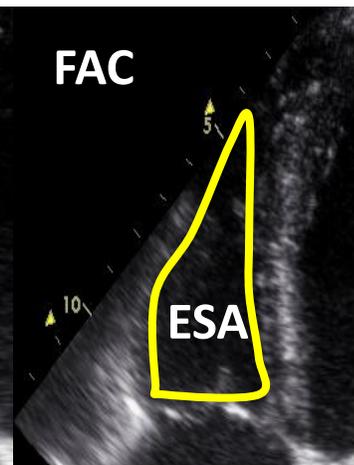
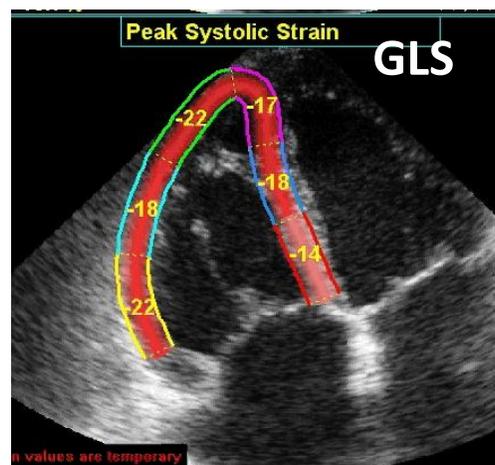
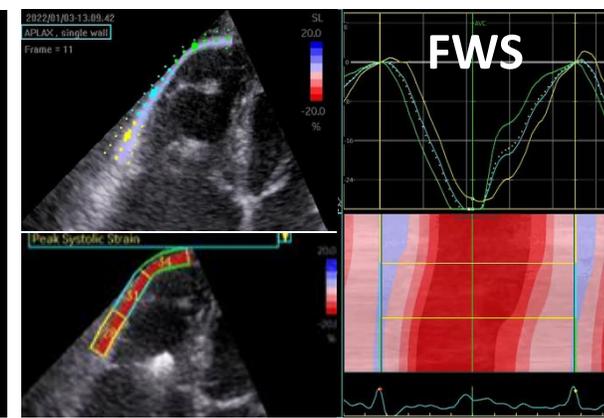
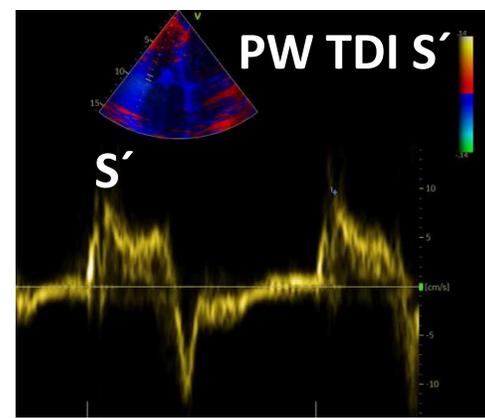
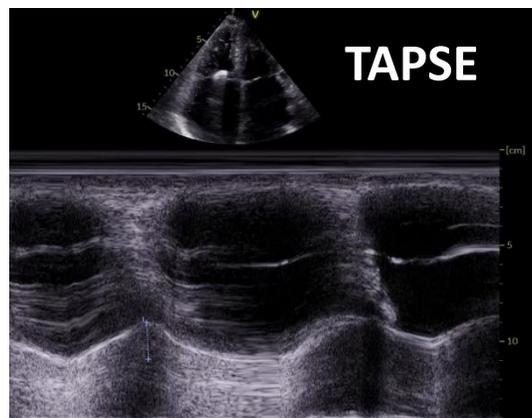
# Hodnocení funkce pravé komory

## RV dysfunction:

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

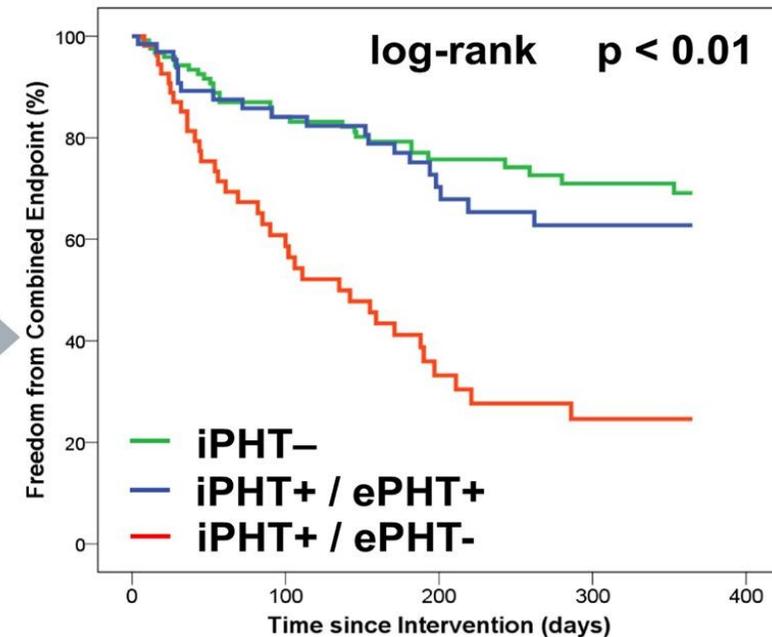
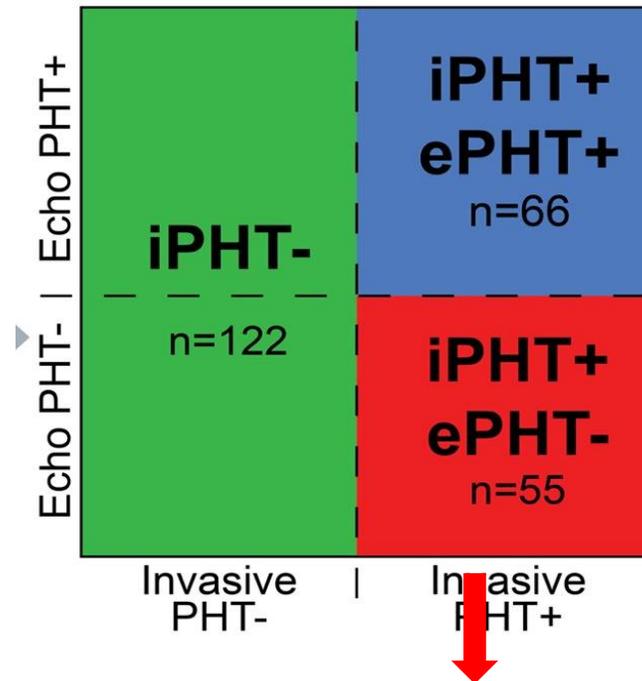
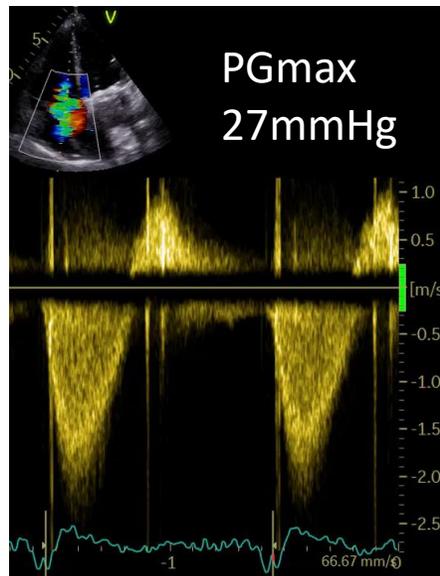
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TAPSE	<10 mm
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RV GLS	<9%
3D RV EF	<35%
FAC	≤22%



