MitraClip et TAVI: Patient selection

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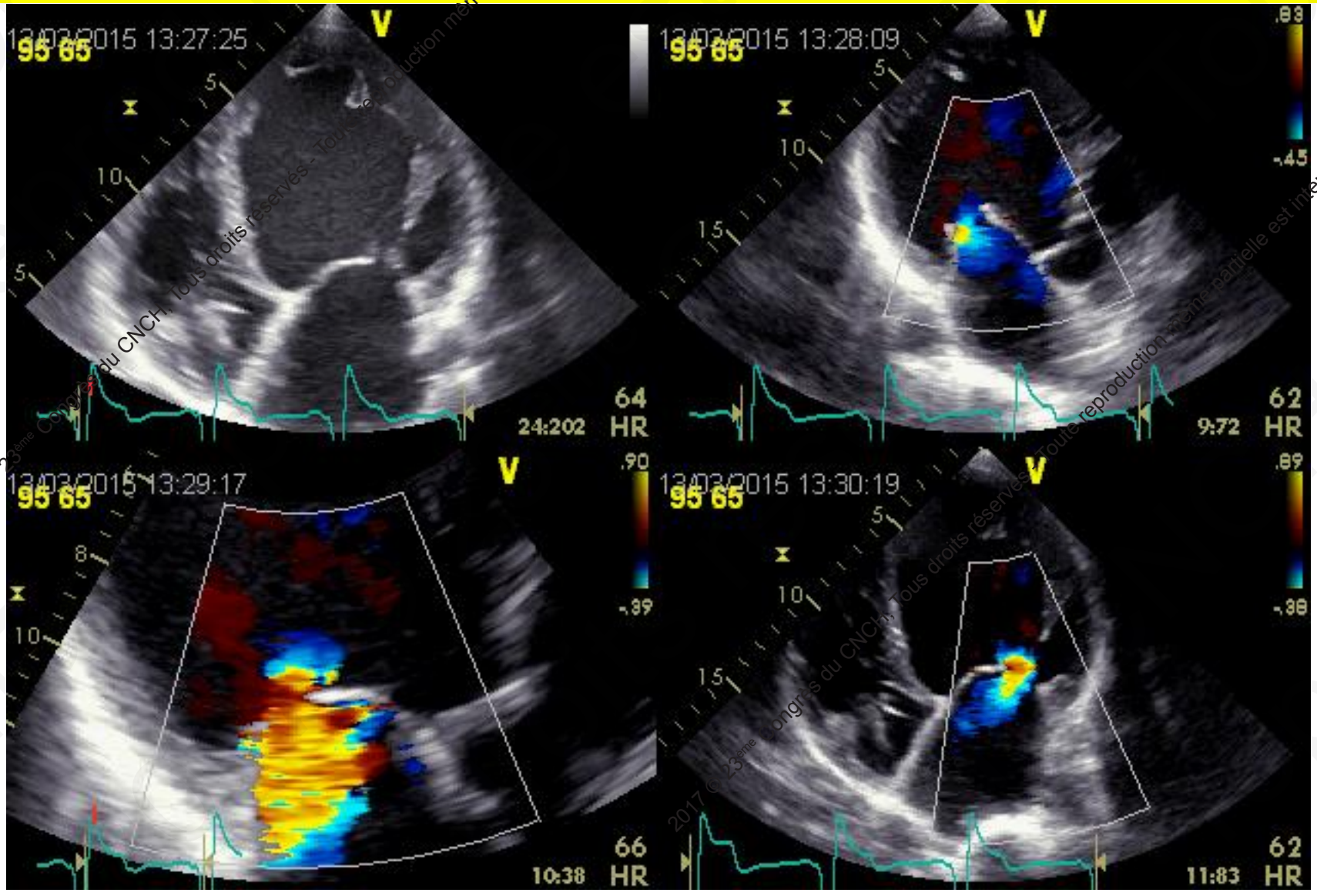
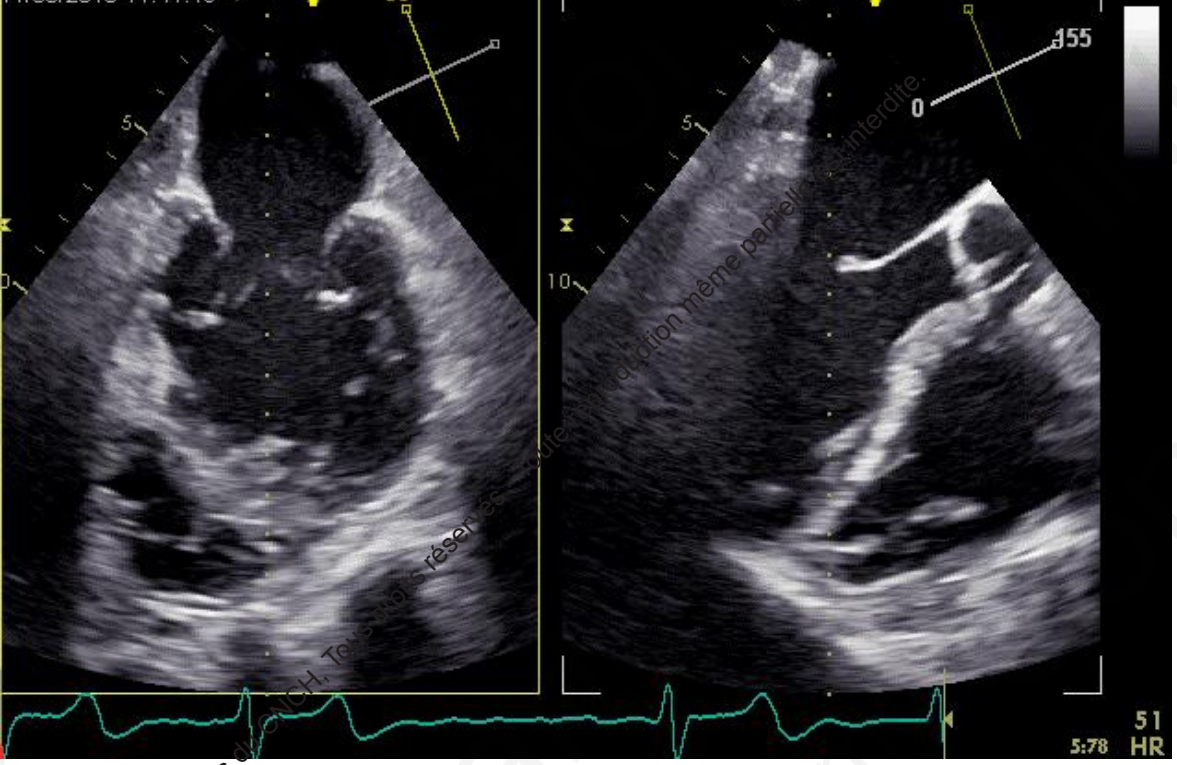
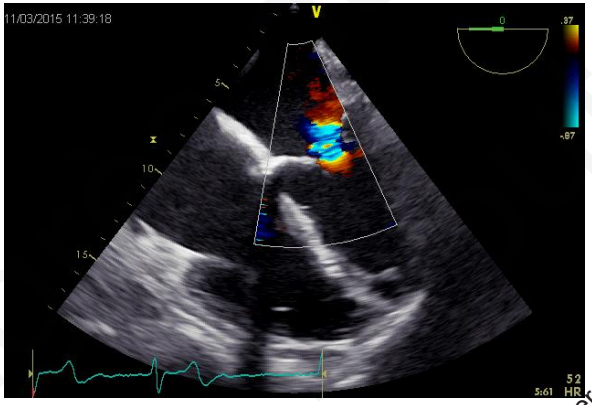
