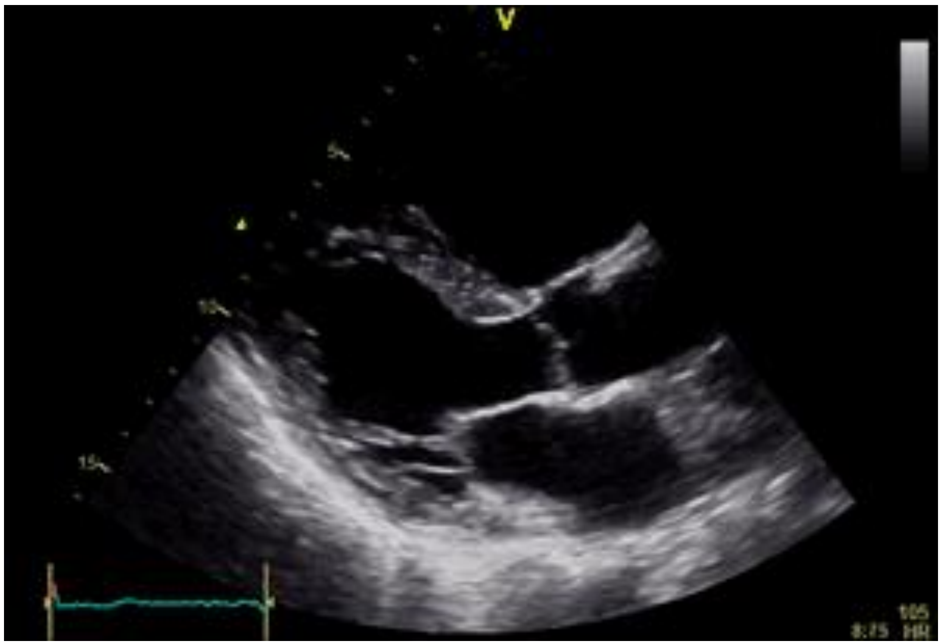
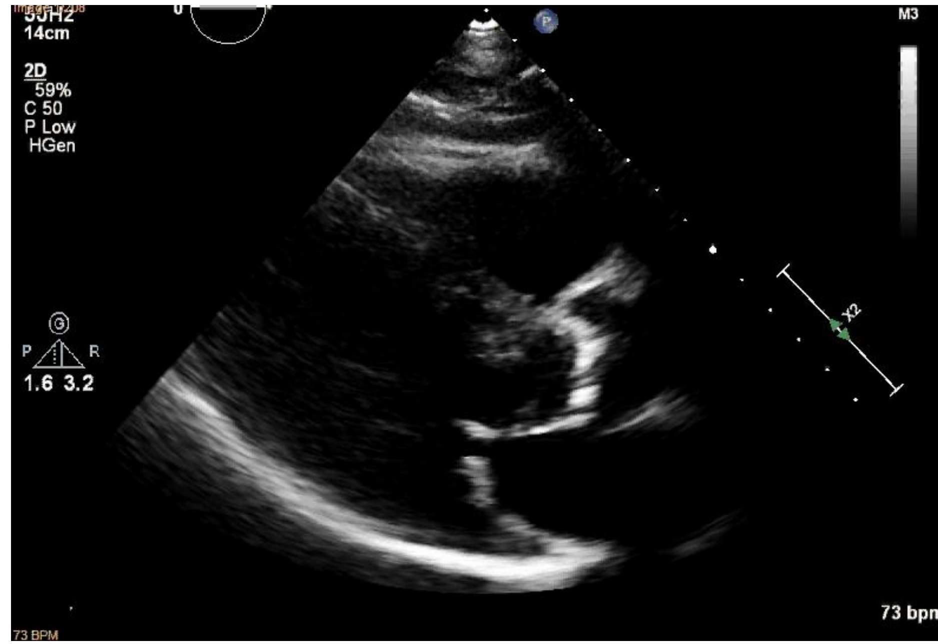
Echokardiografie

Martin Horváth

Kardiologická klinika 2.LF UK a FN Motol

Aortální stenóza


V


14cm
2D
59%
C 50
P Low
HGen
P
R
1.6 3.2
M3
73 bpm
73 BPM

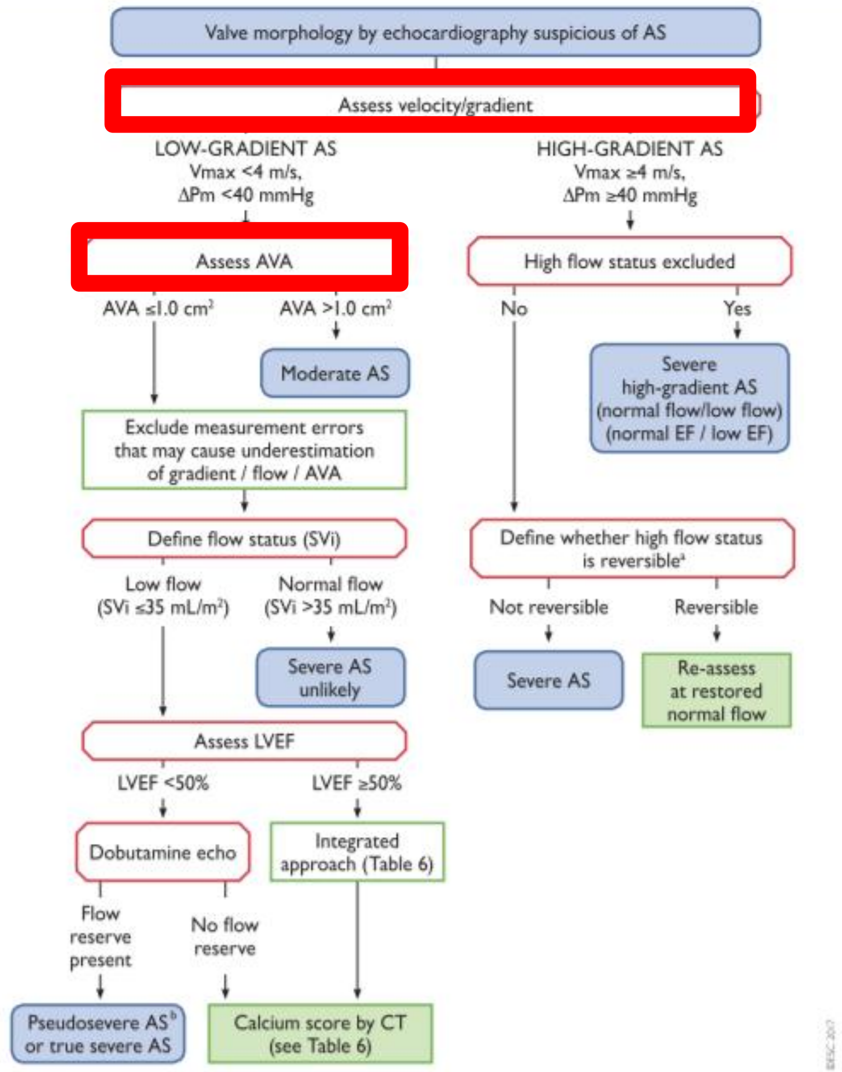
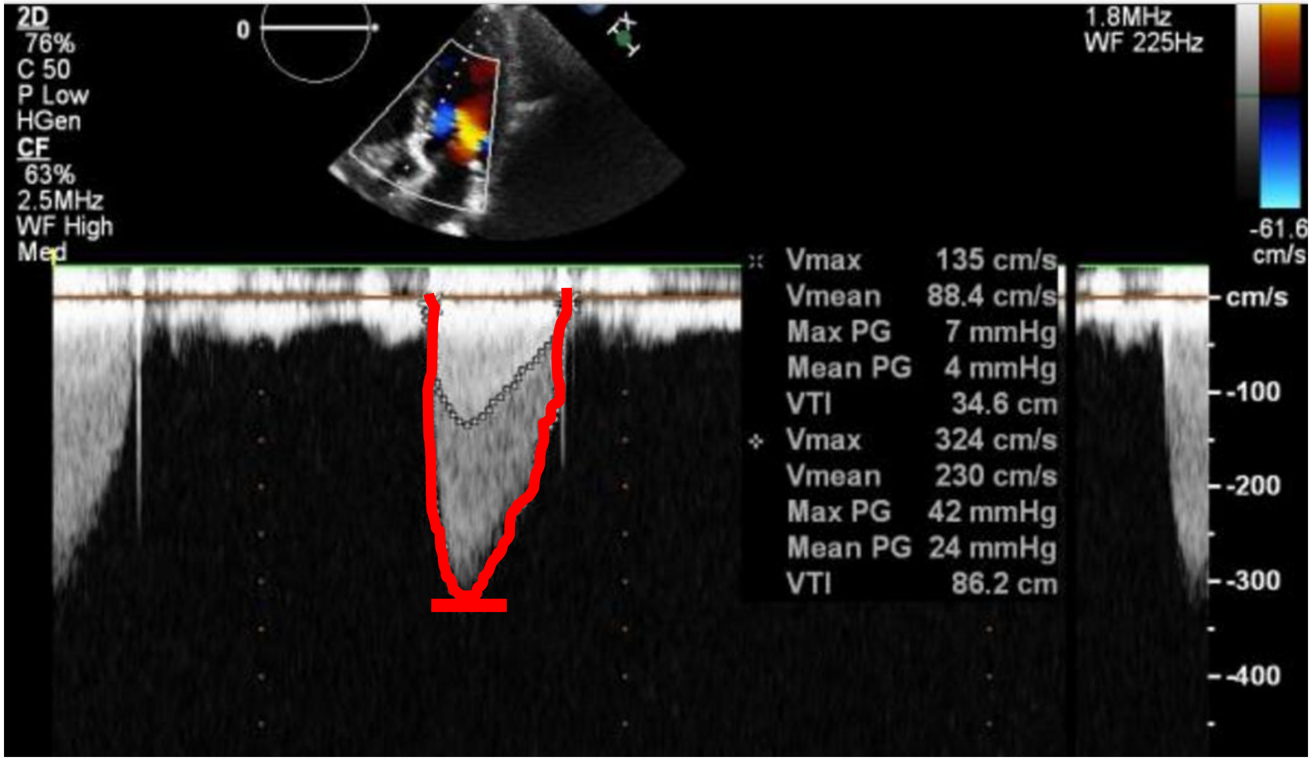


Figure 2 Stepwise integrated approach for the assessment of aortic stenosis severity (modified from Baumgartner *et al*[4]). [a]High flow may be reversible in settings such as anaemia, hyperthyroidism, arteriovenous shunts. [b]Pseudosevere AS is defined by an increase to an AVA >1.0cm² with flow normalization.
ΔPm = mean transvalvular pressure gradient; AS = aortic stenosis; AVA = aortic valve area; CT = computed tomography; EF = ejection fraction; LVEF = left ventricular ejection fraction; SVi = stroke volume index; Vmax = peak transvalvular velocity.

Vmax/gradient

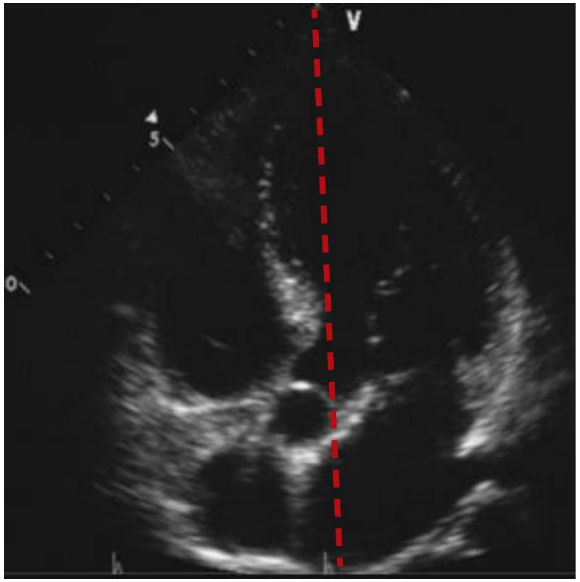
KARDIOLOGICKÁ KLINIKA
2. LF UK a FN MOTOL