# 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

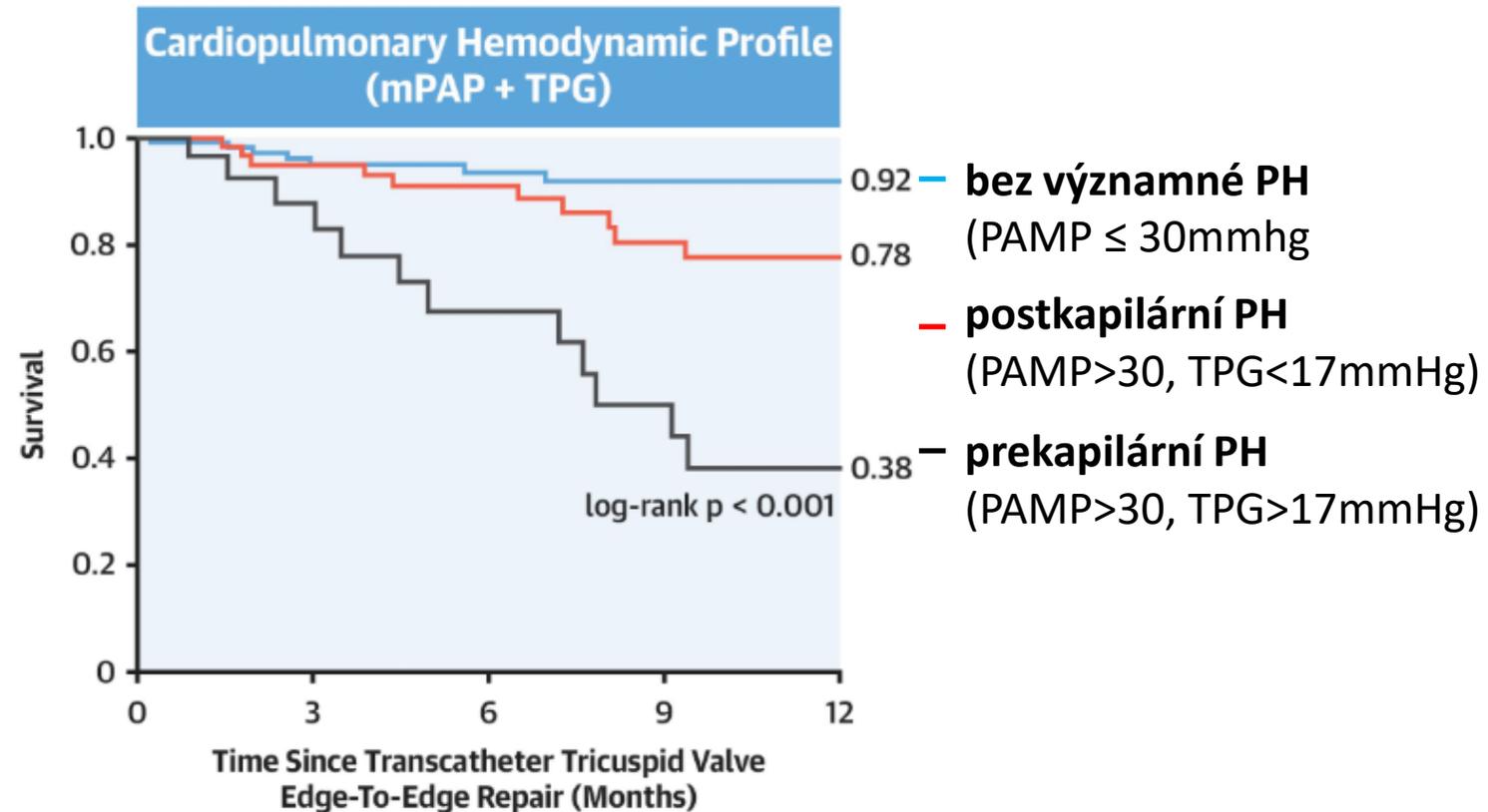
⇒ Pravostranná katetrizace doporučena u významné TR zvažované k intervenci

**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

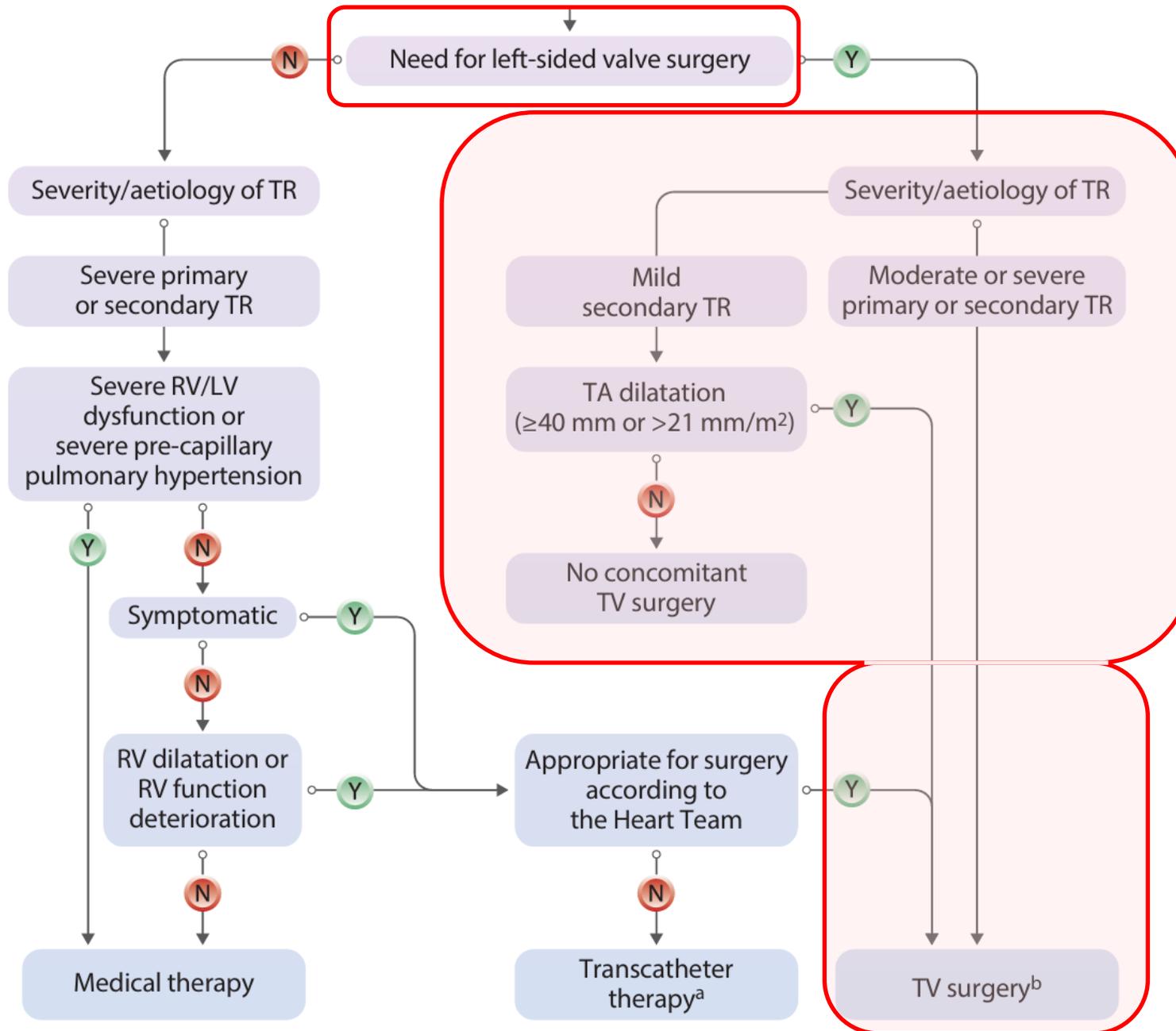
**Severe PH:**  
 PVR >5 WU  
 mPAP >35 mmHg