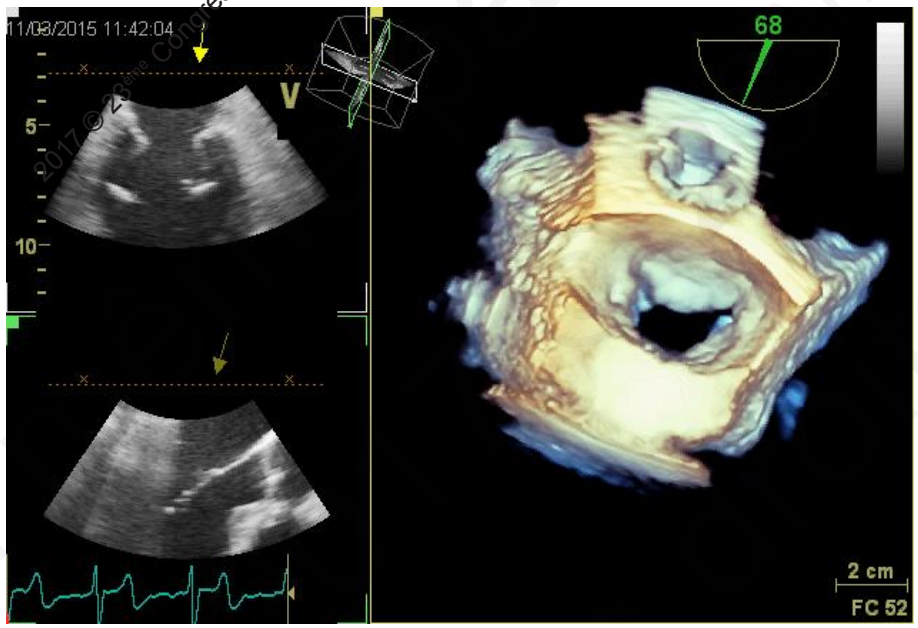
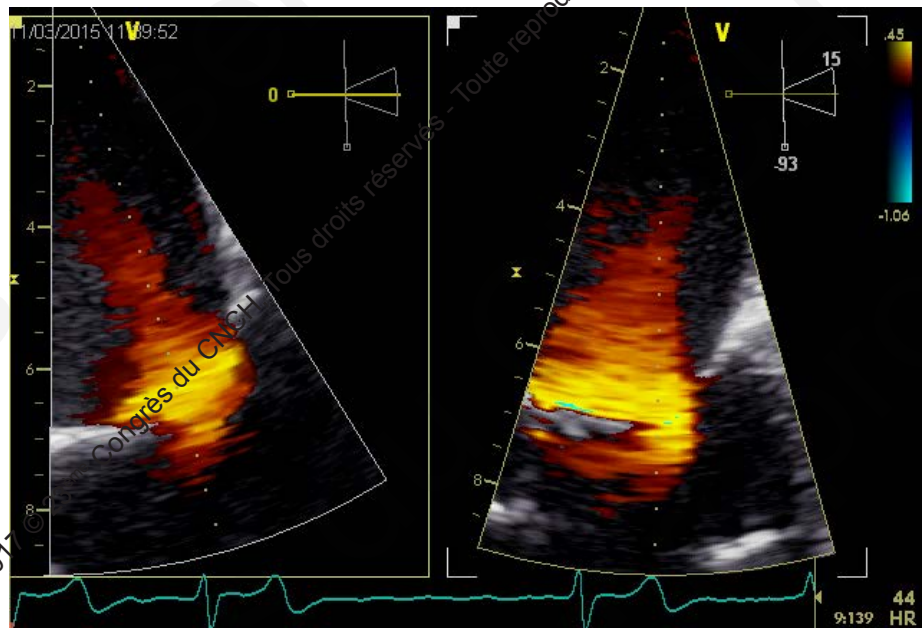
<u>A good