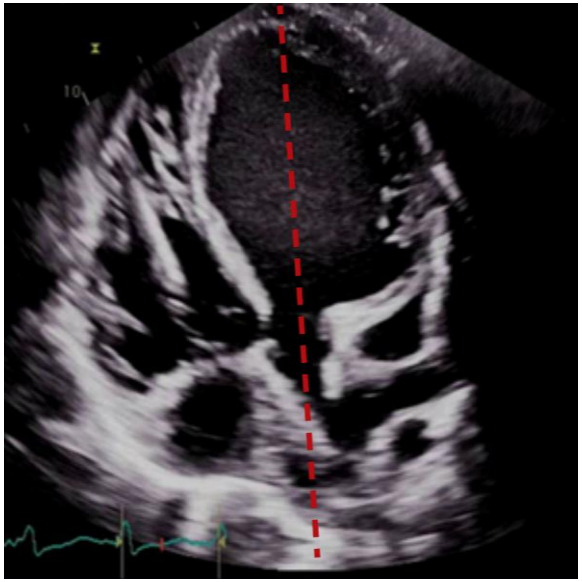


Bernoulliho rovnice

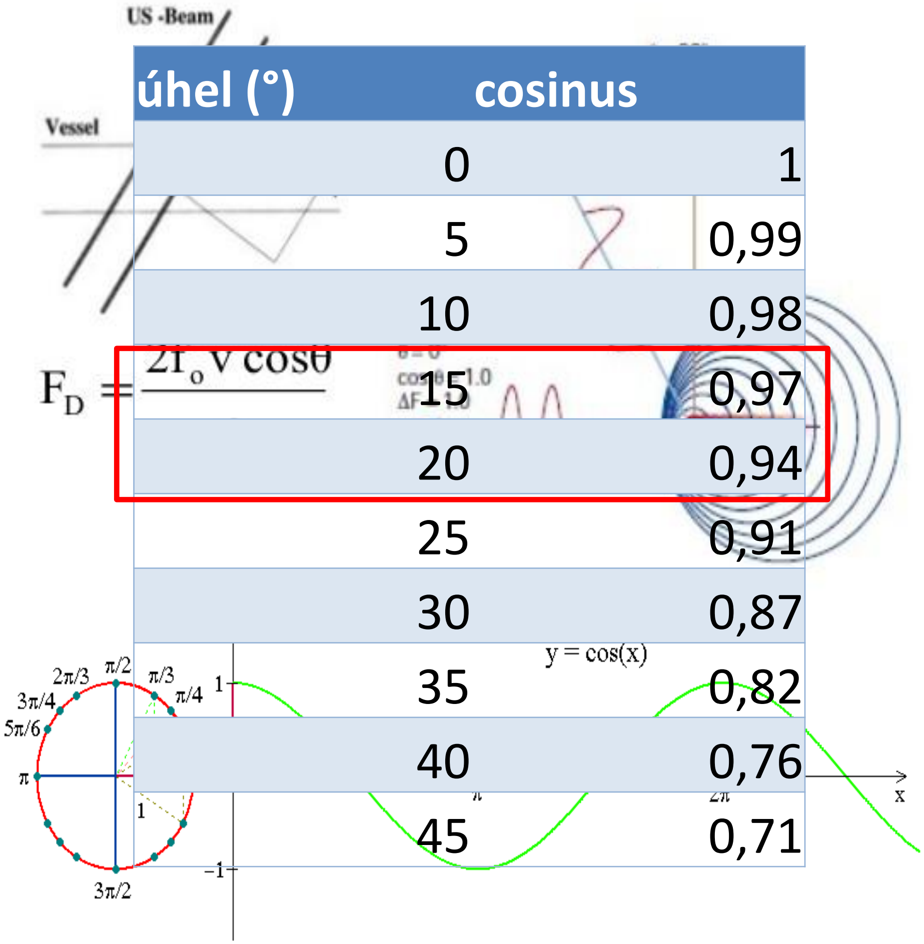
Gradient= 4 x Vmax^2

Střední gradient



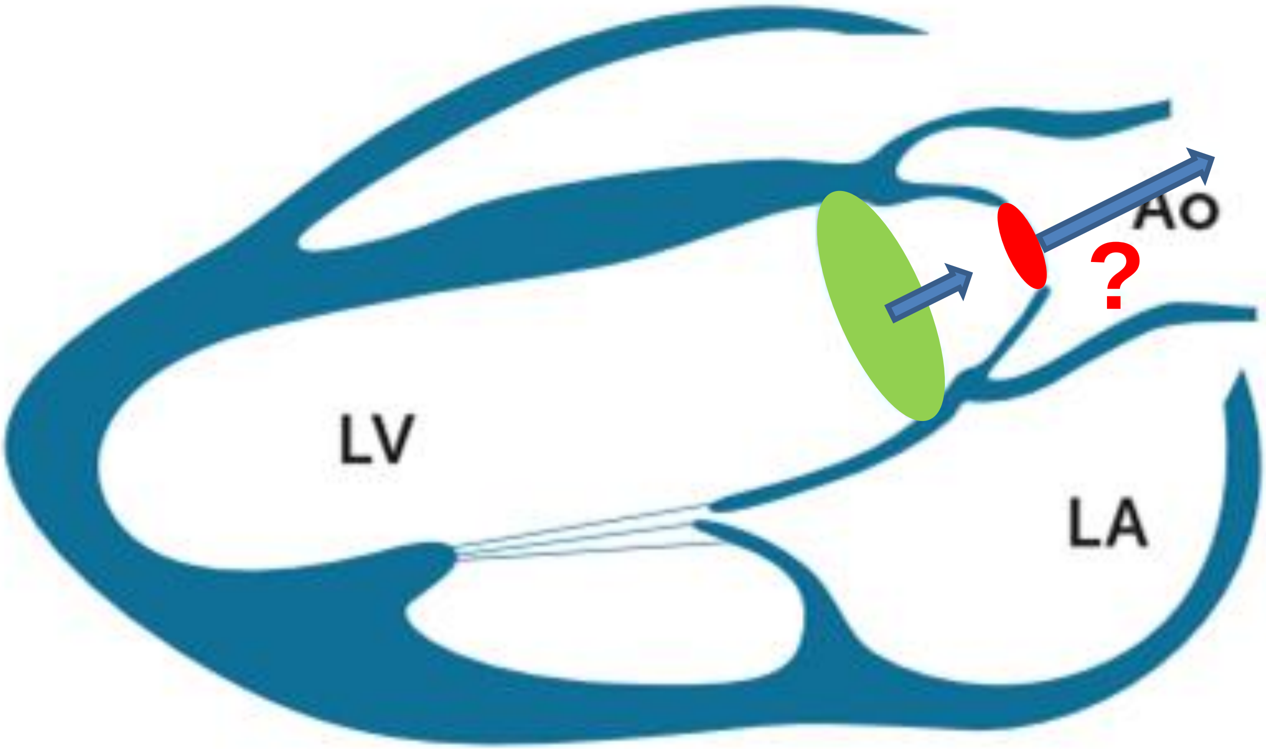


Effect of Doppler angle on frequency shift

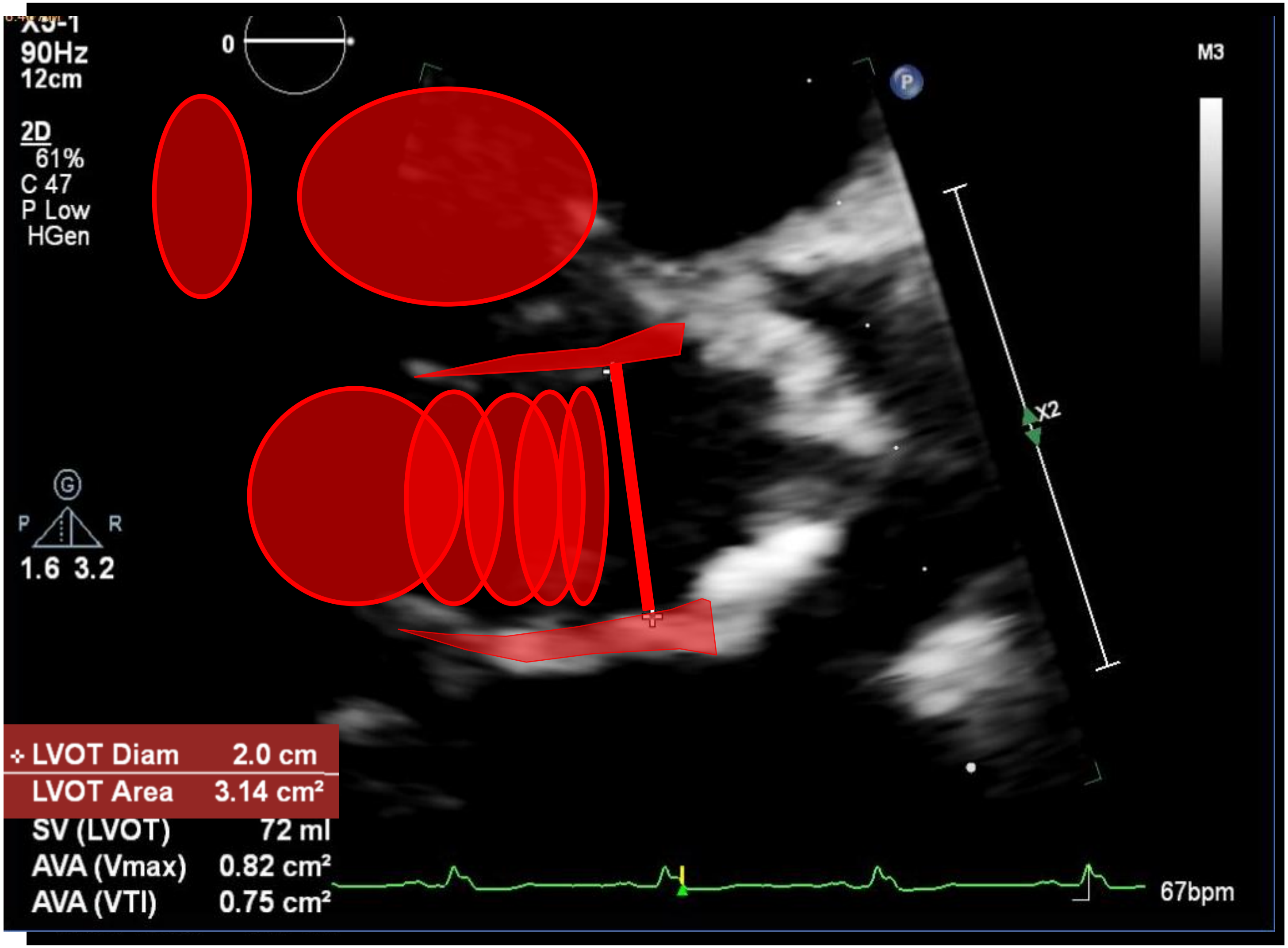


úhel (°)	cosinus
0	1
5	0,99
10	0,98
15	0,97
20	0,94
25	0,91
30	0,87
35	0,82
40	0,76
45	0,71

AVA



Plocha aortálního ústí = plocha LVOT x VTI $_{(LVOT)}$ / VTI $_{(Ao)}$

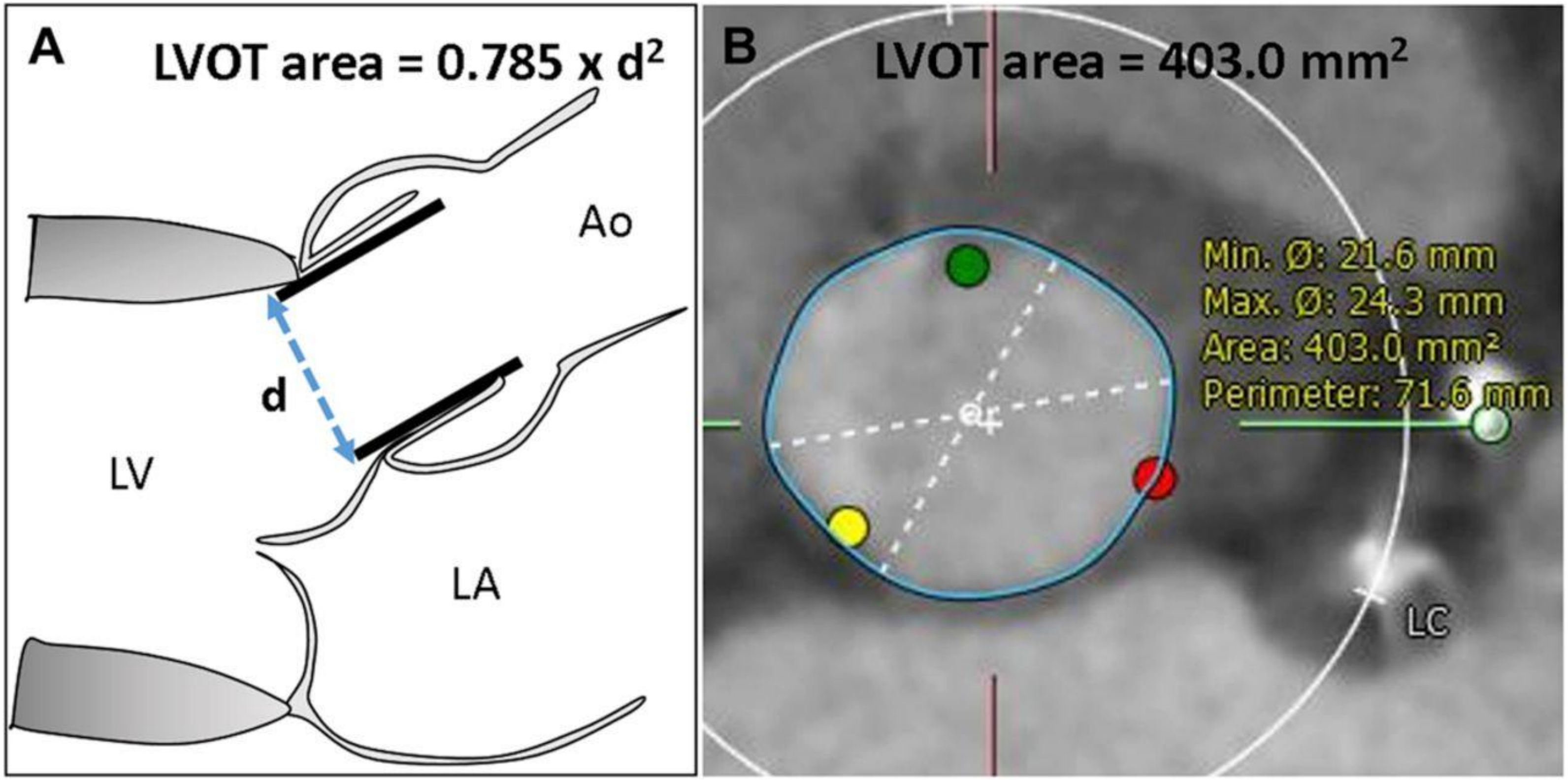


LVOTd = (5,7x BSA)+ 12,1 ± 2

Plocha LVOT = $(\pi \times d^2)/4$

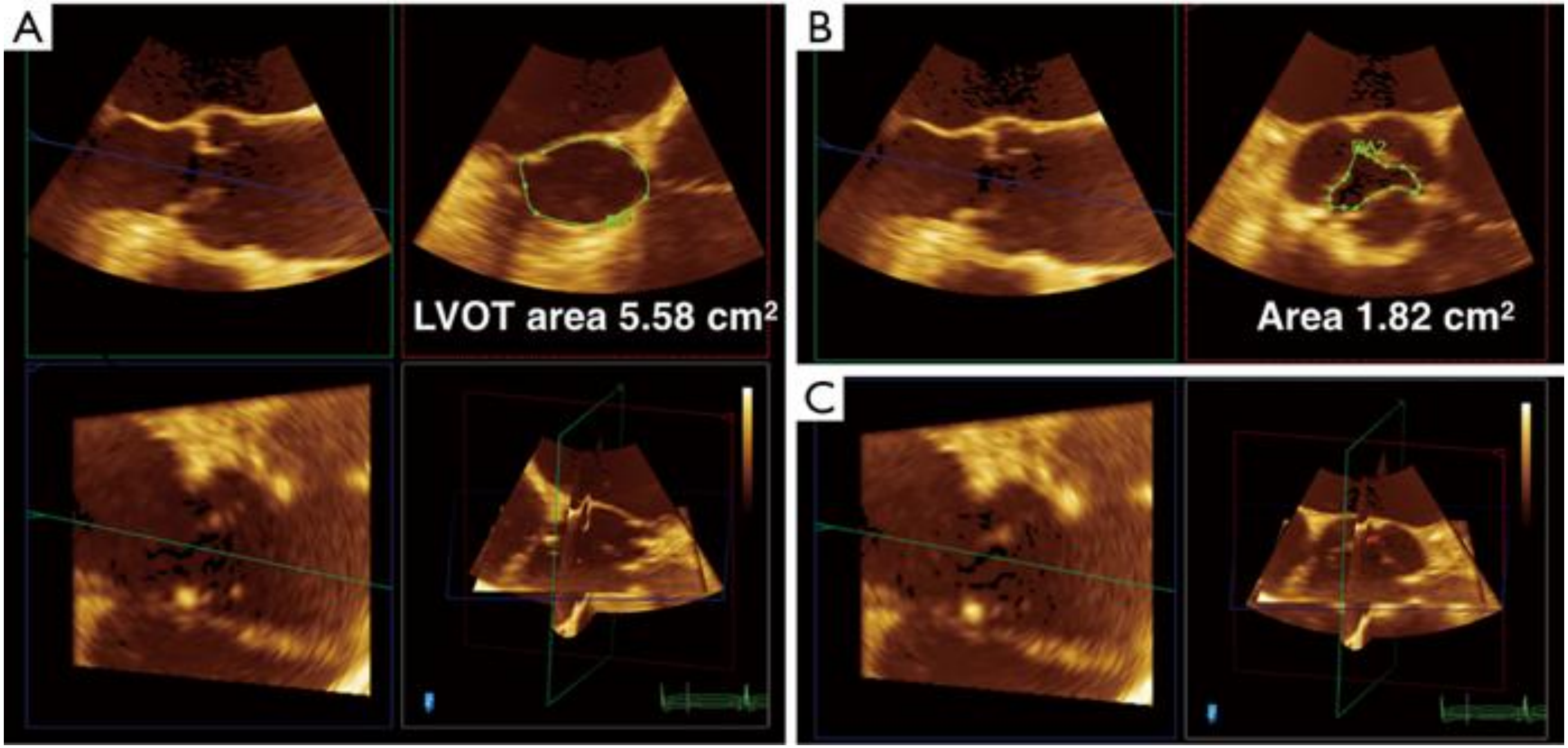
KARDIOLOGICKÁ KLINIKA
2. LF UK a FN MOTOL