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
<b>Patients with tricuspid regurgitation and left-sided valvular heart disease requiring surgery</b>		
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> ( $\geq 40$ mm or $> 21$ mm/m <sup>2</sup> ), 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.

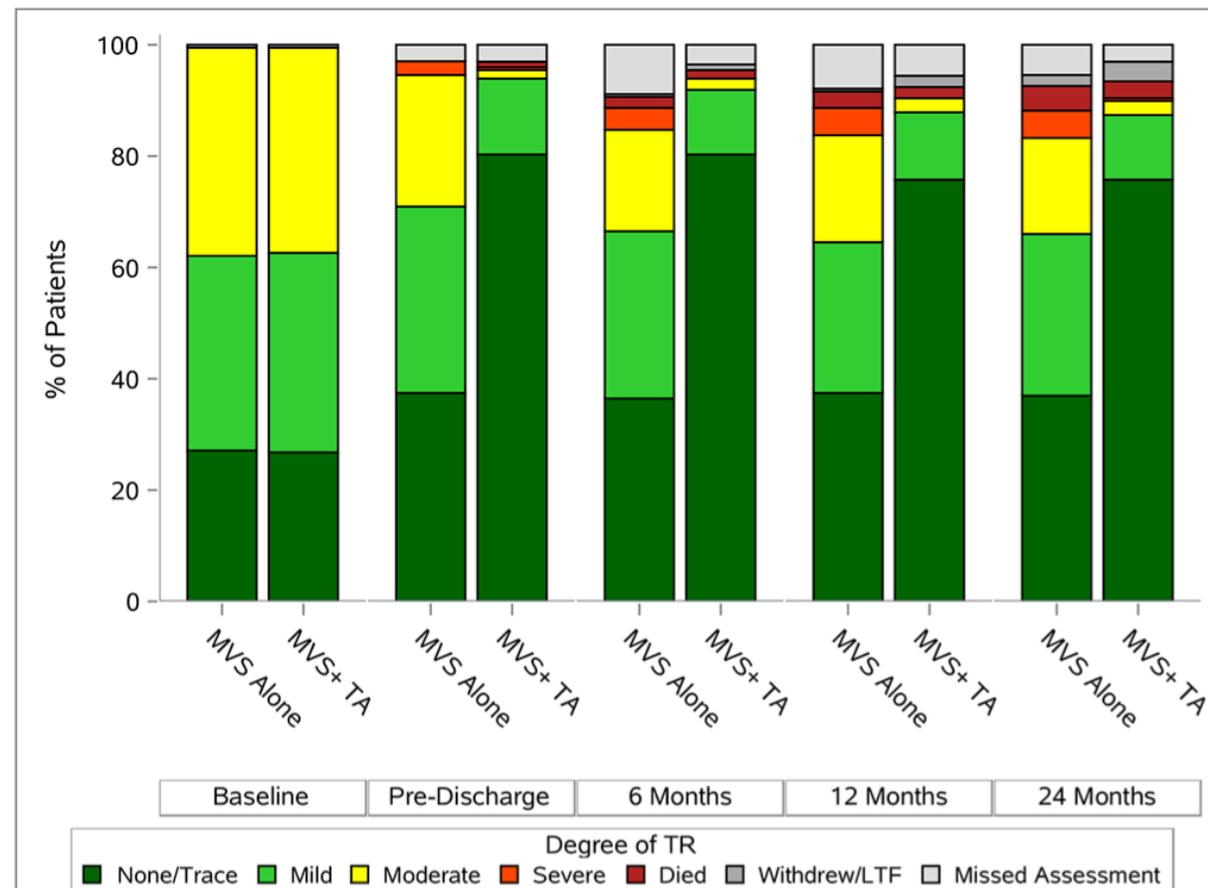
## Concomitant Tricuspid Repair in Patients with Degenerative Mitral Regurgitation

All Patients	MVS Alone (N=203)	MVS + TA (N=198)	Relative Risk (95% CI)	P-value
<b>Primary Endpoint</b>				
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)	-	-
<b>Progression of TR at 2 Years</b>	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%)