case</u> : woman 75 yo, idiopathic DCM, CRT ICD, optimal medical therapy but still NYHA II+ and recently hospitalized for acute HF

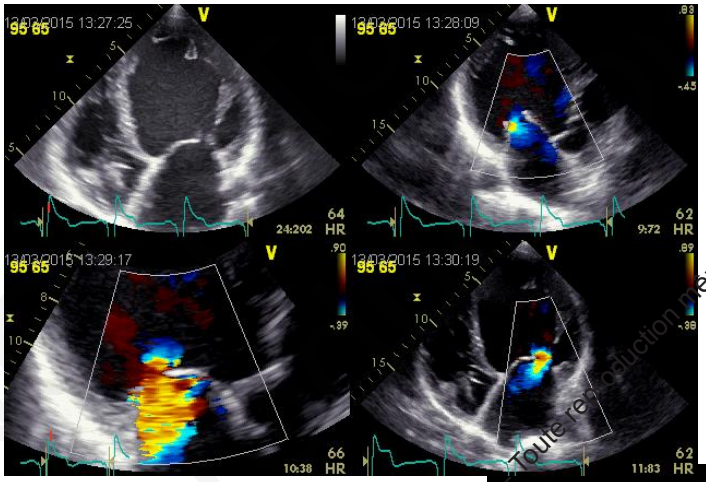






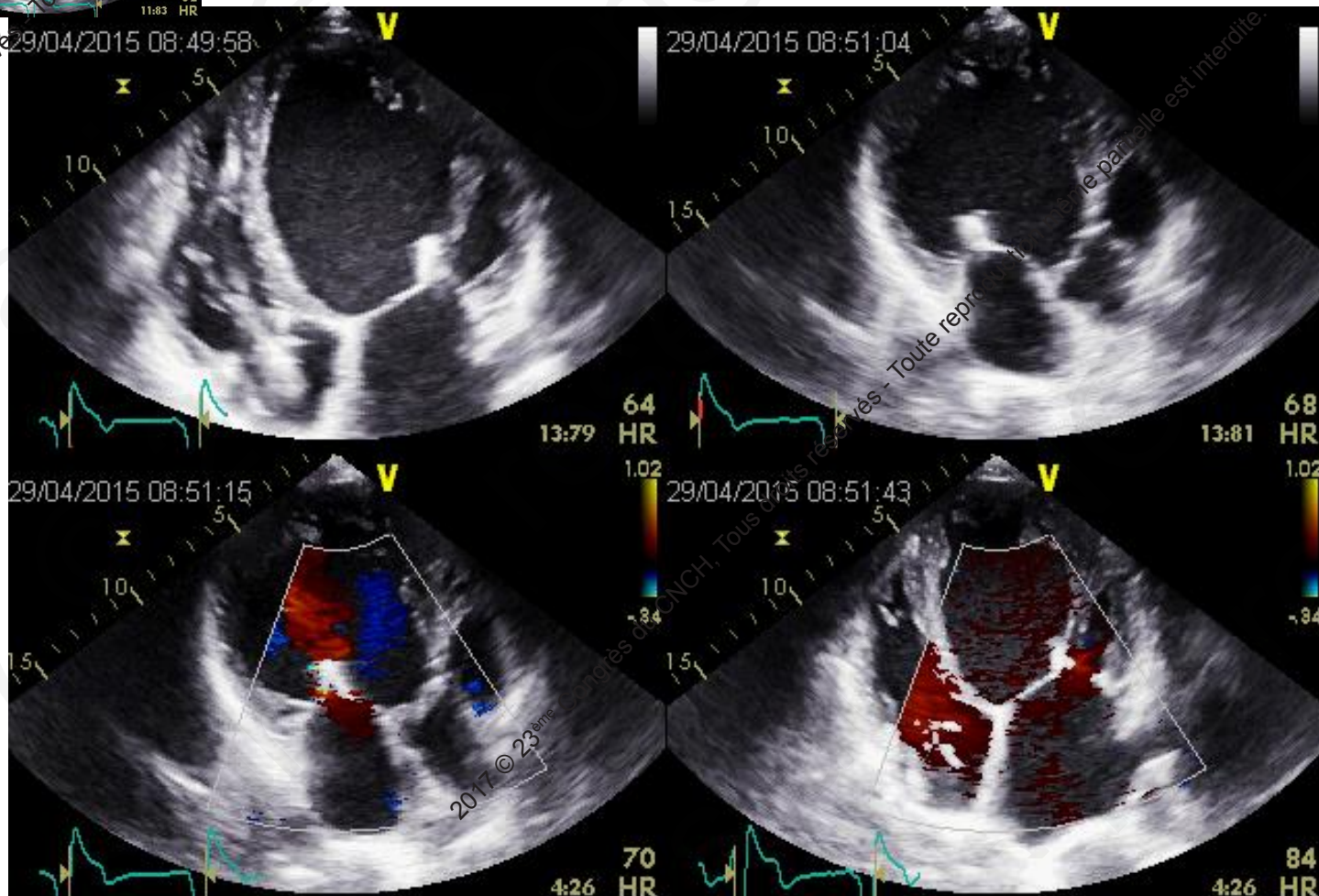