Hybridní AVA

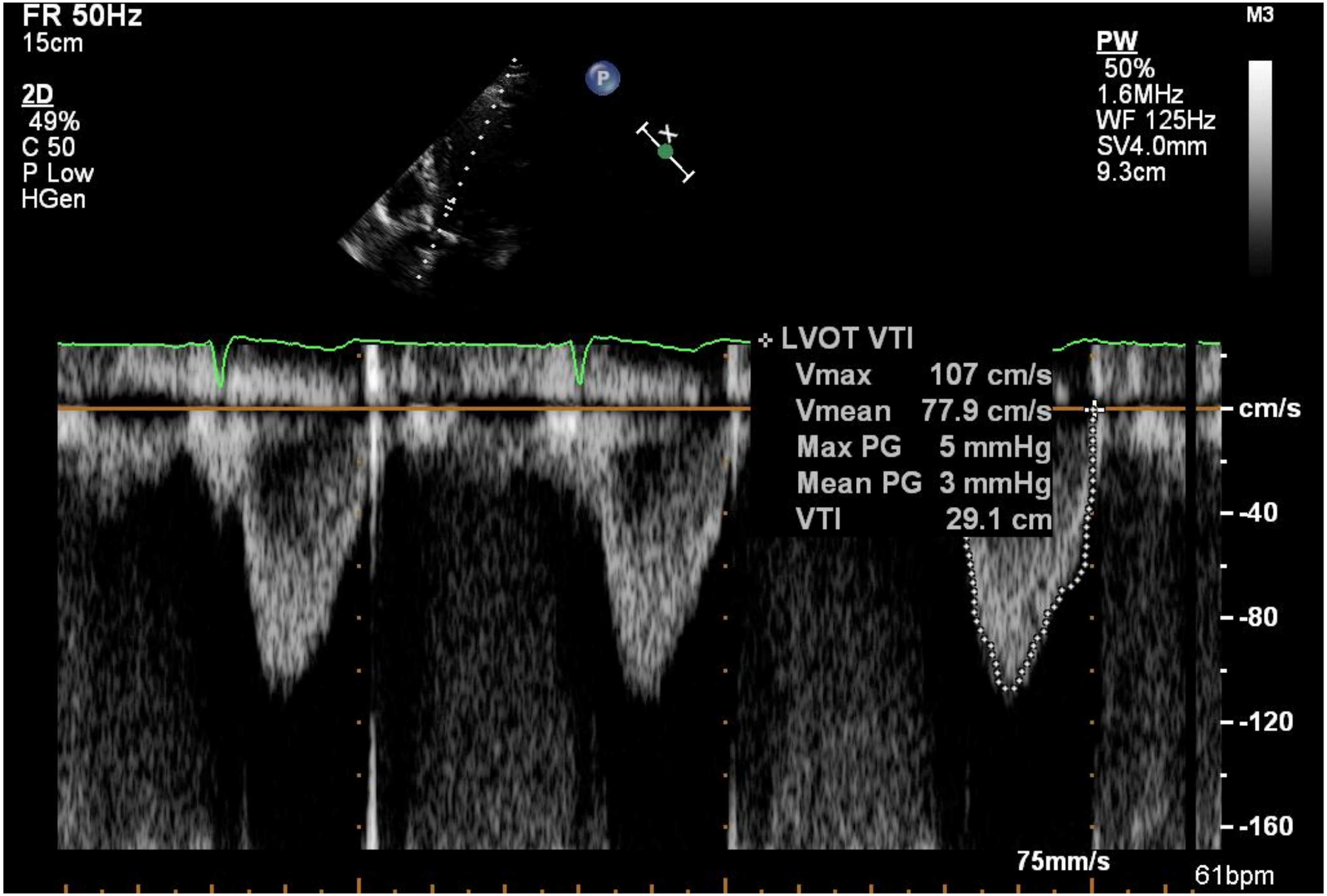


Monney et al.; JACC, 2017

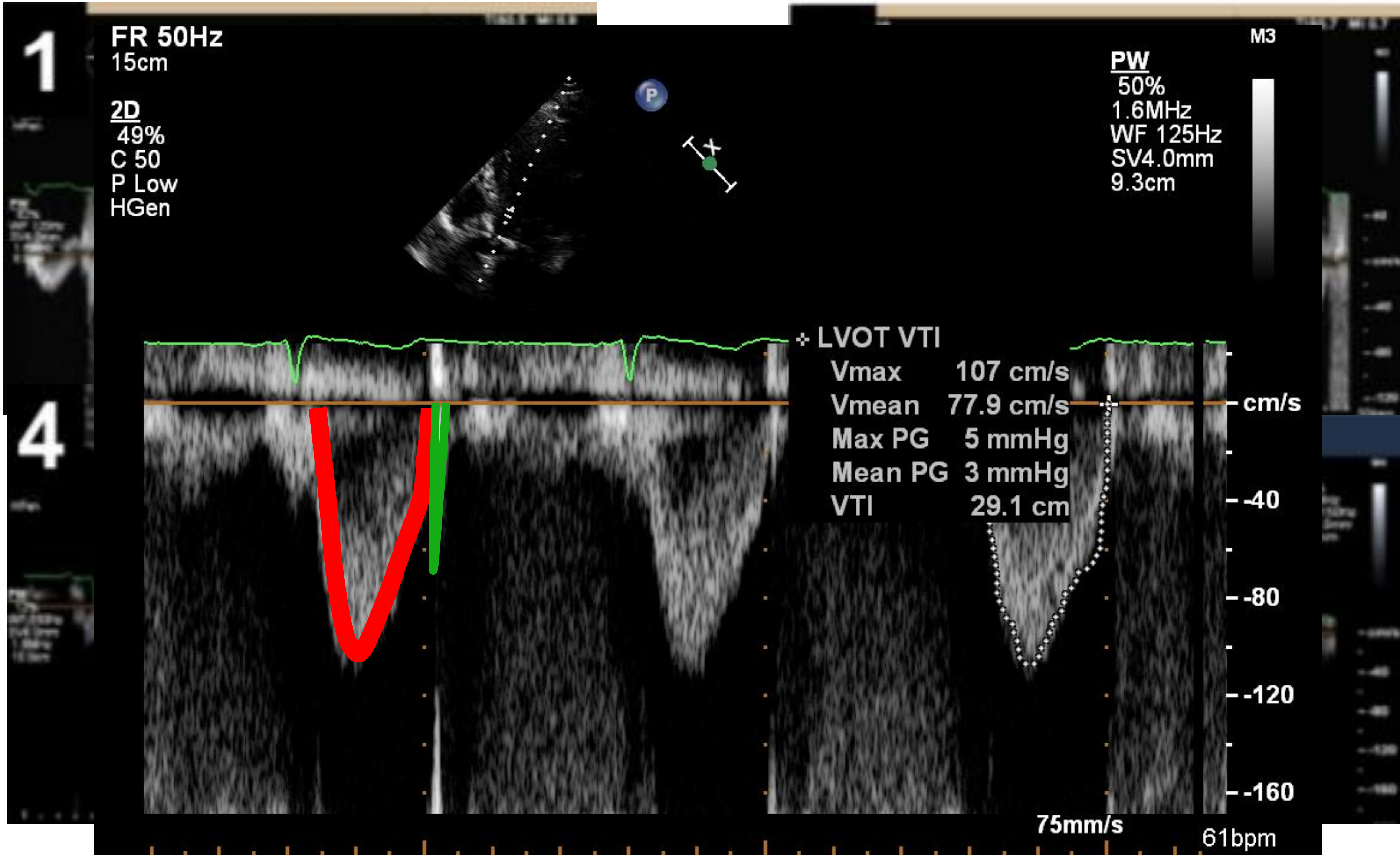
Hybridní AVA



Rong et al.; Journal of Thoracic Disease, 2017


FR 50Hz
15cm
2D
49%
C 50
P Low
HGen
M3
PW
50%
1.6MHz
WF 125Hz
SV4.0mm
9.3cm
LVOT VTI
Vmax 107 cm/s
Vmean 77.9 cm/s
Max PG 5 mmHg
Mean PG 3 mmHg
VTI 29.1 cm
cm/s
-40
-80
-120
-160
75mm/s
61bpm

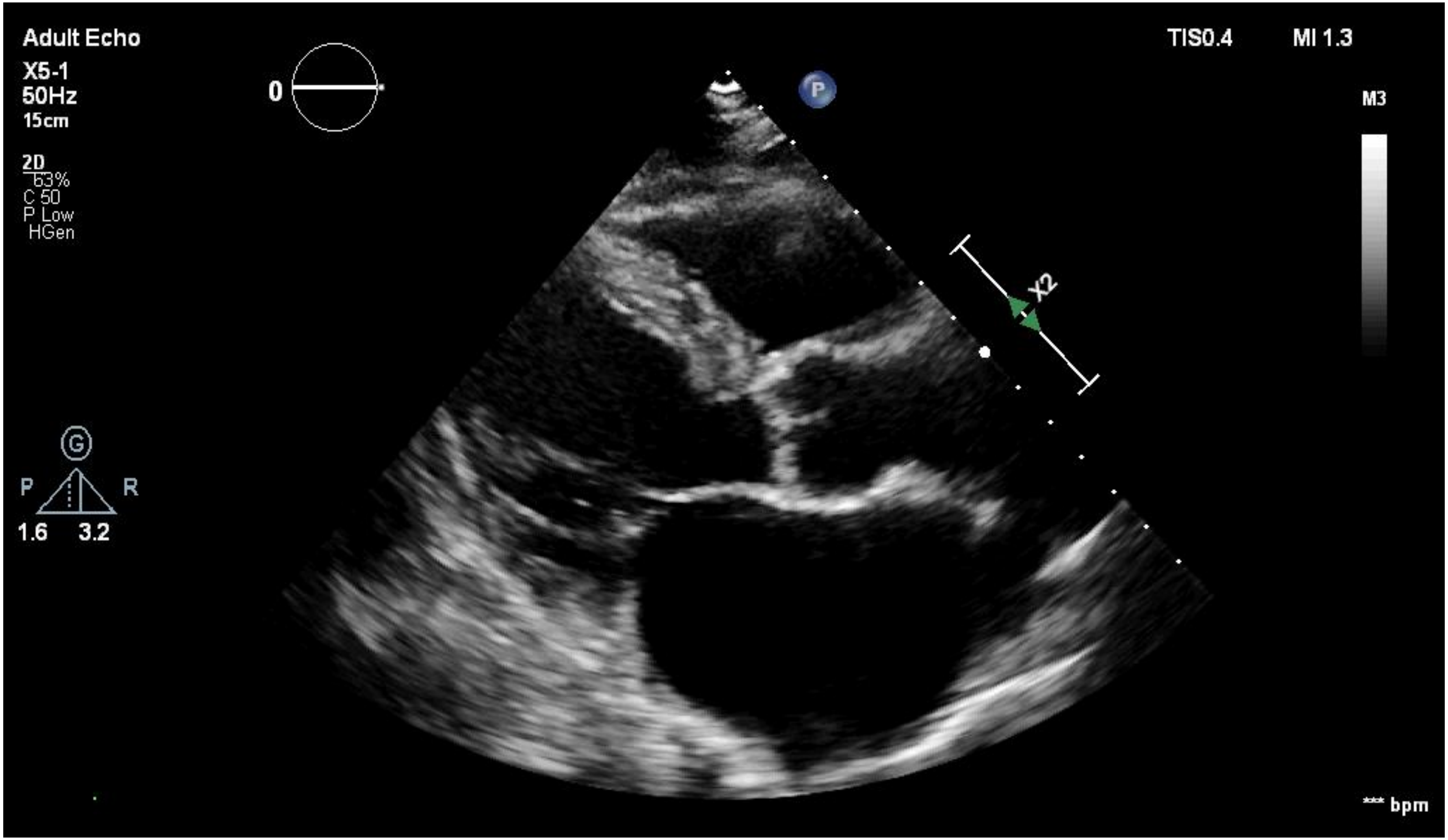
LVOT velocity measurement



Hung J, et al. Heart 2018

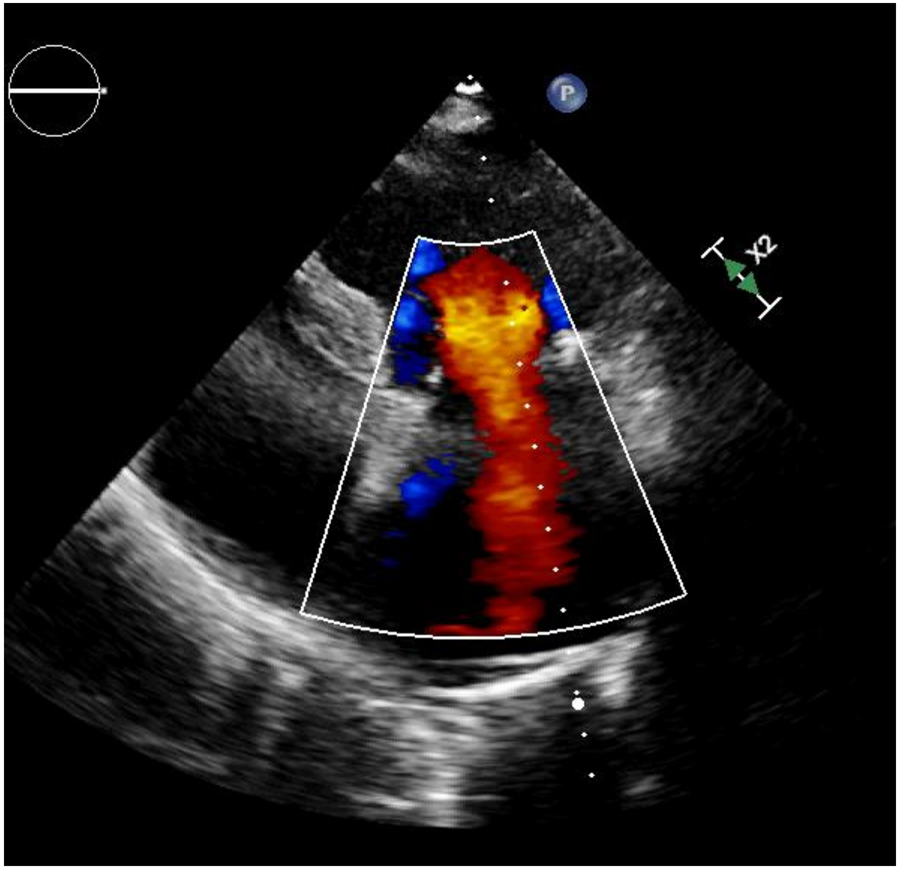
Kazuistika 1

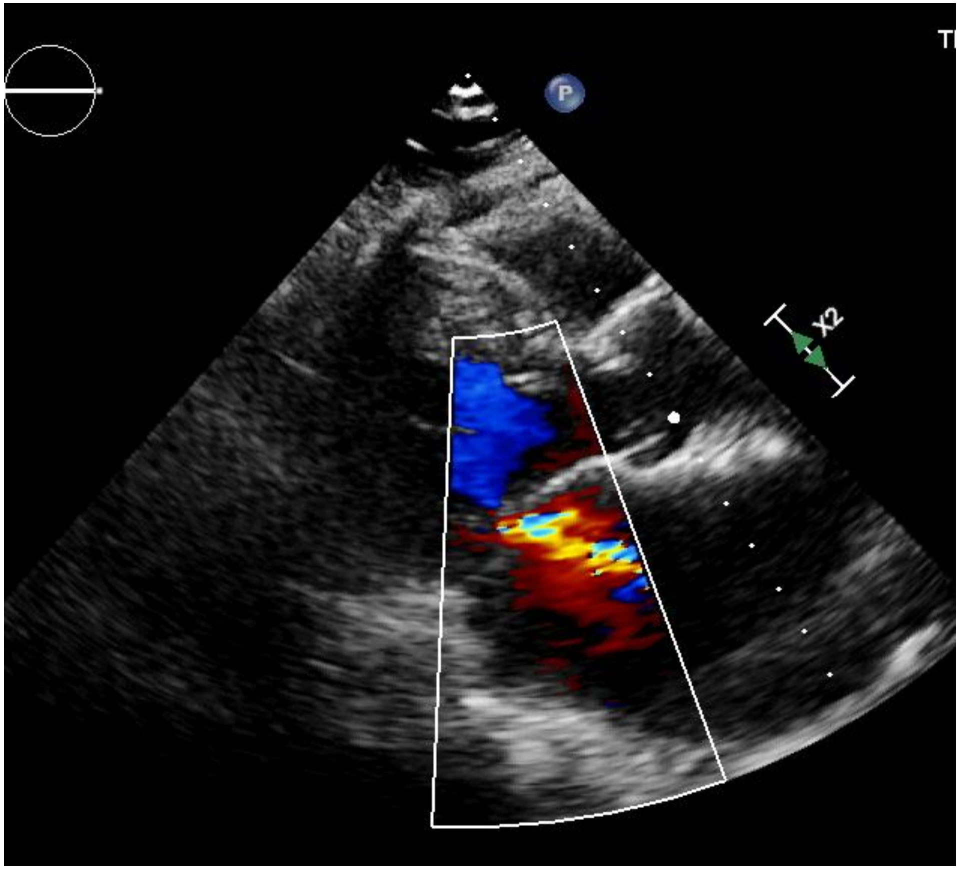
- 73-letá pacientka referována do ambulance chlopenních vad pro suspektní těžkou aortální stenózu
- Arteriální hypertenze, jinak dosud zcela zdráva
- Námahová dušnost NYHA II v posledních 3 měsících
- Systolický šelest slyšitelný v celém prekordiu, v aortální pozici, nad levou a. carotis interna, na hrotu levé komory
- ECHO z periferie dobrá systolická funkce levé komory, susp. těžká AoS s Vmax 4,3m/s


Adult Echo
X5-1
50Hz
15cm
2D
63%
C 50
P Low
HGen
0
TIS0.4
MI 1.3
M3
X2
P
R
1.6
3.2
*** bpm

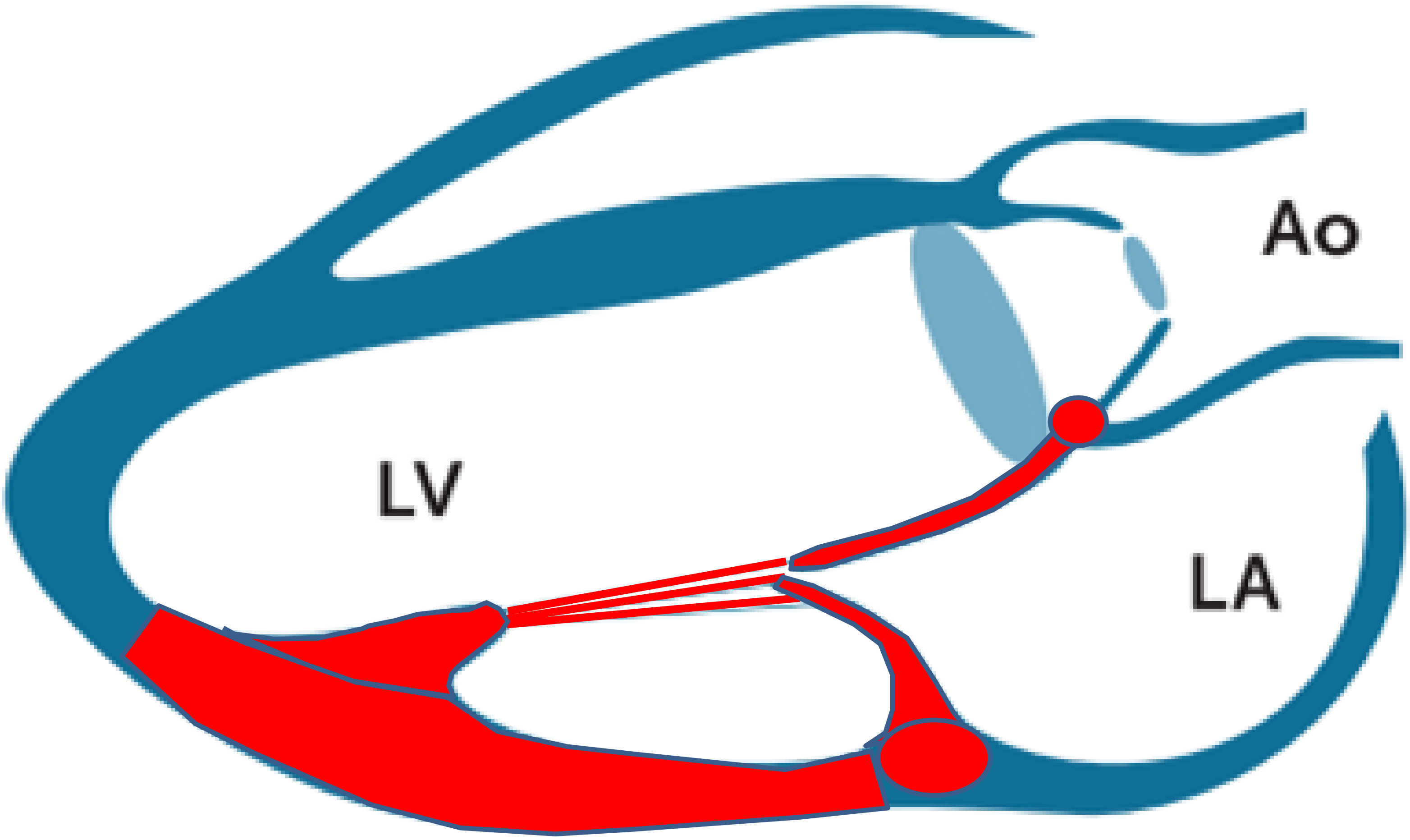
Jaká je diagnóza?