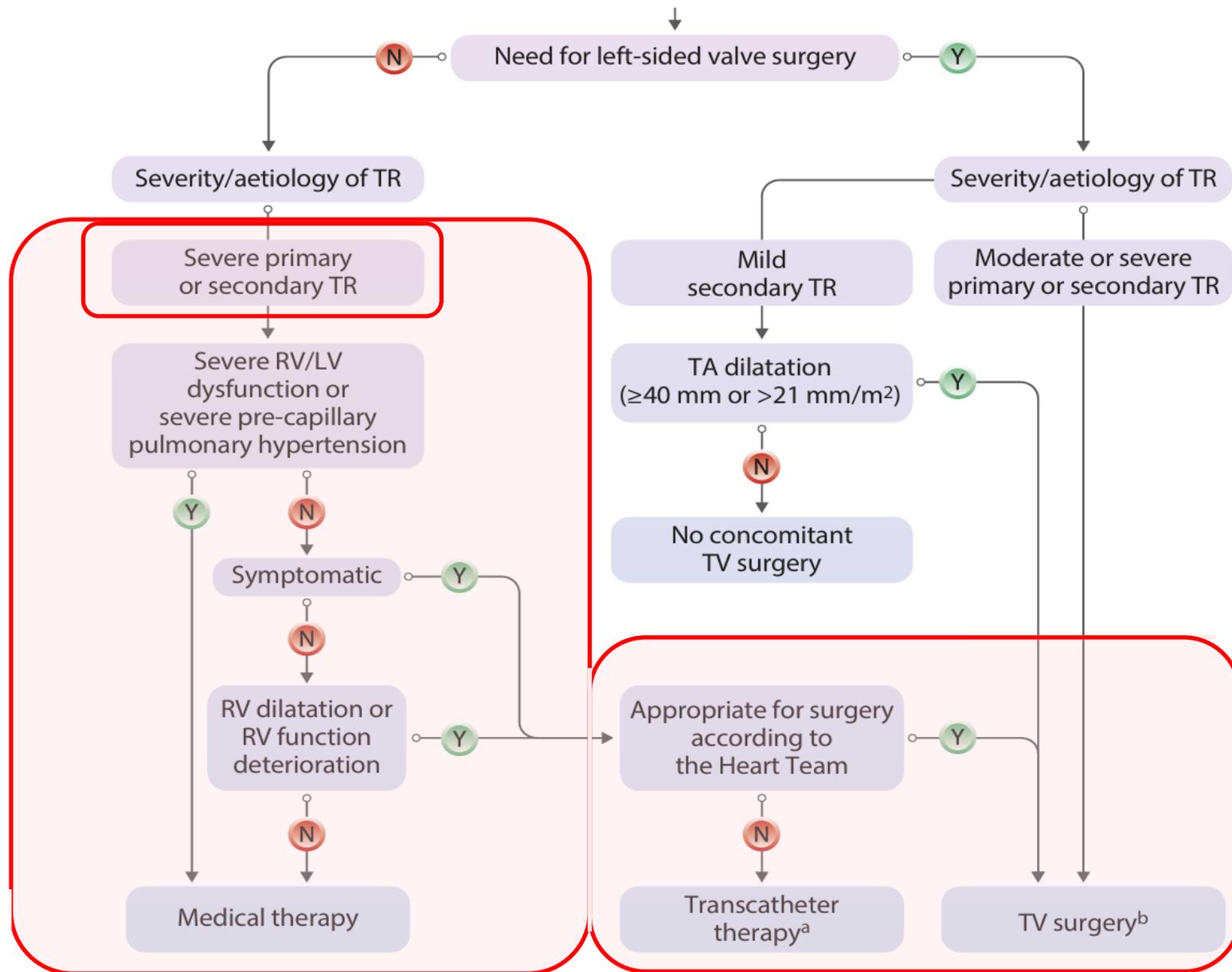


# Trikuspidální anuloplastika při operaci levostranné vady

Factors favouring concomitant TV surgery	Factors not favouring concomitant TV surgery
TR moderate or more	TR mild
Tricuspid annular dilatation	No tricuspid annular dilatation
Chronic AF	First-degree atrioventricular block, pre-existing left bundle branch block
Significant RA dilatation	Normal RA dimension
RV dilatation or (non-severe) dysfunction	Normal RV function and diameter
Presence of (non-severe) TV leaflet tethering	Absence of TV leaflet tethering
Pulmonary hypertension SPAP $\geq$ 50 mmHg	Normal pulmonary pressures
Reversible renal and liver dysfunction	No other comorbidities



# Indikace k intervenci u pacientů s TR



# Indikace k operaci u významné izolované TR

Recommendations	Class	Level
<b>Patients with severe tricuspid regurgitation without left-sided valvular heart disease requiring surgery</b>		
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 k operaci u významné izolované TR

## Severe RV dysfunction:

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

## Severe PH:

PVR	>5 WU
mPAP	>35 mmHg

### Recommendations

Patients with severe tricuspid regurgitation and severe RV dysfunction or severe PH.

TV surgery is recommended in symptomatic patients with severe RV dysfunction or severe PH.

TV surgery should be considered in asymptomatic patients who have RV dilatation/RV function deterioration or severe PH.

TV surgery should be considered in patients who are symptomatic or have RV dilatation/RV dysfunction or PH.

	Class	Level
Heart disease requiring		
TR without	I	C
Primary TR who have RV dysfunction or	IIa	C
are symptomatic or have severe LV/RV dysfunction	IIa	B

# Indikace ke katetrizační intervenci trikuspidální regurgitace

Recommendations	Class	Level
<b>Patients with severe tricuspid regurgitation without left-sided valvular heart disease requiring surgery</b>		
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**

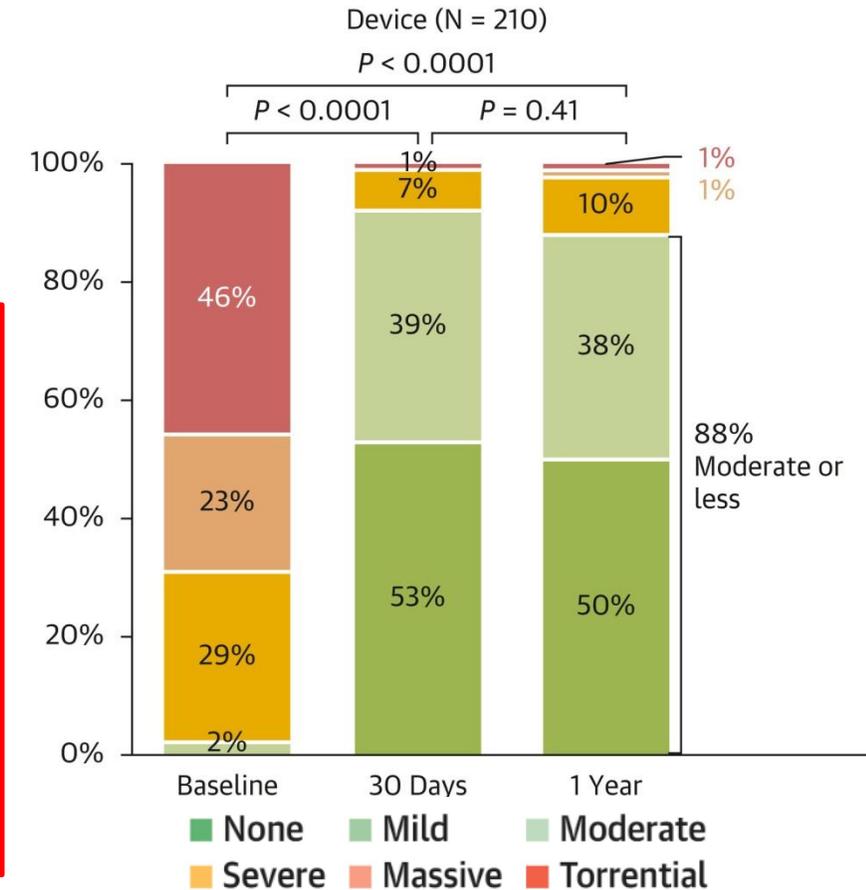
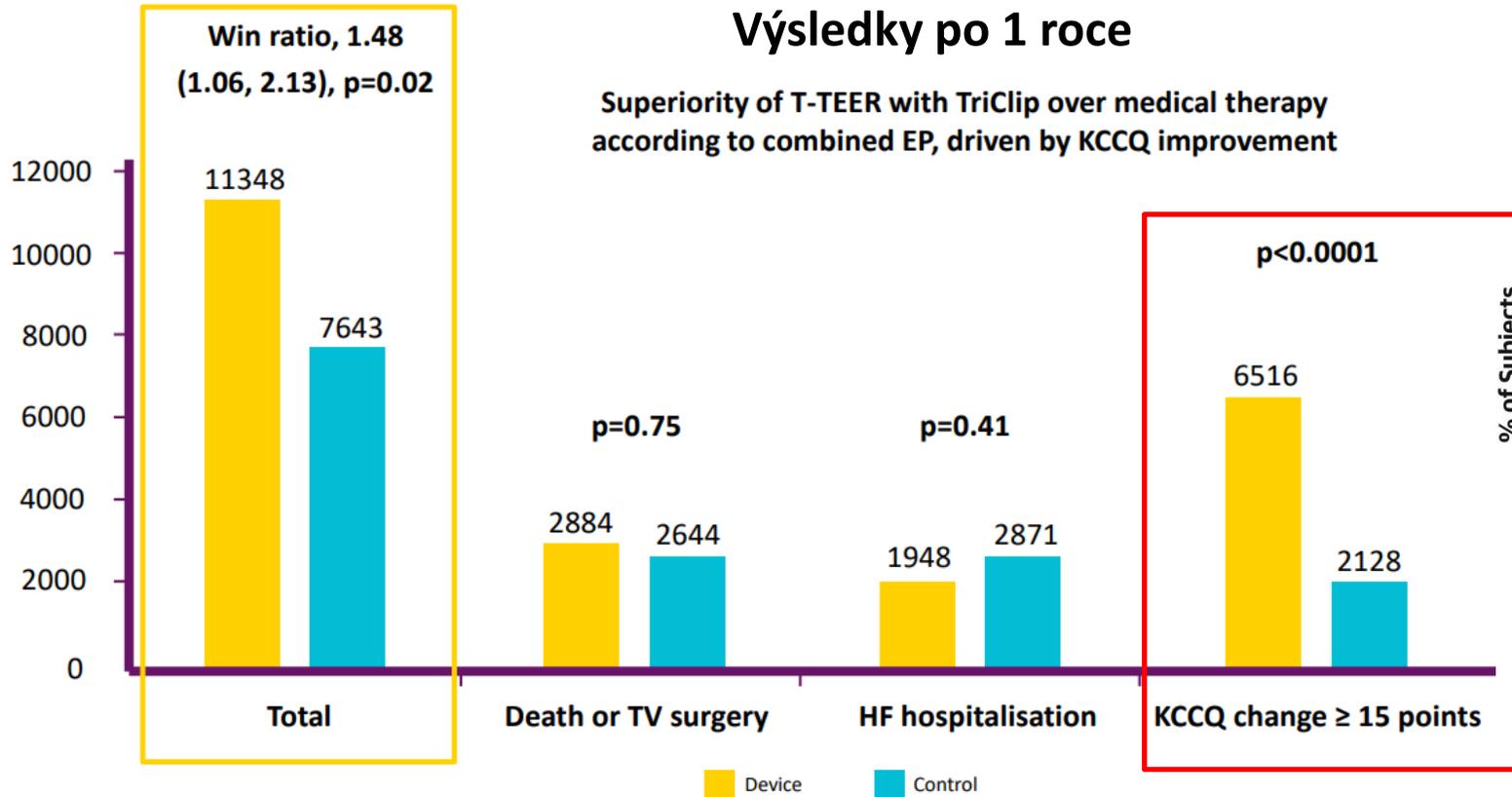


*Eur Heart J*, 2025, 00:0-102., <https://doi.org/10.1093/eurheartj/ehaf194>



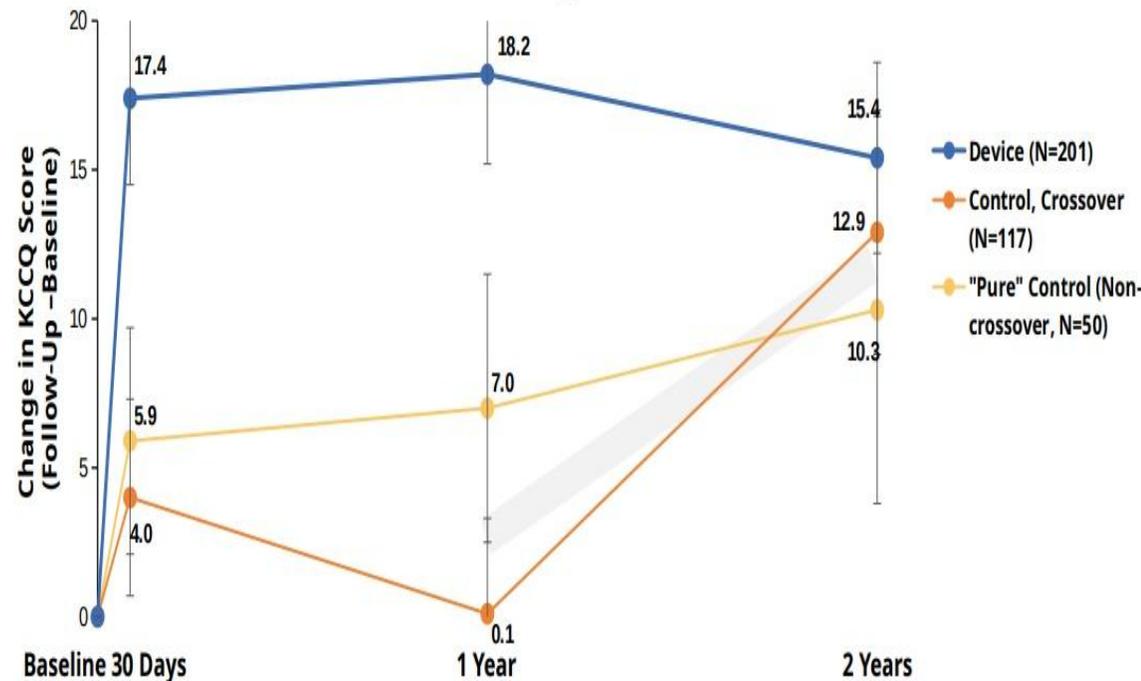
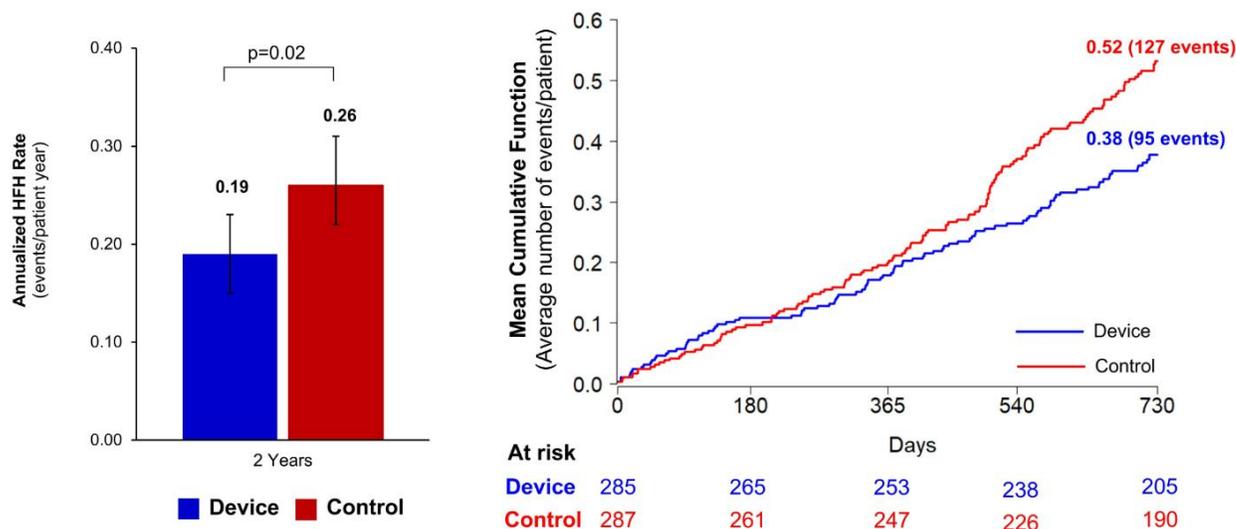
# TRILUMINATE Pivotal Trial – katetrizační plastika (TEER) systémem TriClip