1. Těžká aortální stenóza
2. Dynamická obstrukce v LVOT
3. Pacientka nemá srdeční onemocnění
4. Mitrální insuficience


X2


X2

Mitrální insuficience



KARDIOLOGICKÁ KLINIKA
2. LF UK a FN MOTOL

	Mitral regurgitation	
Qualitative		
Valve morphology	Flail leaflet/ruptured papillary muscle/ large coaptation defect	
Colour flow regurgitant jet	Very large central jet or eccentric jet adhering, swirling, and reaching the posterior wall of the LA	
CW signal of regurgitant jet	Dense/triangular	
Other	Large flow convergence zone[a]	
Semiquantitative		
Vena contracta width (mm)	≥7 (>8 for biplane)[b]	
Upstream vein flow[c]	Systolic pulmonary vein flow reversal	
Inflow	E-wave dominant ≥1.5 m/s[d]	
Other	TVI mitral/TVI aortic >1.4	
Quantitative	Primary	Secondary[h]
EROA (mm^2)	≥40	≥20
Regurgitant volume (mL/beat)	≥60	≥30
+ enlargement of cardiac chambers/vessels	LV, LA	

Baumgartner et al.; European Heart Journal, 2017

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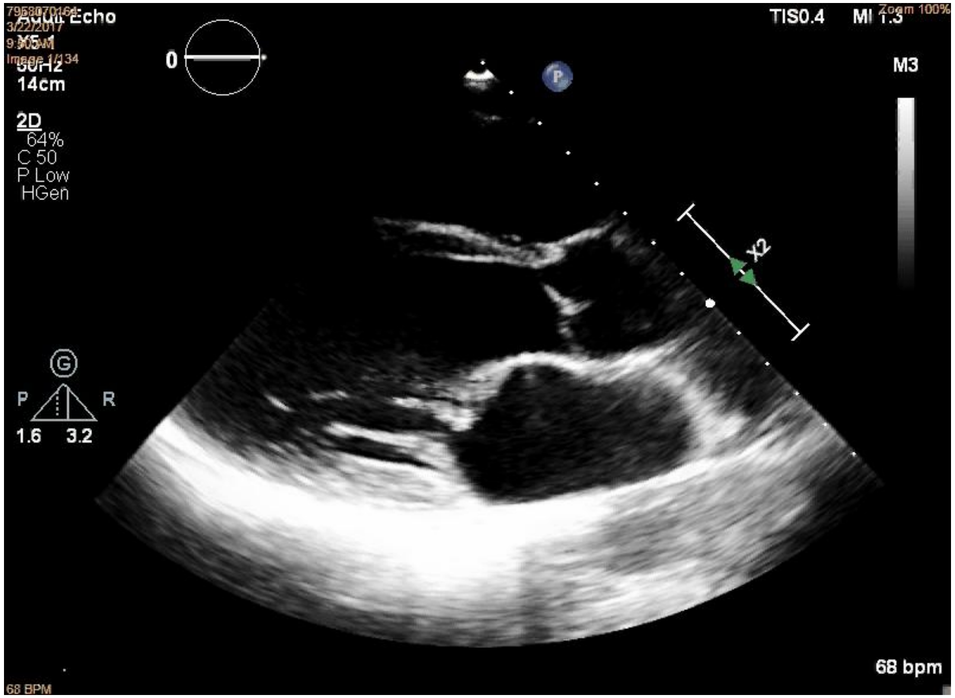
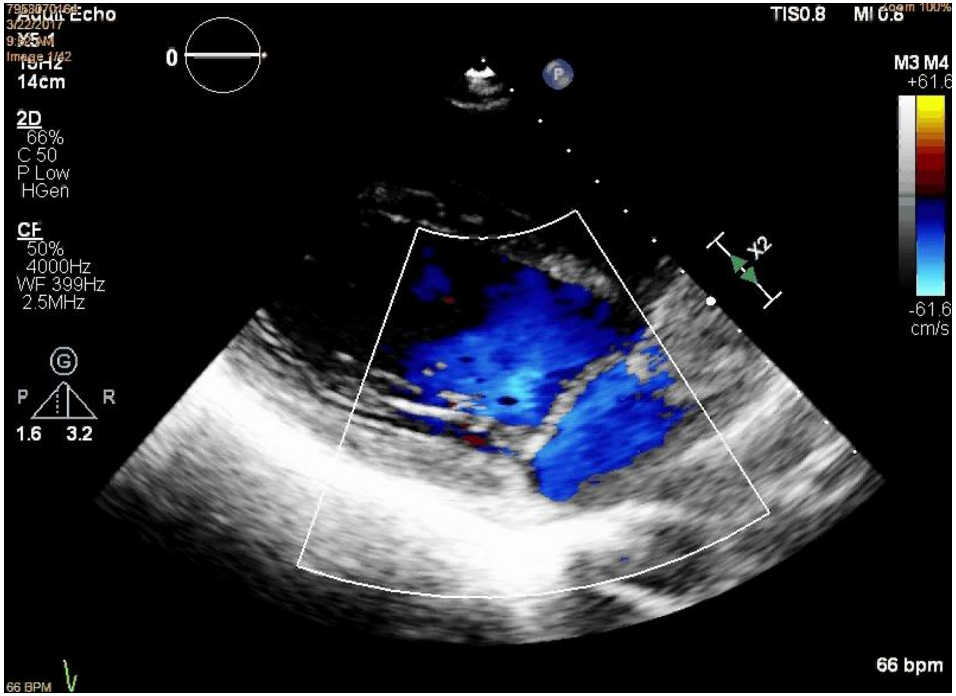
Baumgartner et al.; European Heart Journal, 2017

Kvalitativní hodnocení

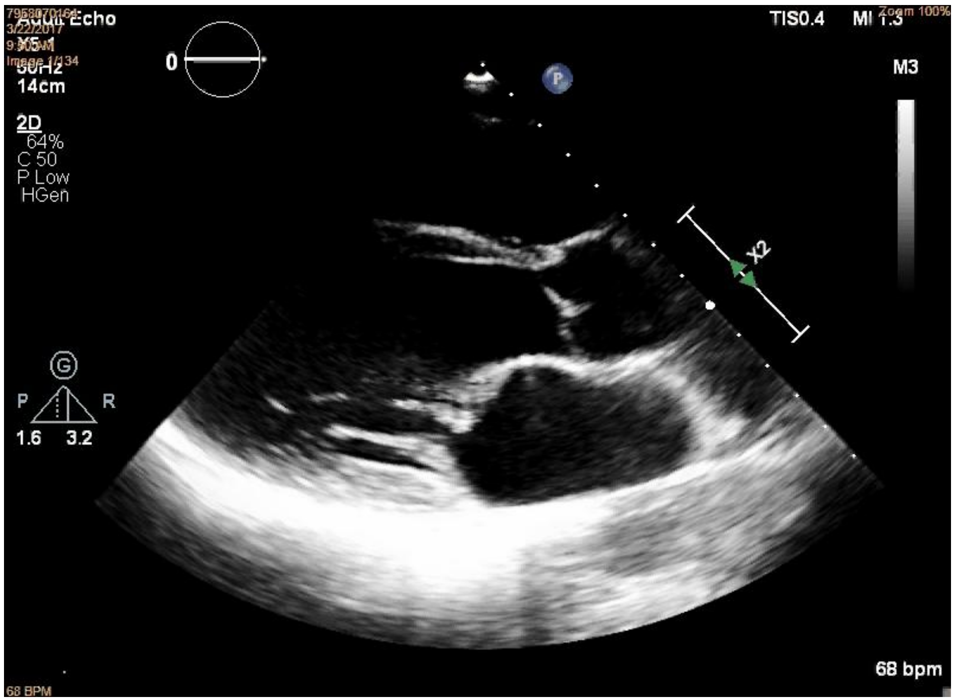


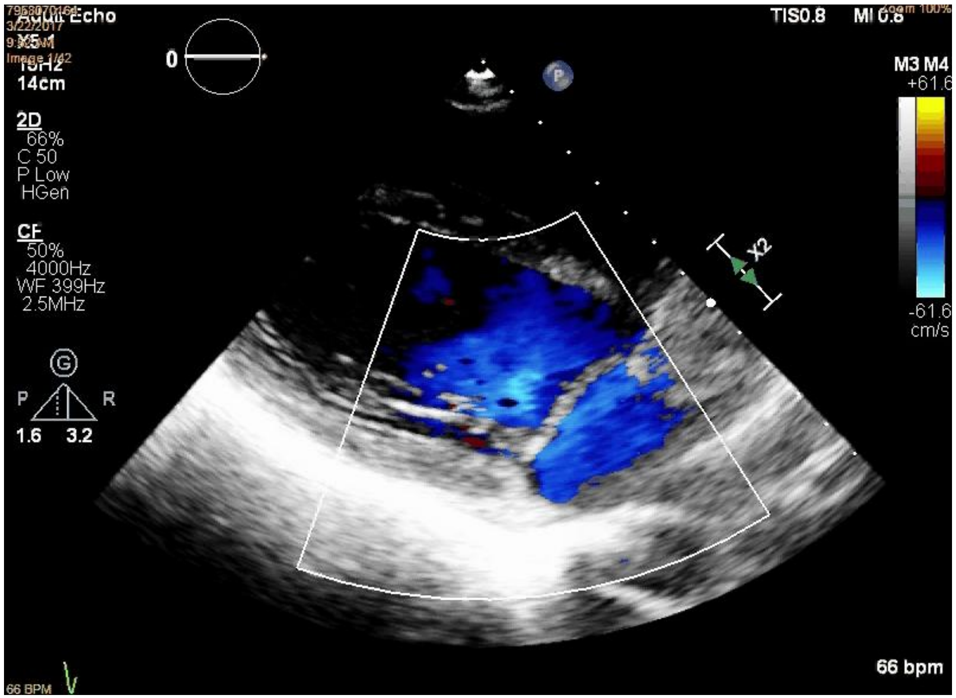


Etiologie?

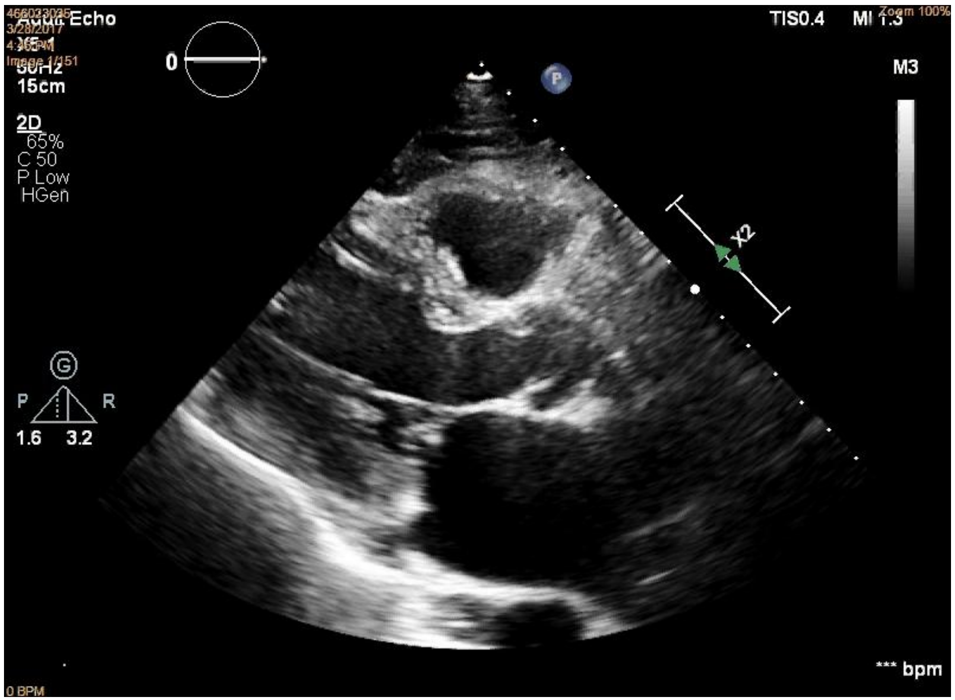
1. Restrikce předního cípu
2. Restrikce zadního cípu
3. Prolaps předního cípu
4. Prolaps zadního cípu