RCT, 350 symptomatických pacientů s TR ≥ 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**

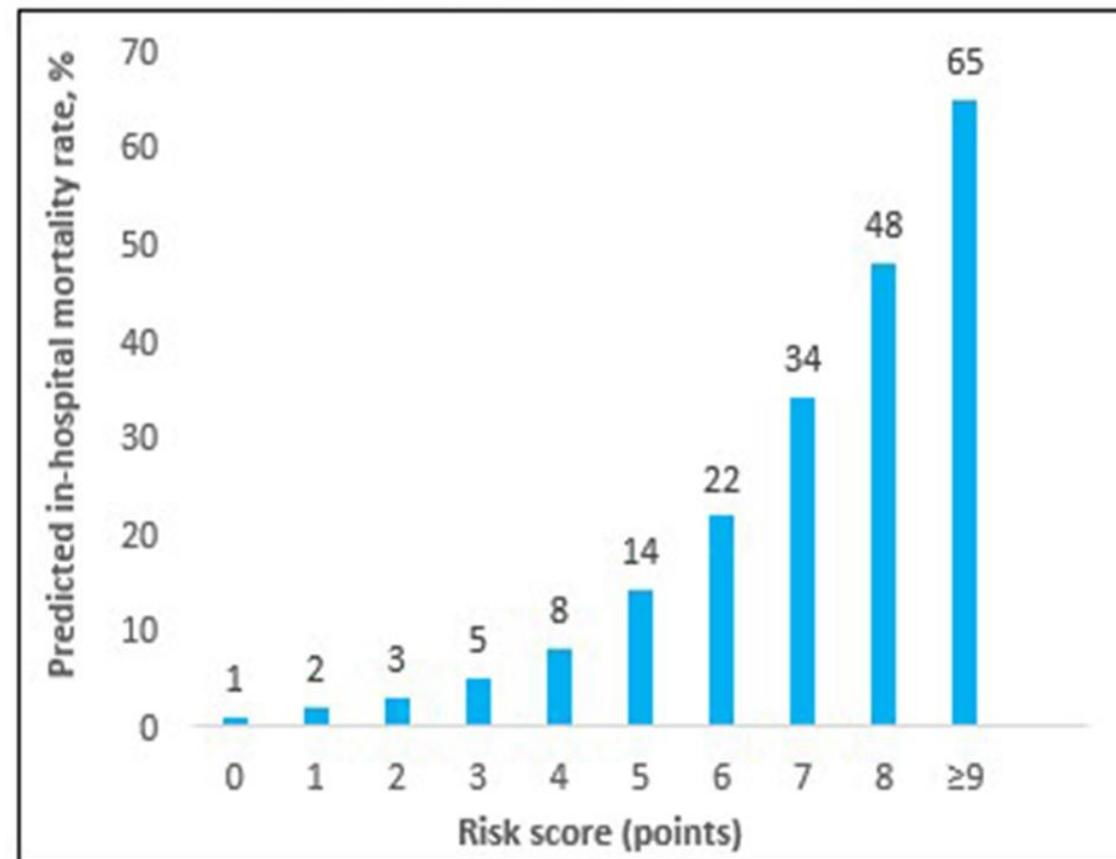
Kar S. et al. Circulation 2025; 151(23) , <https://doi.org/10.1161/CIRCULATIONAHA.125.074536>

# Tri-Score – odhad časně mortality operace izolované TR

## Rizikové faktory časně 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
<b>Total</b>	<b>12</b>

## 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 <sup>(1)</sup>
- 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 <sup>(2)</sup>
- Elevated total bilirubin <sup>(3)</sup>
- Left ventricular ejection fraction  $<$  60% <sup>(4)</sup>
- Moderate/severe right ventricular dysfunction <sup>(5)</sup>
  - 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