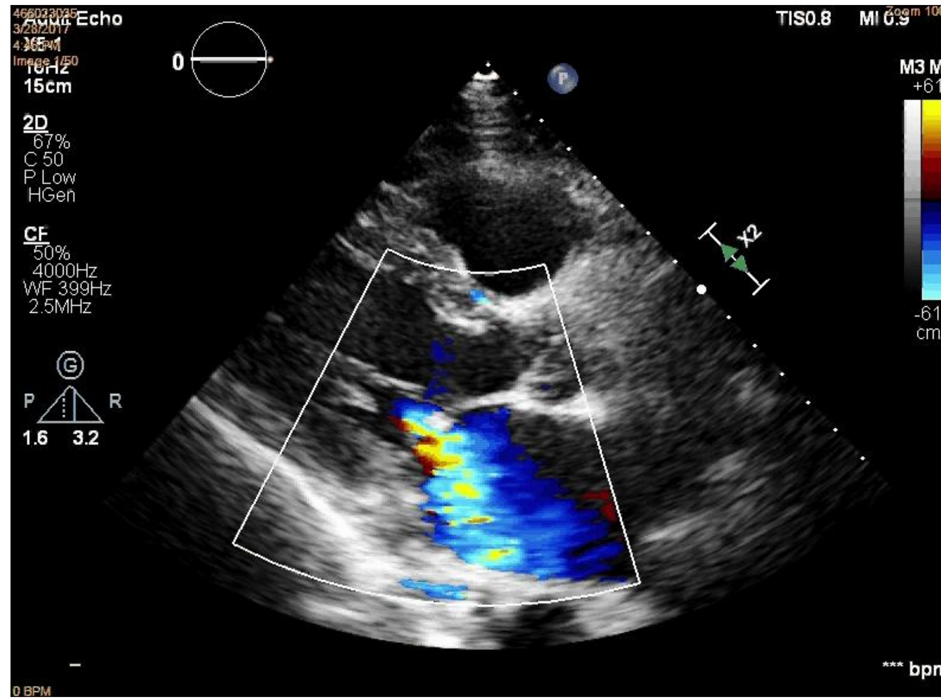
Kvalitativní hodnocení





Kvalitativní hodnocení





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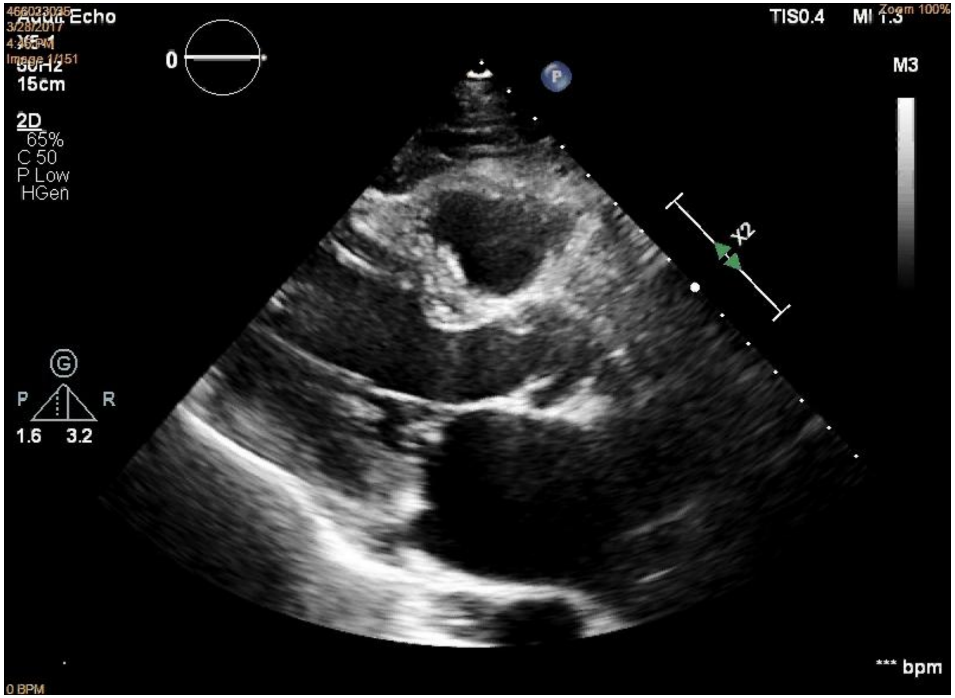
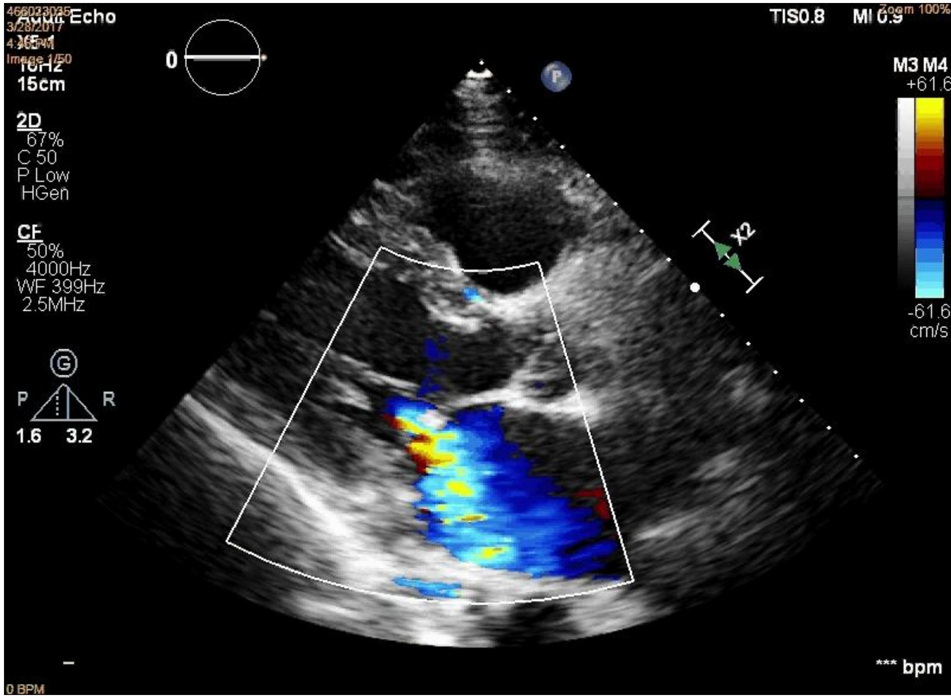
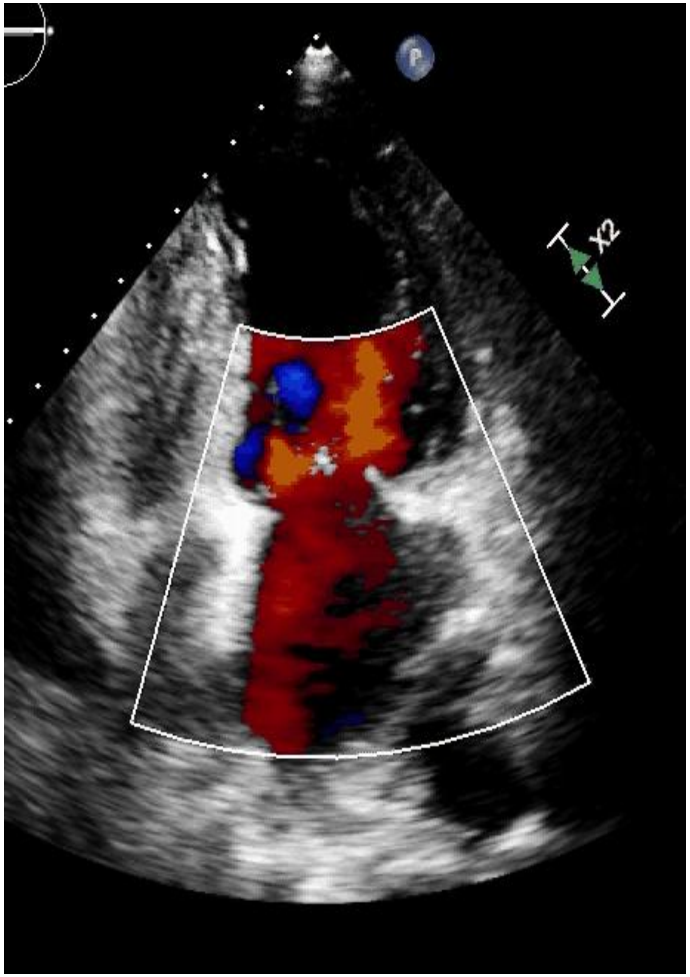
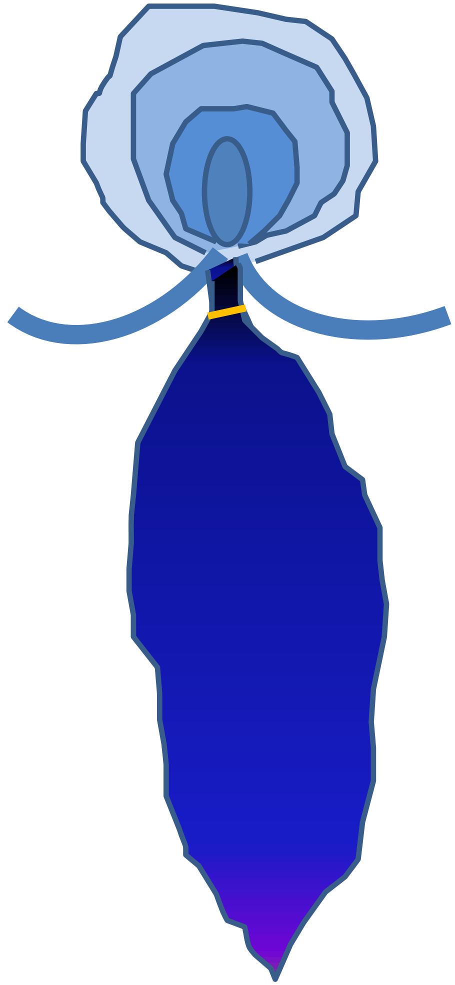






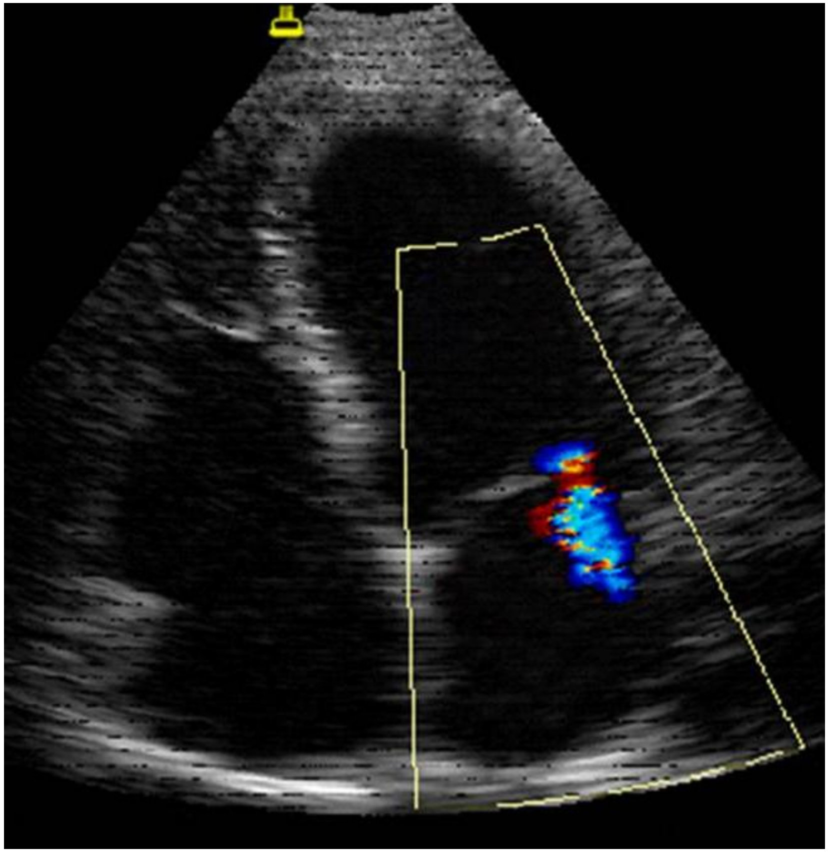
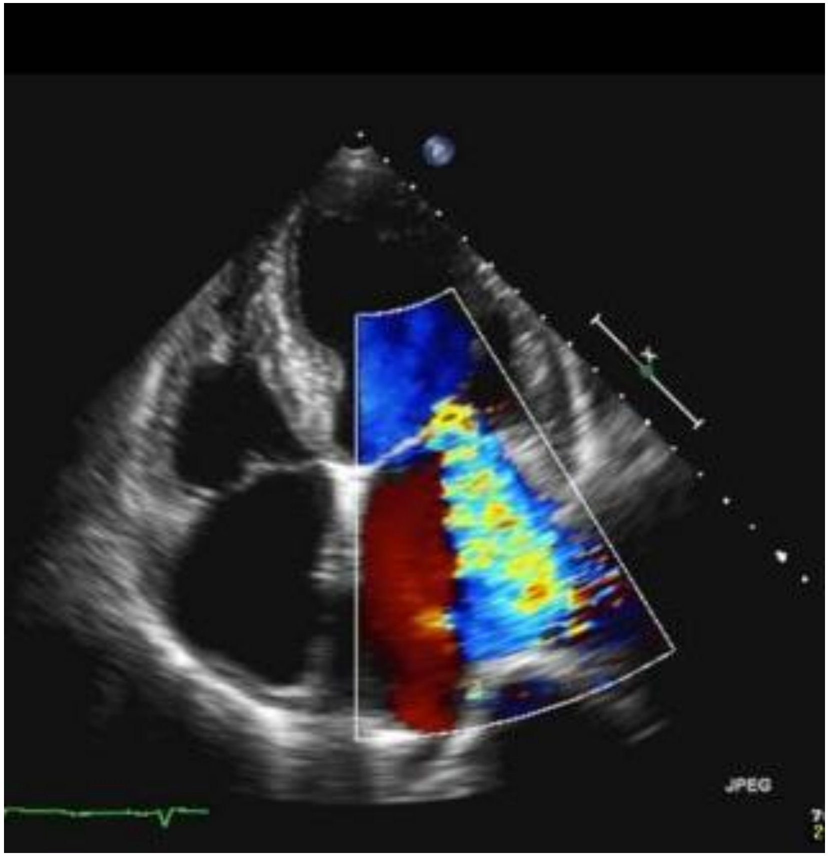


Zóna konvergence

Vena contracta

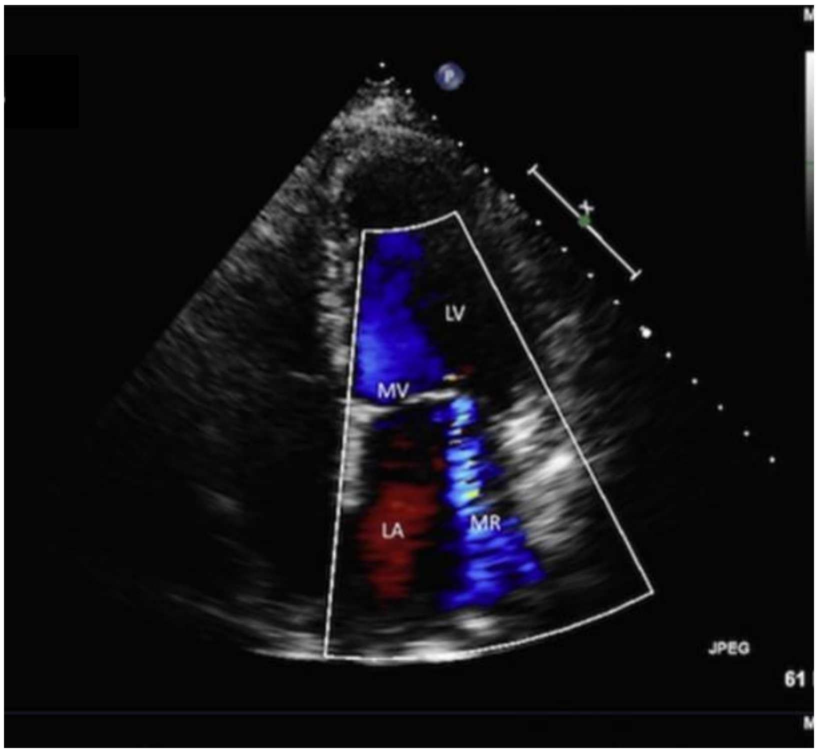
Plocha jetu

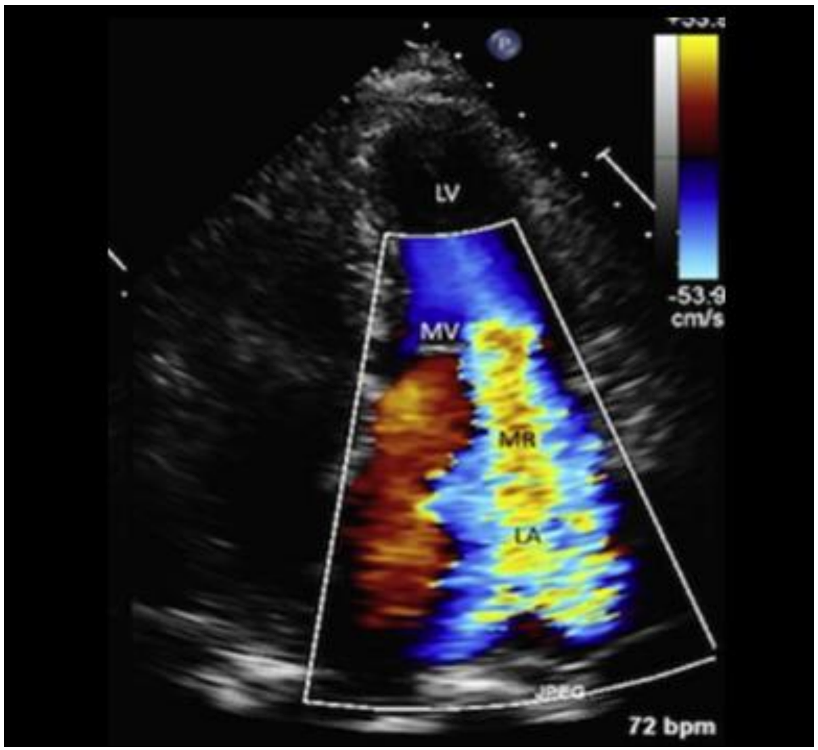
Kvalitativní hodnocení CF doppler

Pacient A

Pacient B





Furfaro et al.; The American Journal of Medicine, 2016

Který pacient má těžkou MR?

1. Pacient A
2. Pacient B
3. Oba pacienti
4. Jedná se o stejného pacienta za různých hemodynamických podmínek

Effect of Pressure Difference on Regurgitation Severity

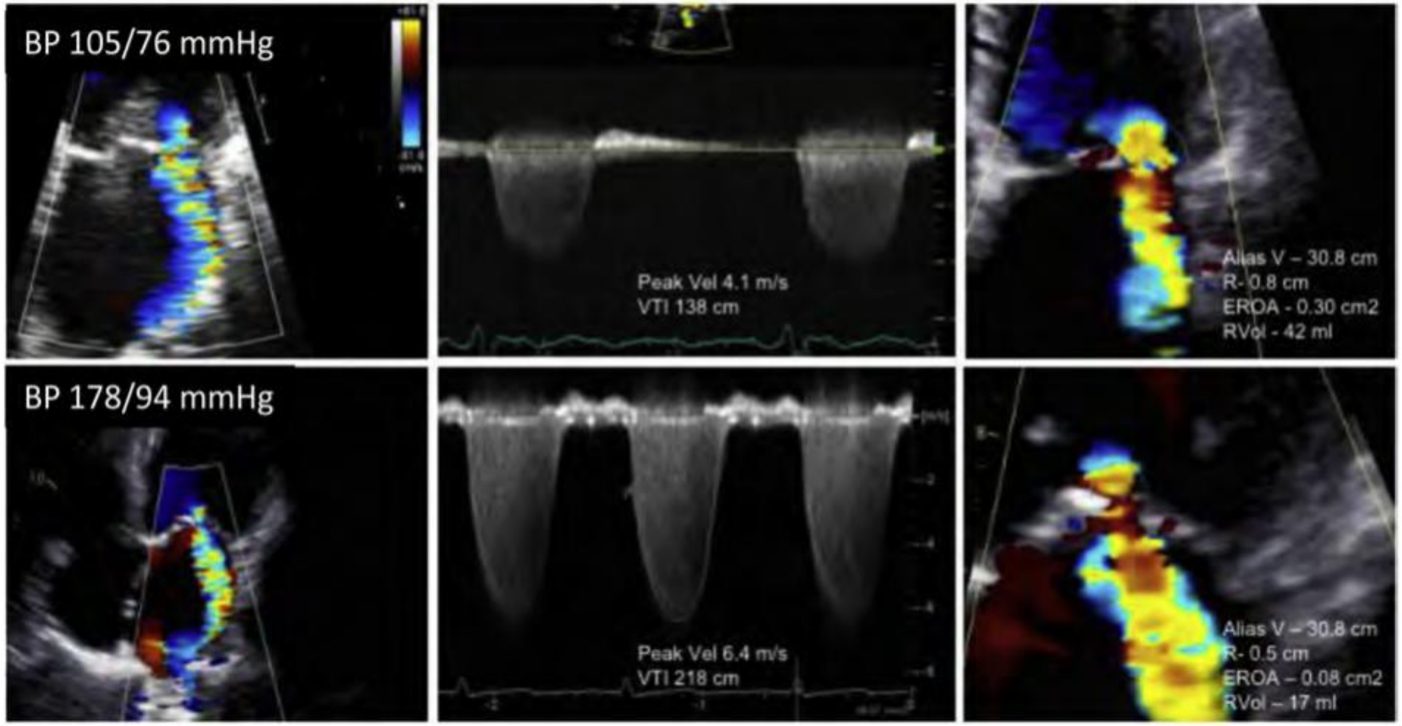
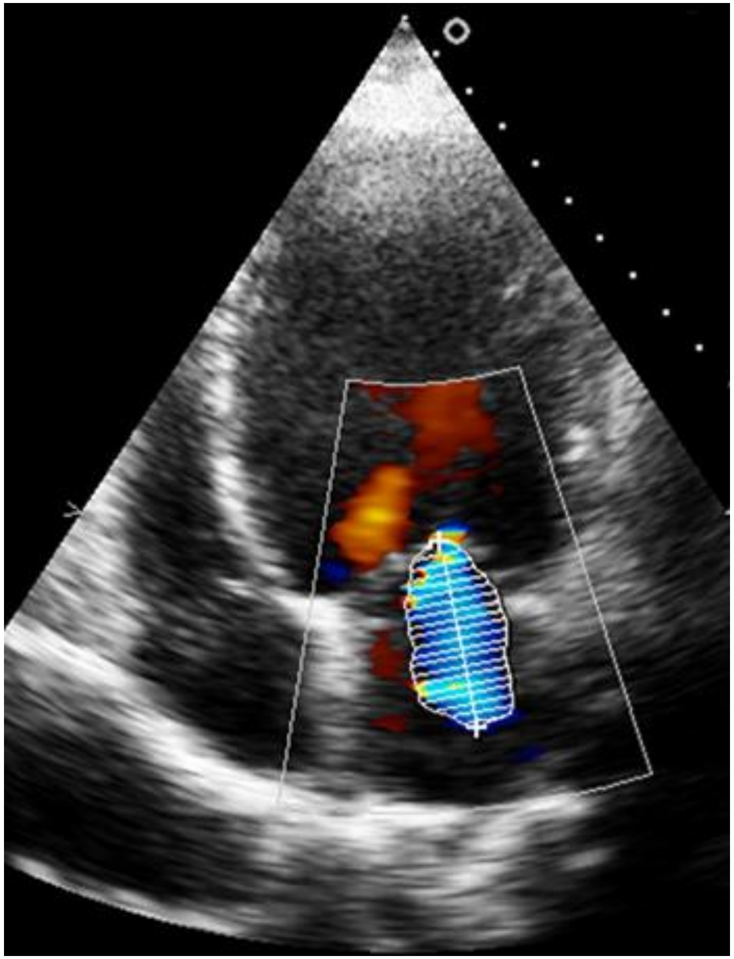