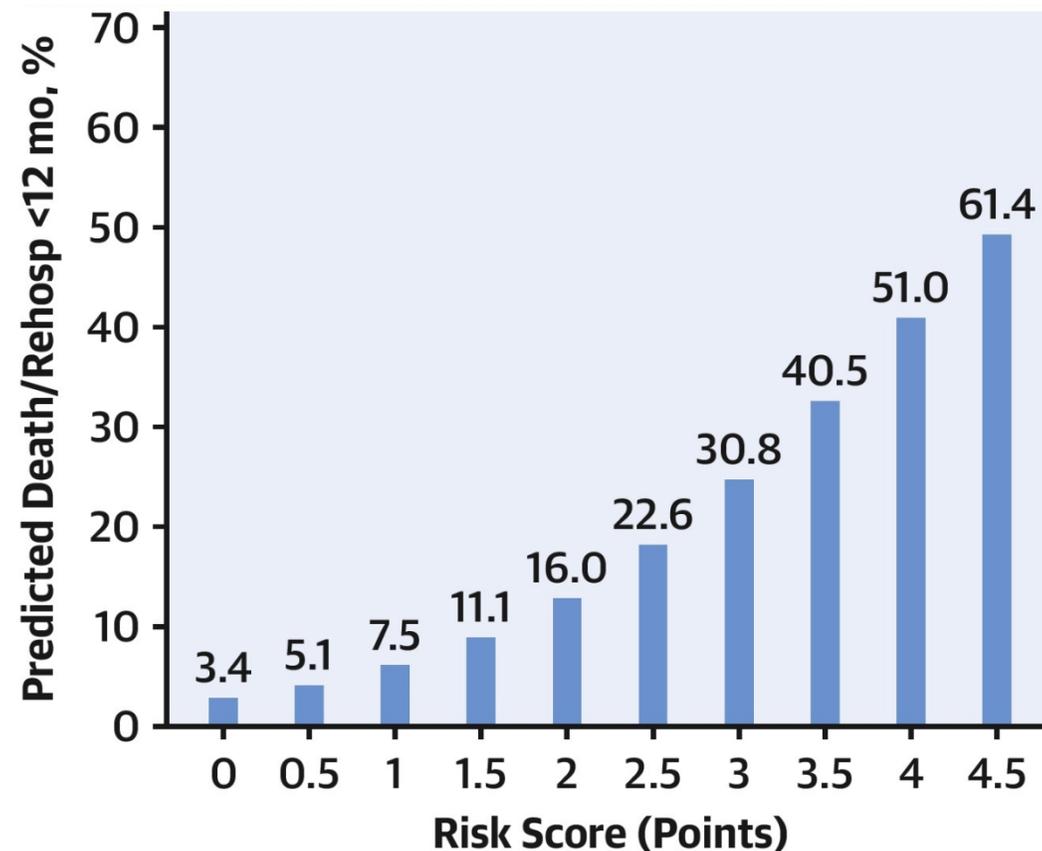
<https://www.tri-score.com/>



# TRIVALVE - rizikové skóre u významné TR řešené katetrizačně (TTVI)

- 483-pacientů z **TRIVALVE registru** pacientů s trikuspidálních intervencí
- Predikce roční mortality a rehospitalizací pro srdeční selhání

RF roční mortality/rehospitalizací SS	Body
Atrial fibrillation	1
GFR <30 ml/min	1
Elevated GGT or bilirubin	1
Signs of right HF	1
LVEF <50%	0.5



# 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

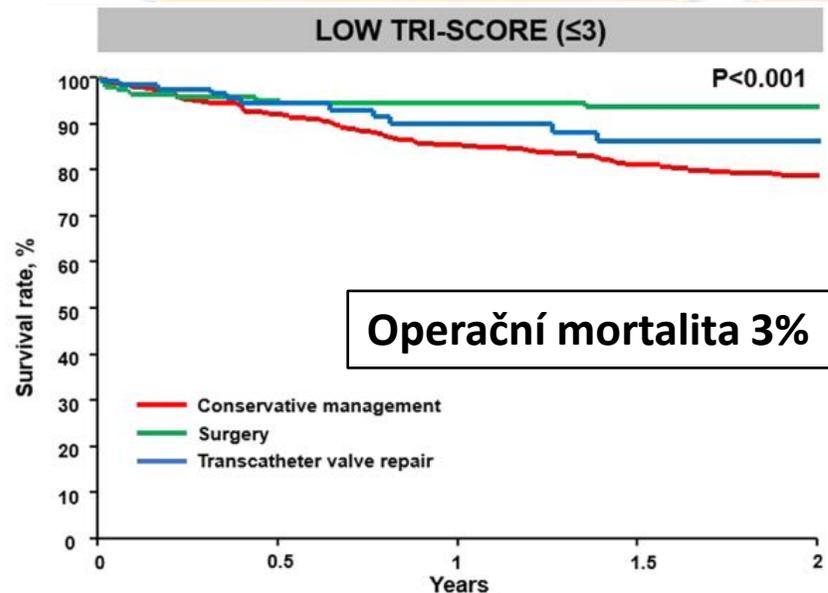
551 underwent isolated tricuspid valve surgery

645 underwent transcatheter valve repair

Low TRI-SCORE ( $\leq 3$ )

Intermediate TRI-SCORE (4–5)

High TRI-SCORE ( $\geq 6$ )



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

**HIGH TRI-SCORE ( $\geq 6$ )**

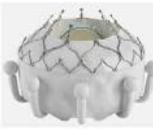
**Chirurgická nebo katetrizační léčba má být indikována časně**

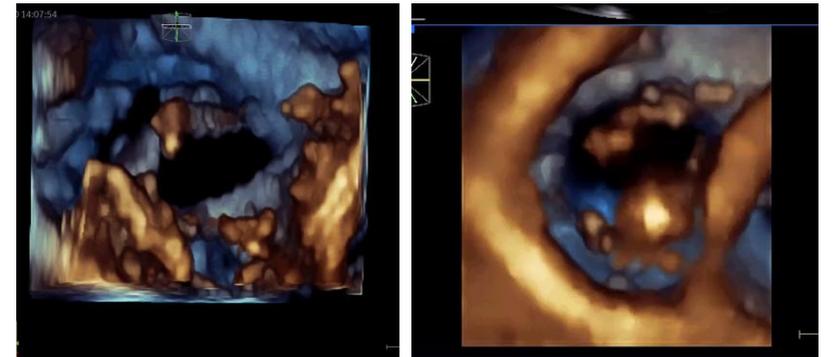
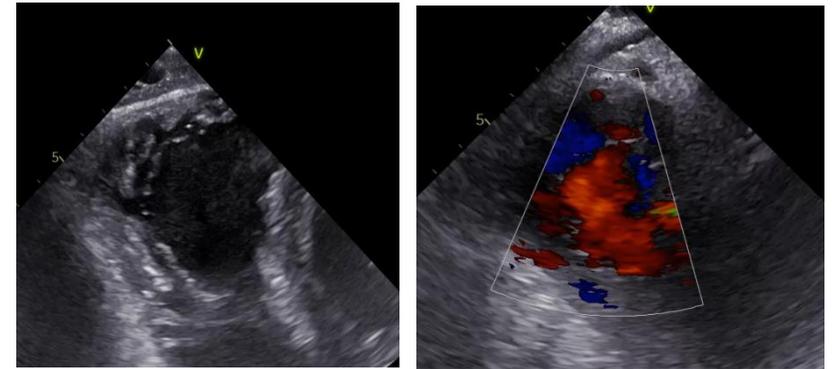
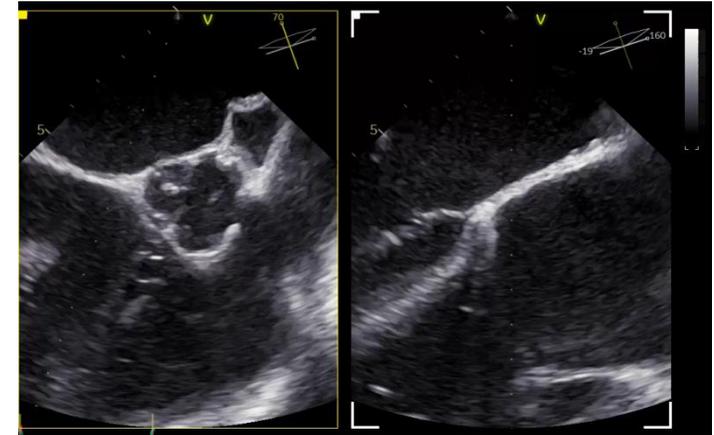
**Zlepšení mortality zejména u nemocných s nízkým rizikem dle TRISCORE**