Figure 14 Importance of MR jet velocity in MR. The images are from two patients with functional ischemic MR due to posterior leaflet restriction, LVEF 30%, and similar appearance of eccentric MR jets directed laterally. The patient in the top panels has a low MR velocity (4.1 m/sec) consistent with low blood pressure and/or elevated LA pressure. His blood pressure (BP) was 105/76 mmHg. EROA by PISA is 0.3 cm^2 with an RVol of 42 mL. The patient in the lower panels has a similar MR jet appearance but has a peak MR velocity of 6.4 m/sec due to hypertension (178/94 mmHg). EROA is 0.08 cm^2 with an RVol of 17 mL. Despite similar MR jet appearance on color Doppler, the patient in the top panel has moderate MR; the patient in the bottom panel has mild MR.

Baumgartner et al.; European Heart Journal, 2017

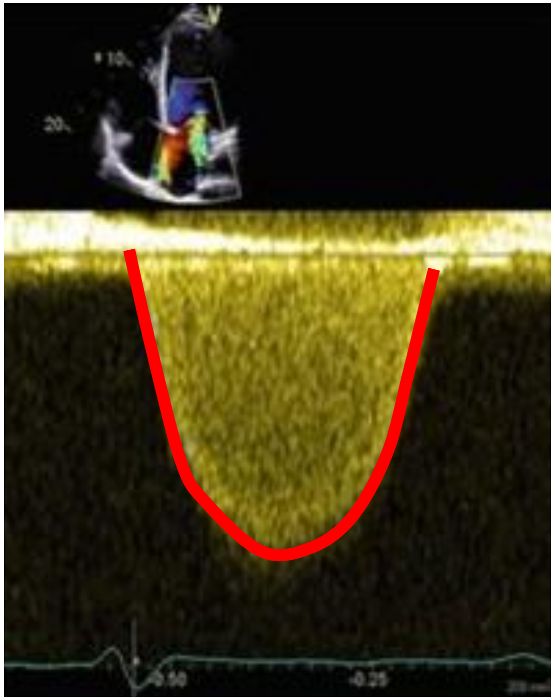
Plocha jetu

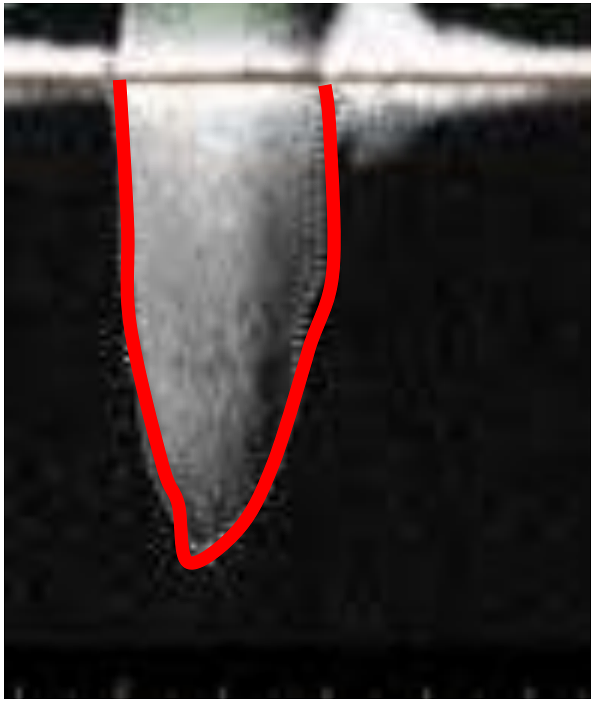


tíže vady	lehká	střední	těžká
Plocha jetu (cm2)	< 4		> 10
poměr k velikosti levé síně (%)	< 20		> 40

Nyquist 50-60cm/s

Kvalitativní hodnocení CW doppler





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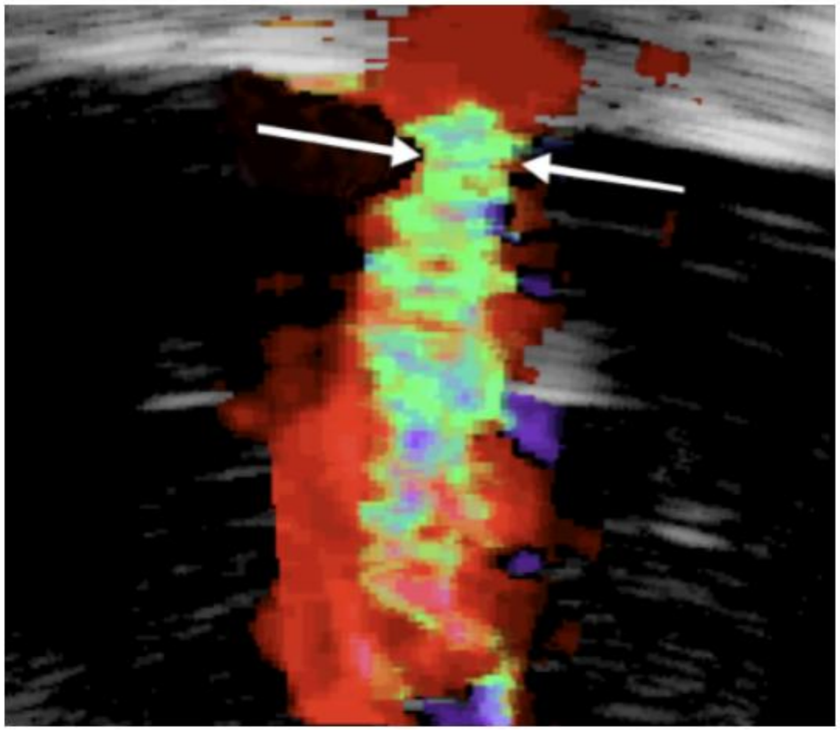
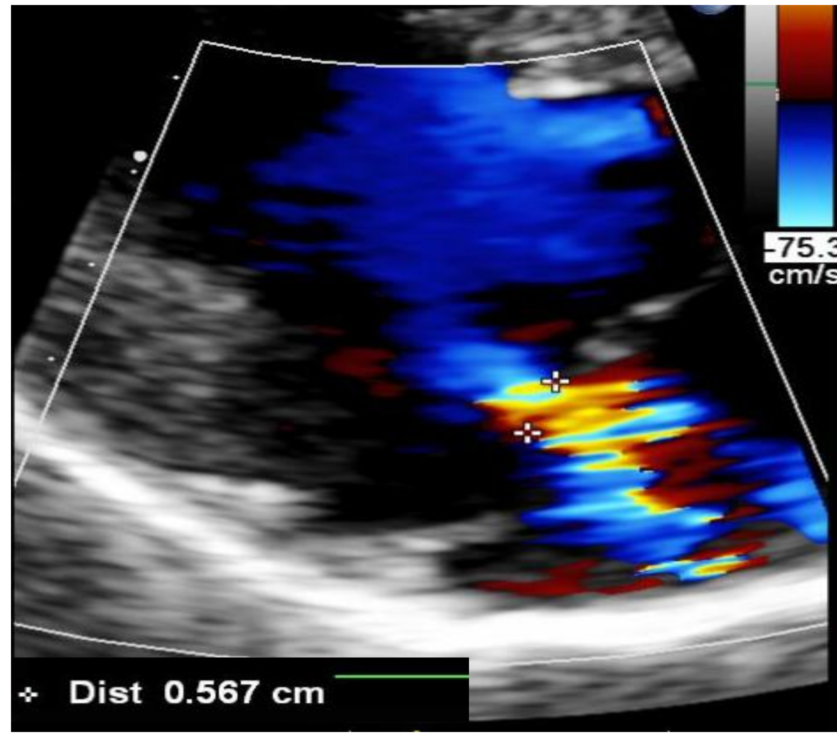
Baumgartner et al.; European Heart Journal, 2017

Vena contracta



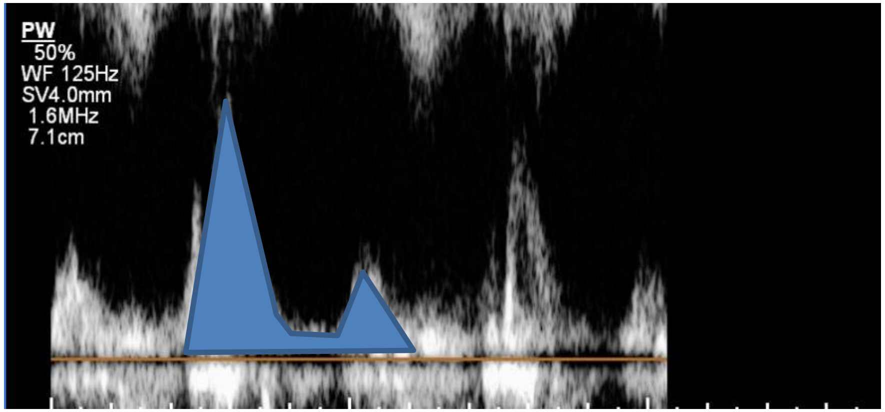


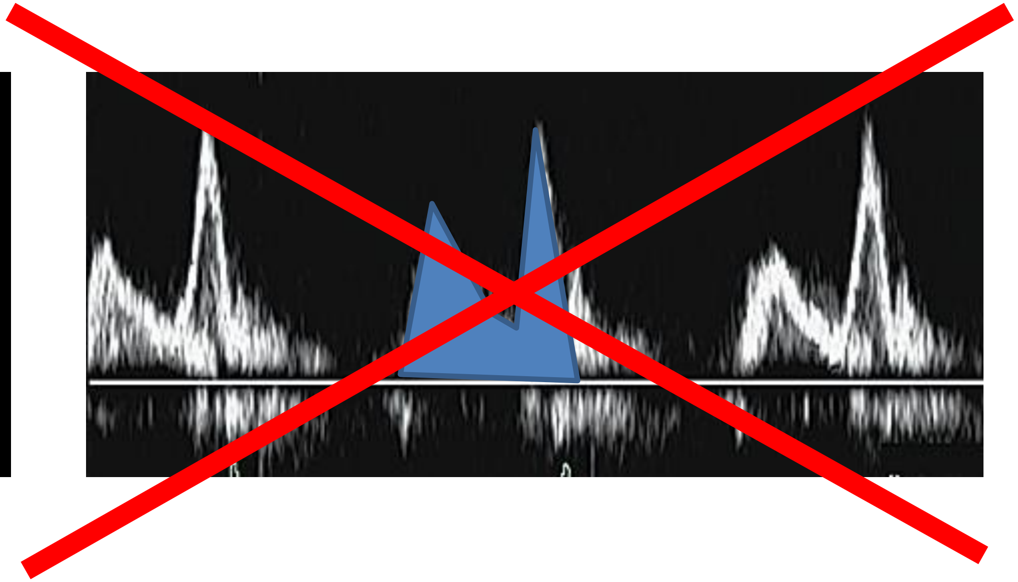
Vena contracta width (mm)	≥7 (>8 for biplane)[b]

Vena contracta area = (π x d²)/4

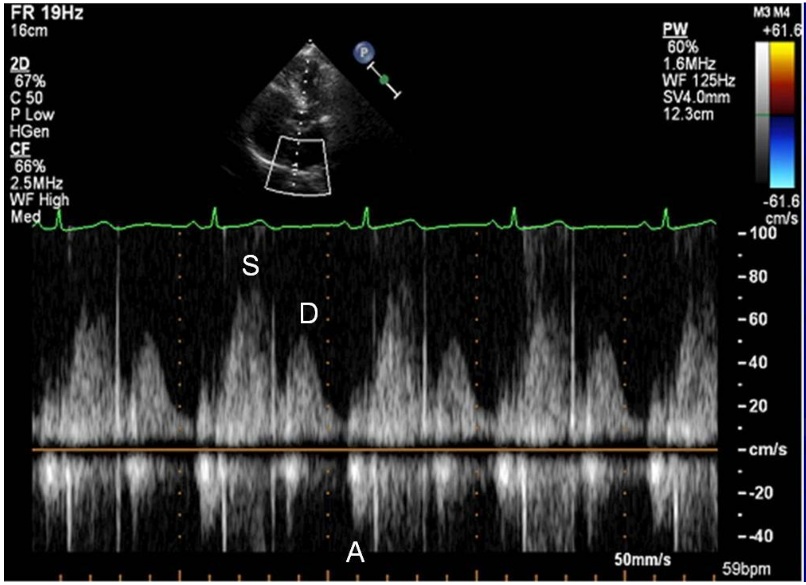
Pro 7mm 0,39 mm2
Pro 8mm 0,50 mm2

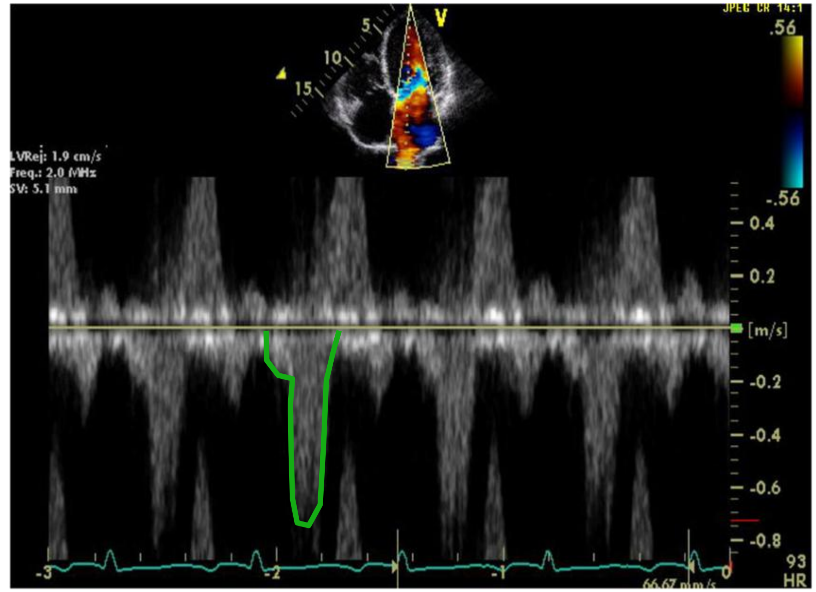
Hodnocení transmitrálního toku

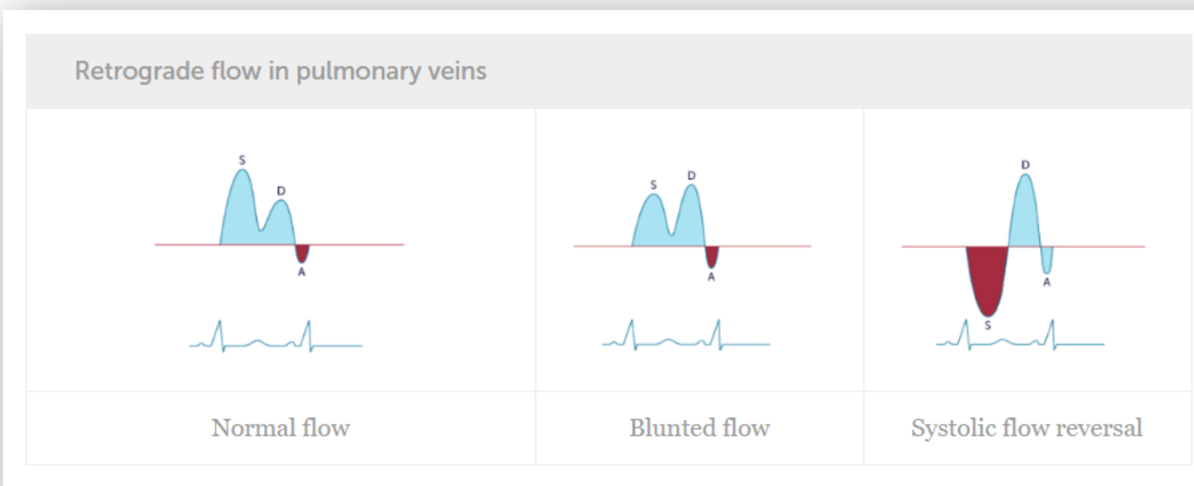




Inflow	E-wave dominant ≥1.5 m/s[d]


FR 19Hz
16cm
2D
67%
C 50
P Low
HGen
CF
66%
2.5MHz
WF High
Med
PW
60%
1.6MHz
WF 125Hz
SV4.0mm
12.3cm
+61.6
-61.6
cm/s
S
D
A
50mm/s
59bpm


.56
-.56
0.4
0.2
[m/s]
-0.2
-0.4
-0.6
-0.8
93
HR


Retrograde flow in pulmonary veins
S
D
A
Normal flow
Blunted flow
Systolic flow reversal

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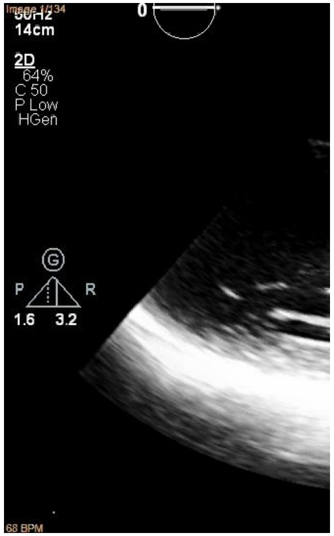
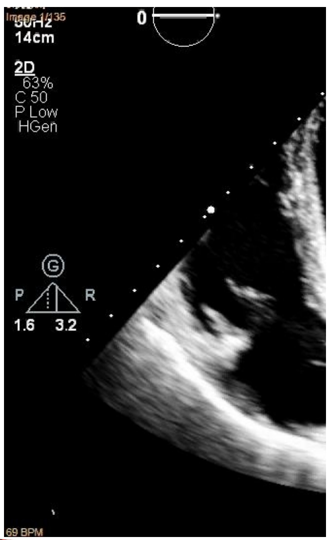
Regurgitant volume (mL/beat)	≥60	≥30
+ enlargement of cardiac chambers/vessels	LV, LA	

Baumgartner et al.; European Heart Journal, 2017

Zhodnocení rozměrů a EFLK





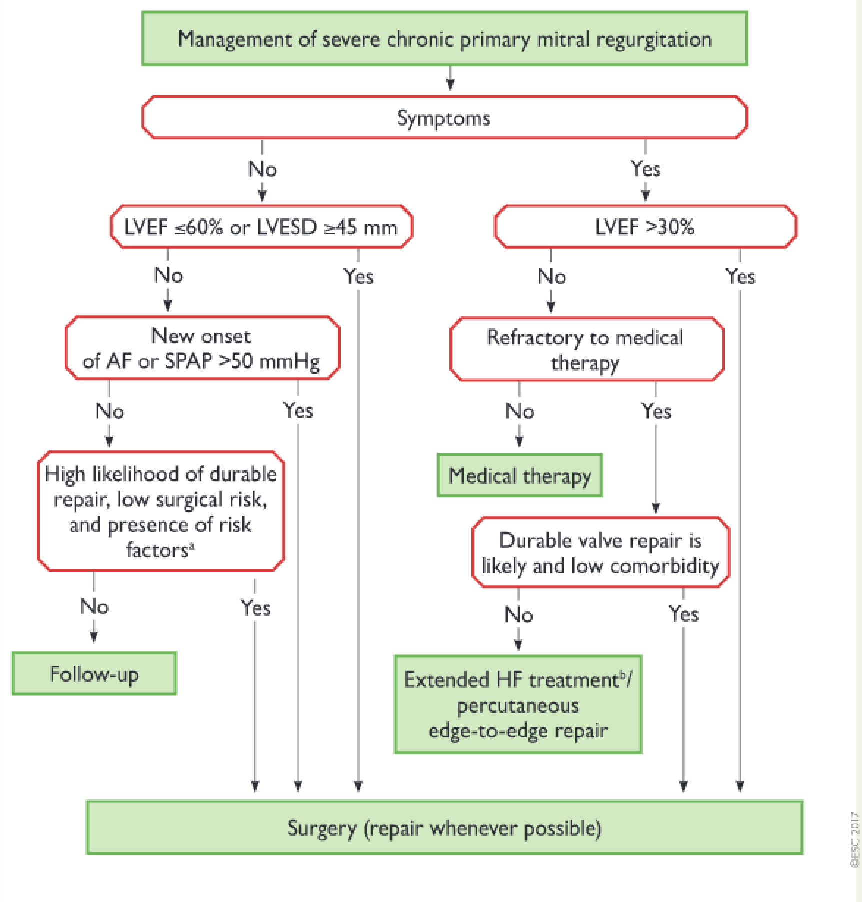
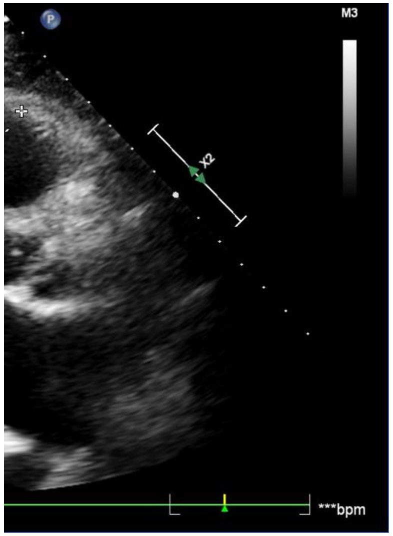
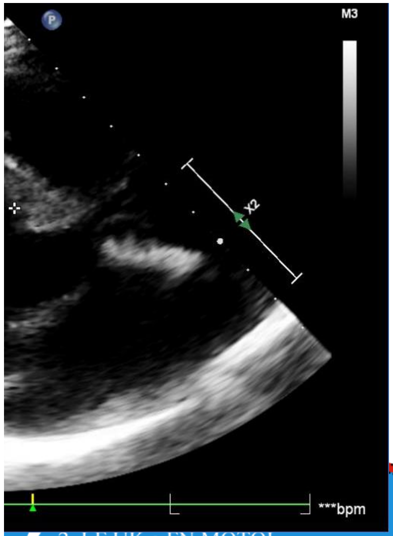
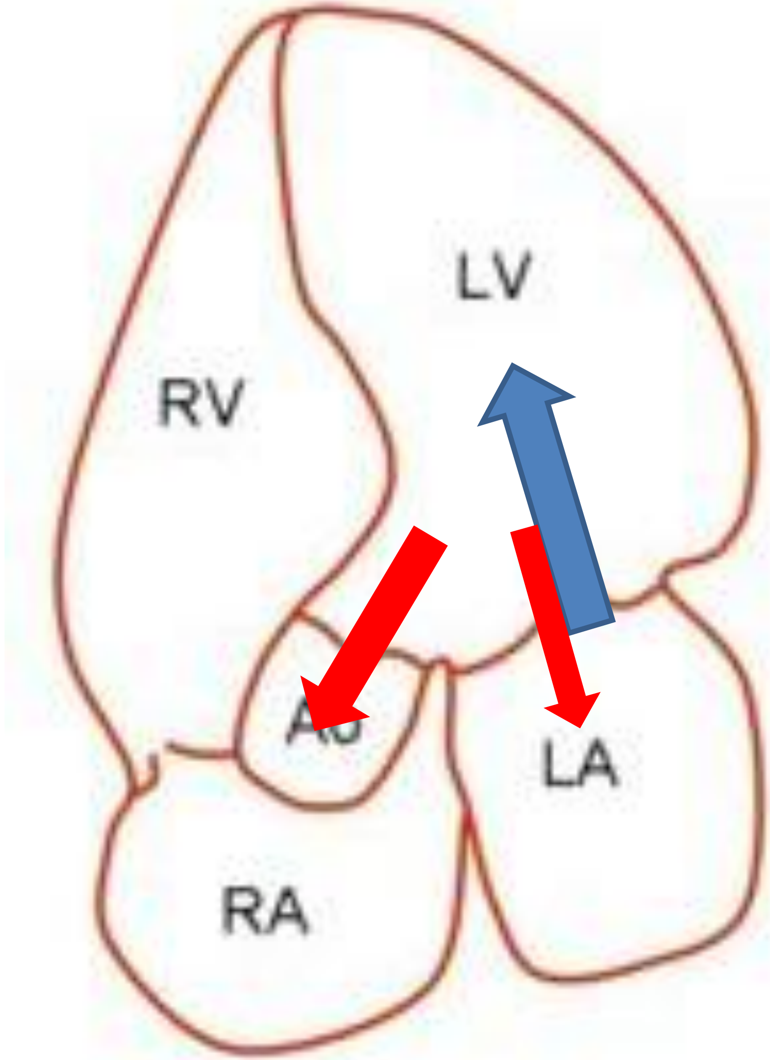
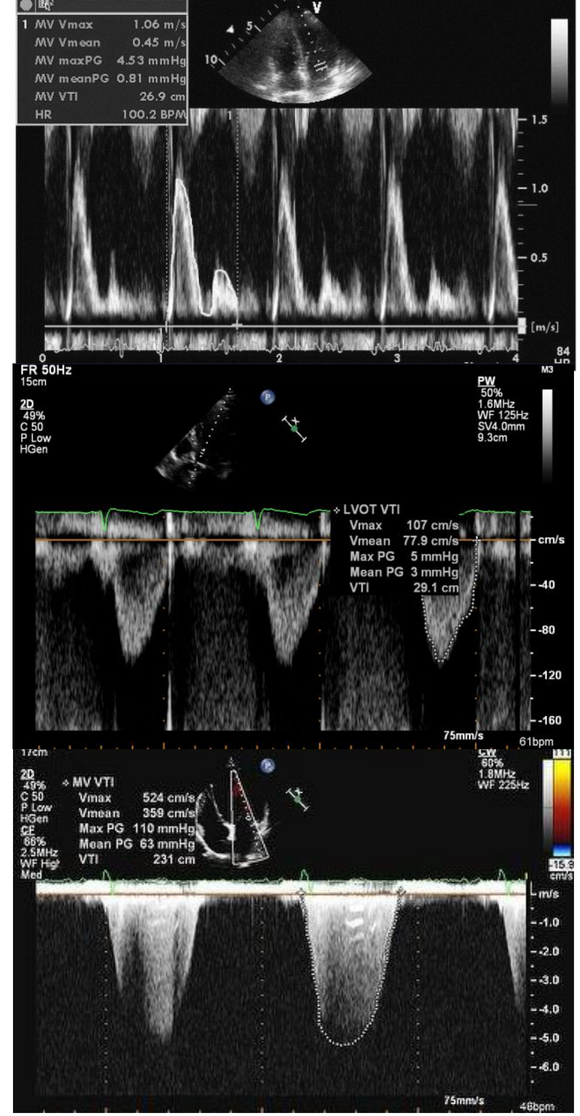


Figure 4 Management of severe chronic primary mitral regurgitation. AF = atrial fibrillation; BSA = body surface area; CRT = cardiac resynchronization therapy; HF = heart failure; LA = left atrial; LVEF = left ventricular ejection fraction; LVESD = left ventricular end-systolic diameter; SPAP = systolic pulmonary arterial pressure.
[a]When there is a high likelihood of durable valve repair at a low-risk, valve repair should be considered (IIa C) in patients with LVESD ≥40 mm and one of the following is present: flail leaflet or LA volume ≥60 mL/m² BSA at sinus rhythm.
[b]Extended HF management includes the following: CRT; ventricular assist devices; cardiac restraint devices; heart transplantation.