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
<b>T-TEER</b> 	Small septolateral gap $\leq 7$ mm <sup>10</sup> Anteroseptal jet location Confined prolapse or flail Trileaflet morphology	Septolateral coaptation gap $>7$ but $\leq 8.5$ mm <sup>65</sup> Posteroseptal jet location Non-trileaflet morphology Incidental CIED RV lead (i.e., without leaflet impingement)	Large septolateral coaptation gap $>8.5$ mm <sup>65</sup> 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 (tenting height $<0.76$ cm, tenting area $<1.63$ cm <sup>2</sup> , tenting volume [3D] $<2.3$ mL) <sup>110,111</sup> Central jet location Sufficient landing zone for anchoring	Moderate tethering (tethering height $\geq 0.76$ cm but $<1.0$ cm, tenting area $>1.63$ but $<2.5$ cm <sup>2</sup> , tenting volume [3D] $\geq 2.3$ mL but $\leq 3.5$ mL) <sup>110,111</sup> 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 <sup>110,111</sup> 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



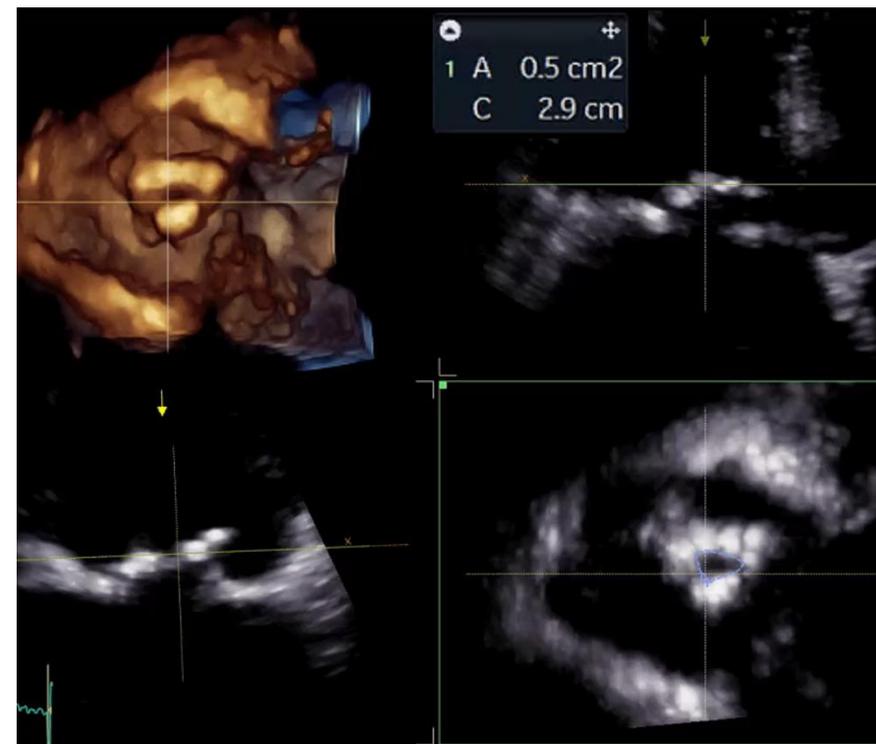
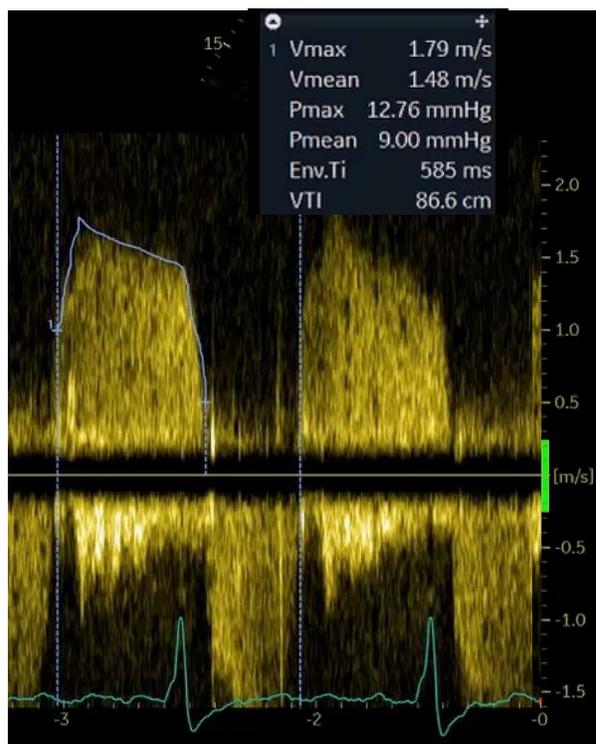
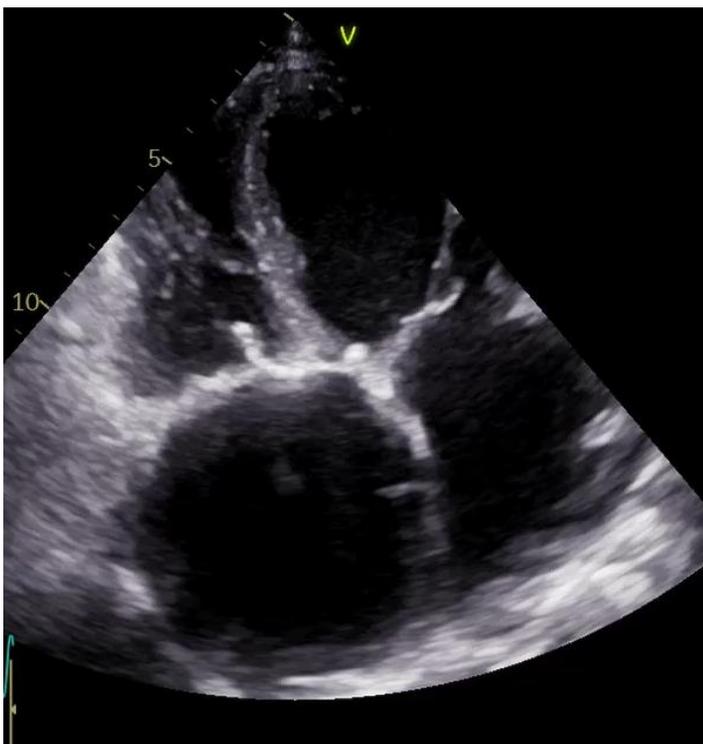
# Trikuspidální stenóza

**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.