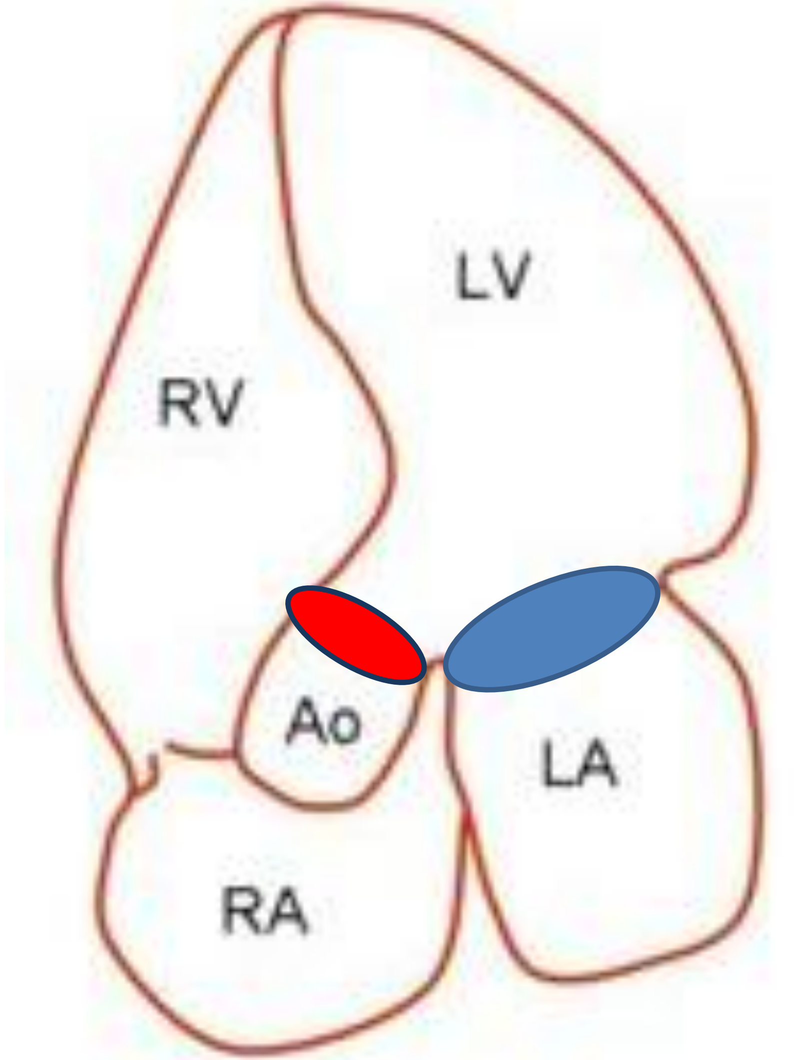


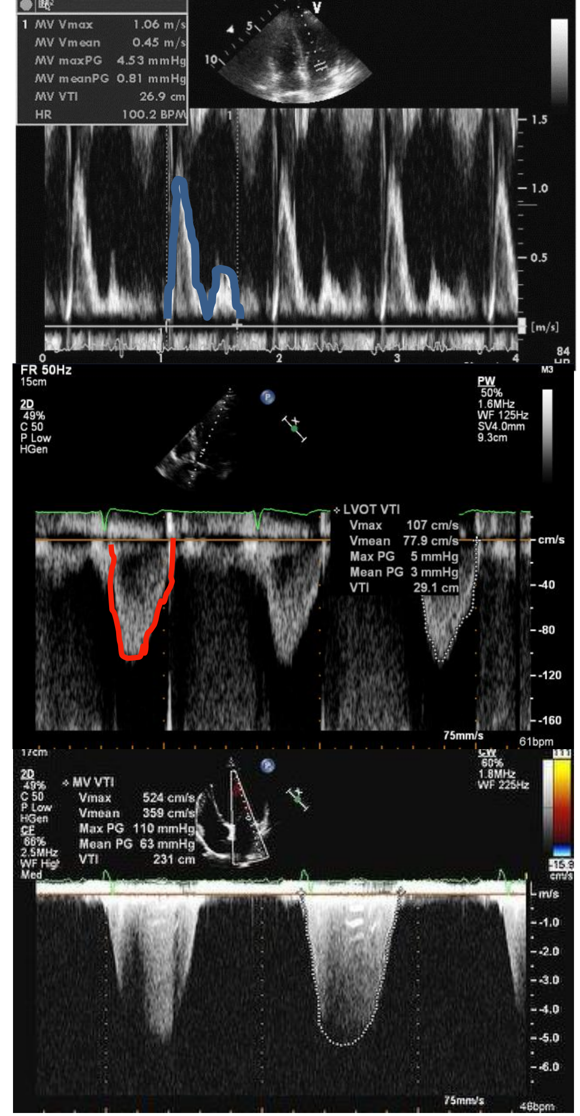




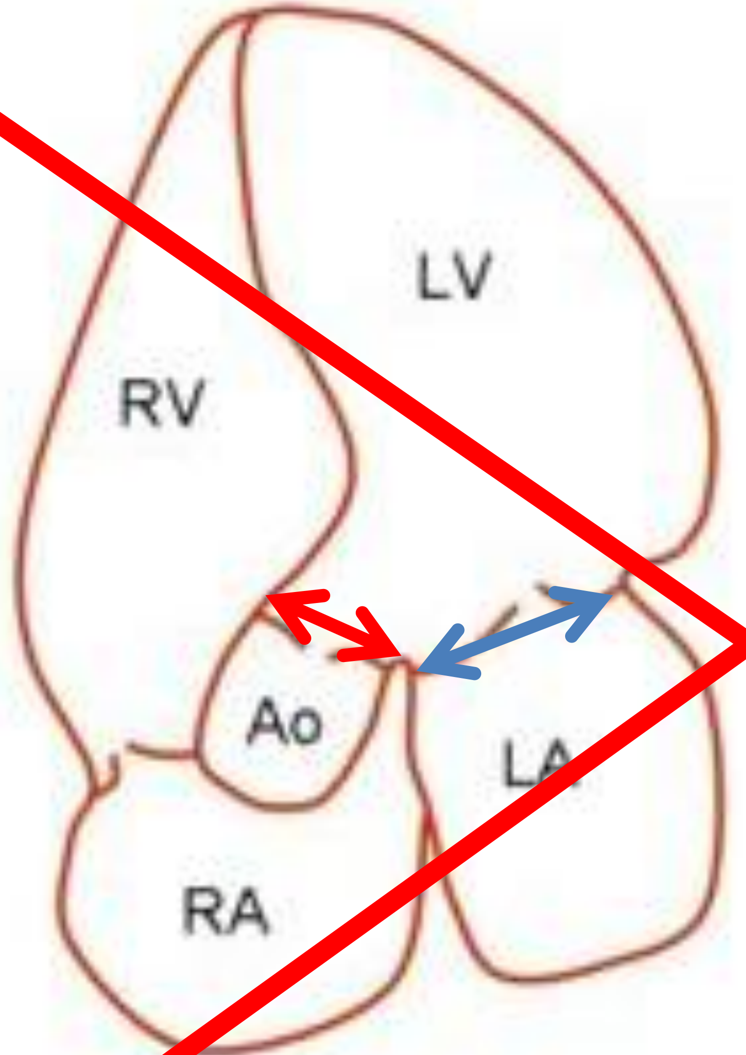


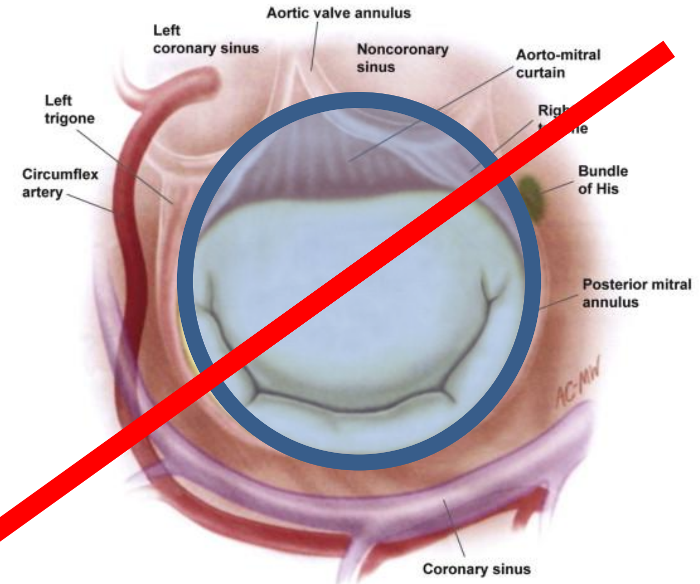
Regurgitační frakce = MR flow / (TMF flow) * 100%

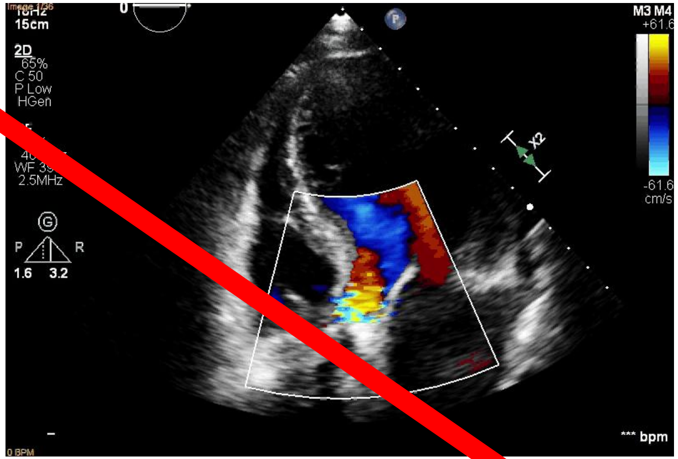




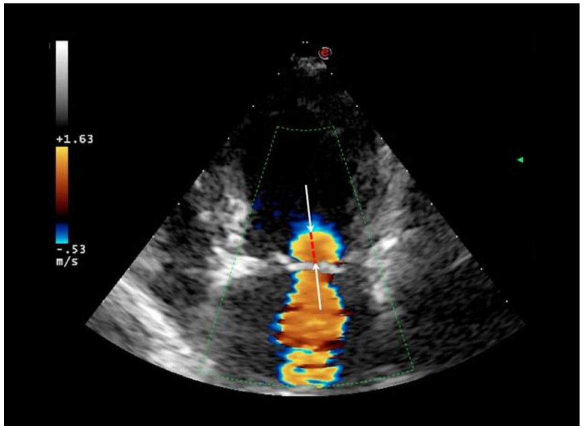
$$\frac{\text{MV VTI} \times \pi(d_{(\text{mitrální})}/2)^2 - \text{LVOT VTI} \times \pi r_{(\text{LVOT})}^2}{\text{MV VTI} \times \pi(d_{(\text{mitrální})}/2)^2} \times 100\%$$


LV
RV
Ao
LA
RA


Aortic valve annulus
Left coronary sinus
Noncoronary sinus
Aorto-mitral curtain
Left trigone
Circumflex artery
Bundle of His
Posterior mitral annulus
Coronary sinus


15cm
2D
65%
C 50
P Low
HGen
2.5MHz
P R
1.6 3.2
M3 M4
+61.6
-61.6
cm/s
*** bpm

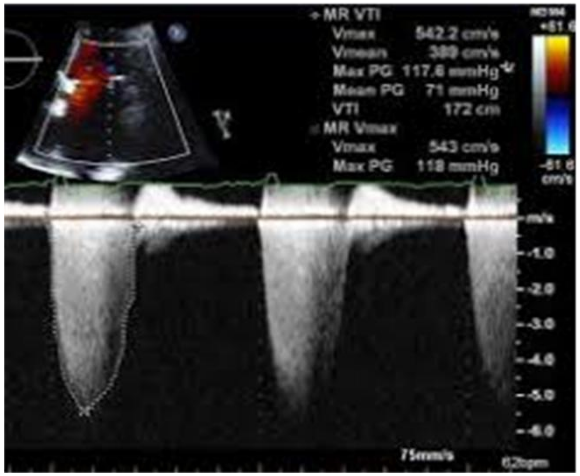
PISA

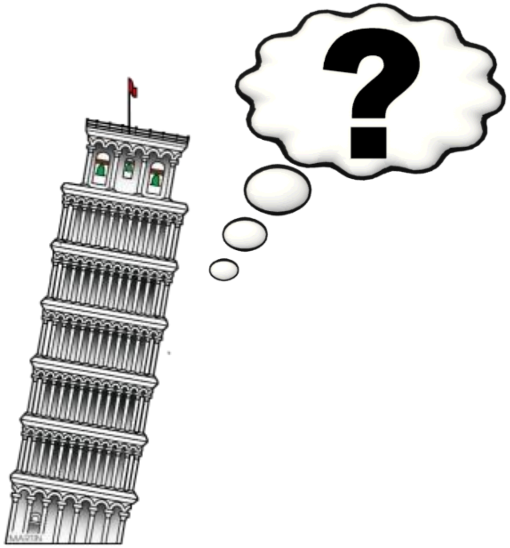


$$VFR = 2 * \pi * r2 * Vr$$

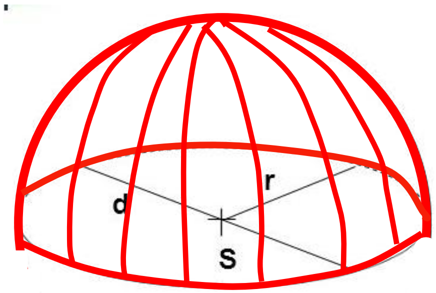
$$ERO = VFR / VMax$$

$$RVol = ERO * VTI$$



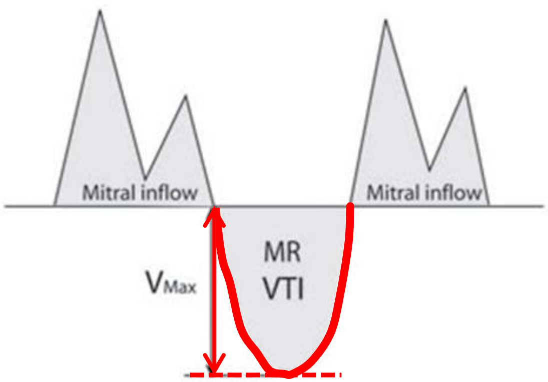


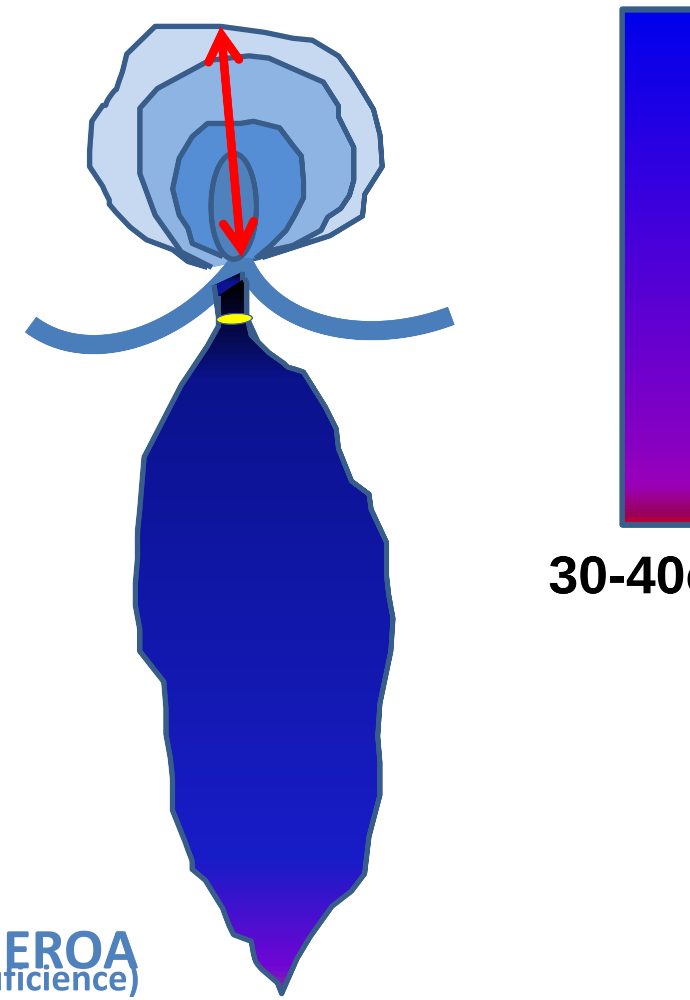
PISA- snížení Nyqistova limitu



$S = 2 \times \pi \times r^2$

$S = 4 \times \pi \times r^2$





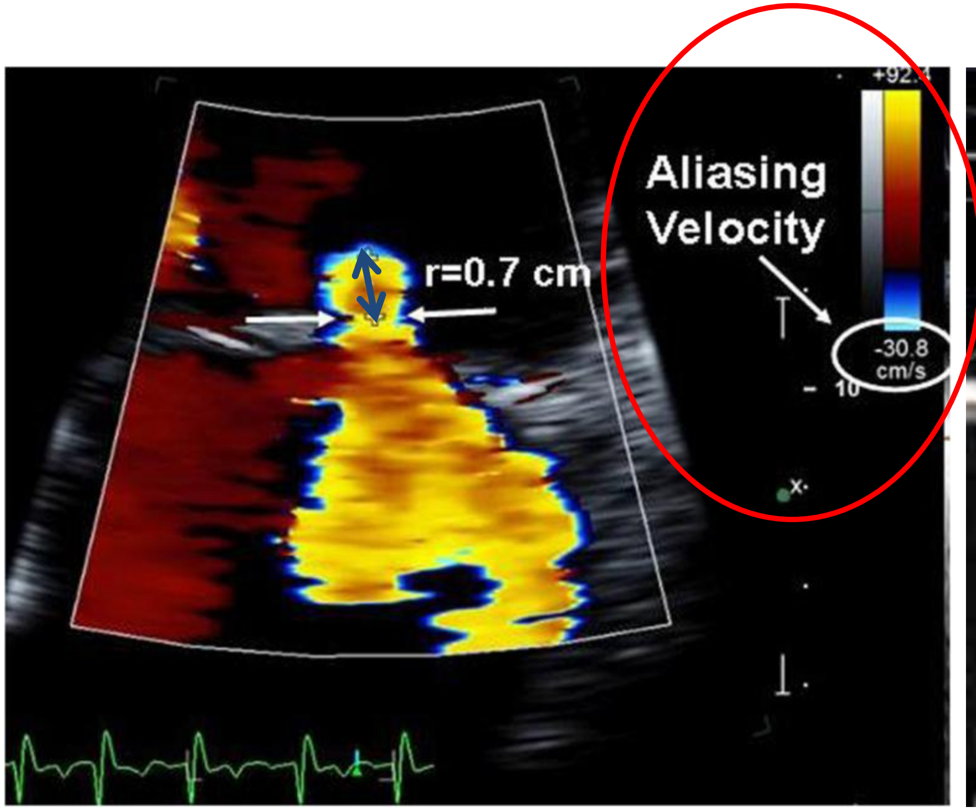
30-40cm/s

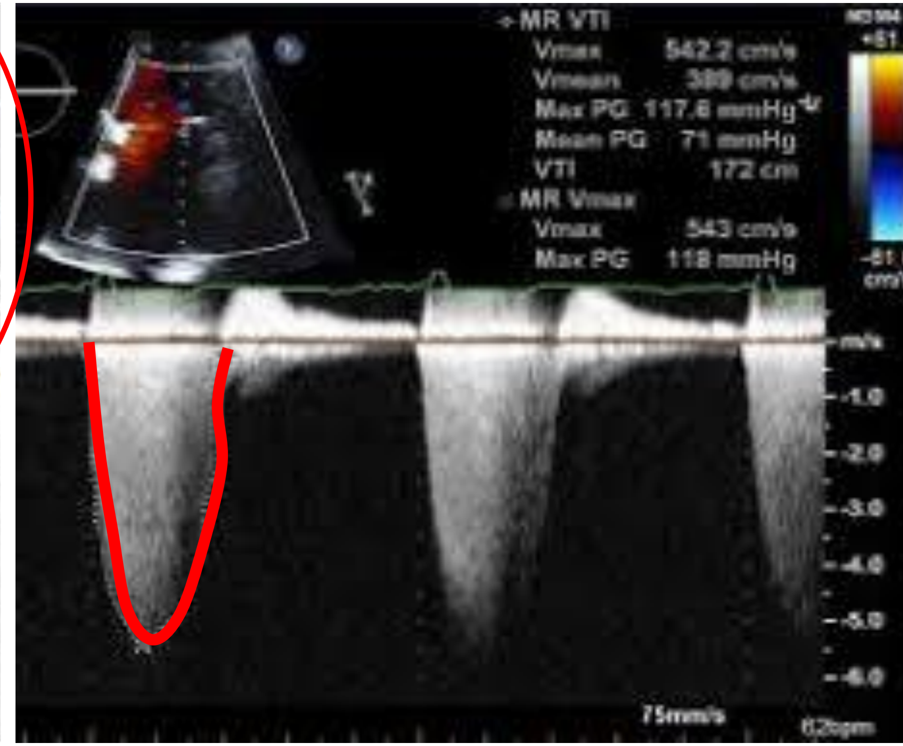
Rovnice kontinuity

$(2 \times \pi \times r^2) \times \text{Nyquist} = \text{Vmax}_{(\text{mitrální insuficience})} \times \text{EROA}$

$\text{EROA} = (2 \times \pi \times r^2) \times \text{Nyquist} / \text{Vmax}_{(\text{mitrální insuficience})}$

RV= EROA x MR VTI





1. změříme poloměr zóny konvergence
2. Zadáme zvolený Nyquistův limit
3. Obkreslíme MR VTI


* GROANING *


OW! MY EYE!