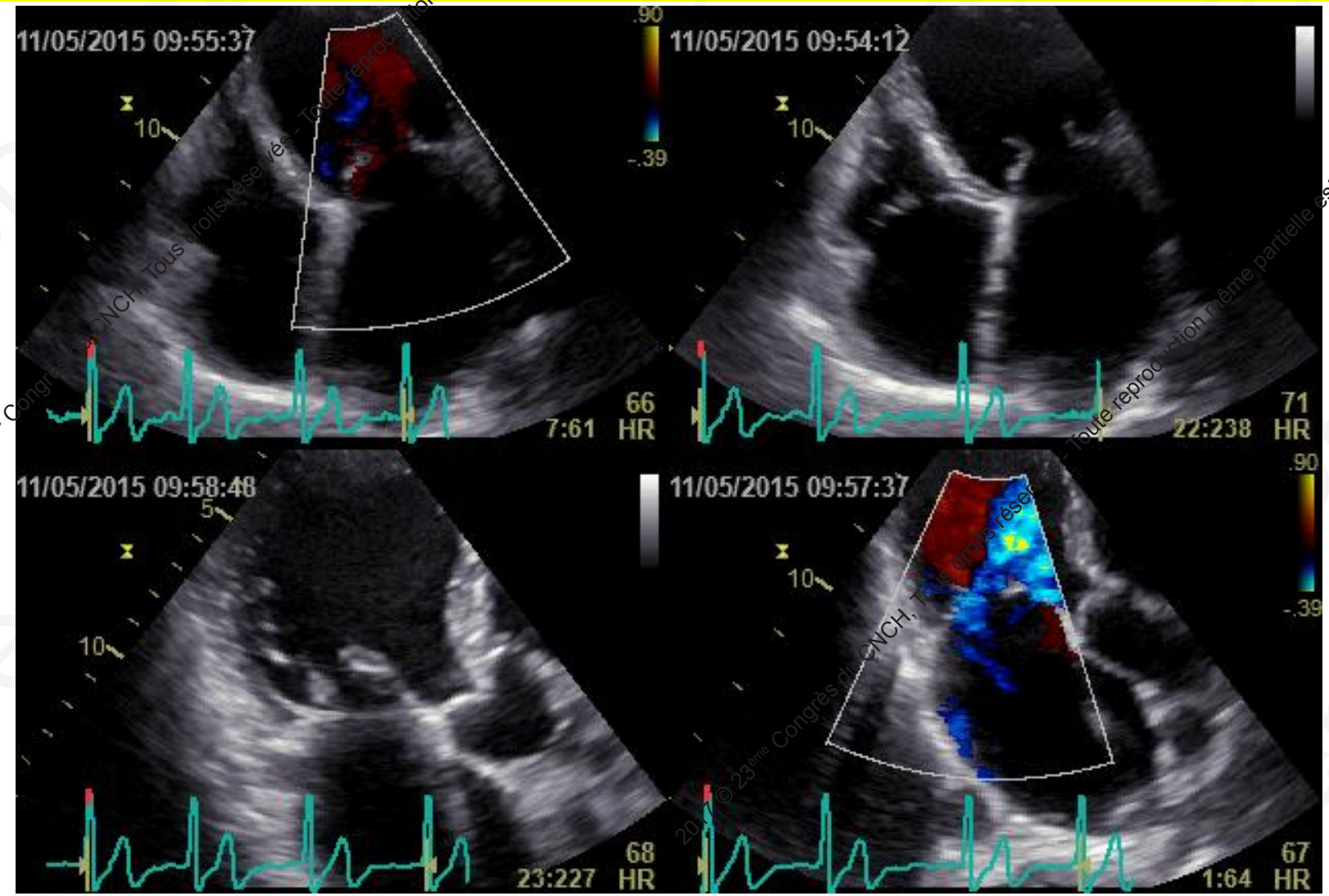


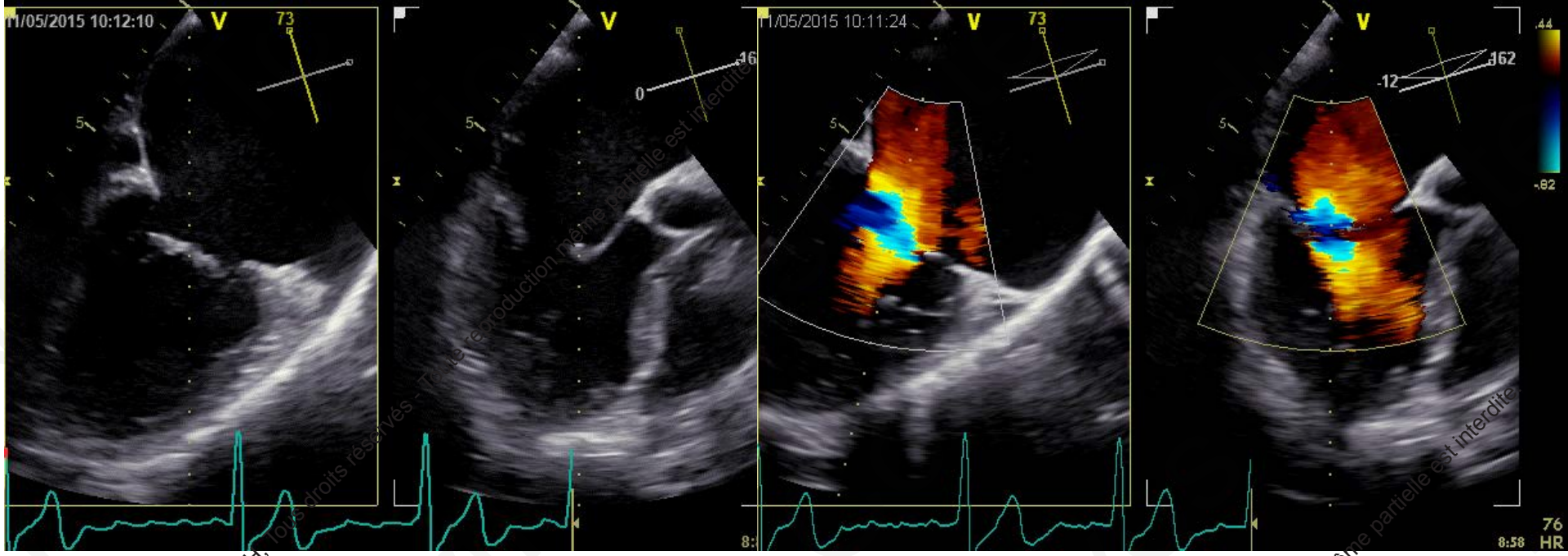
← Before

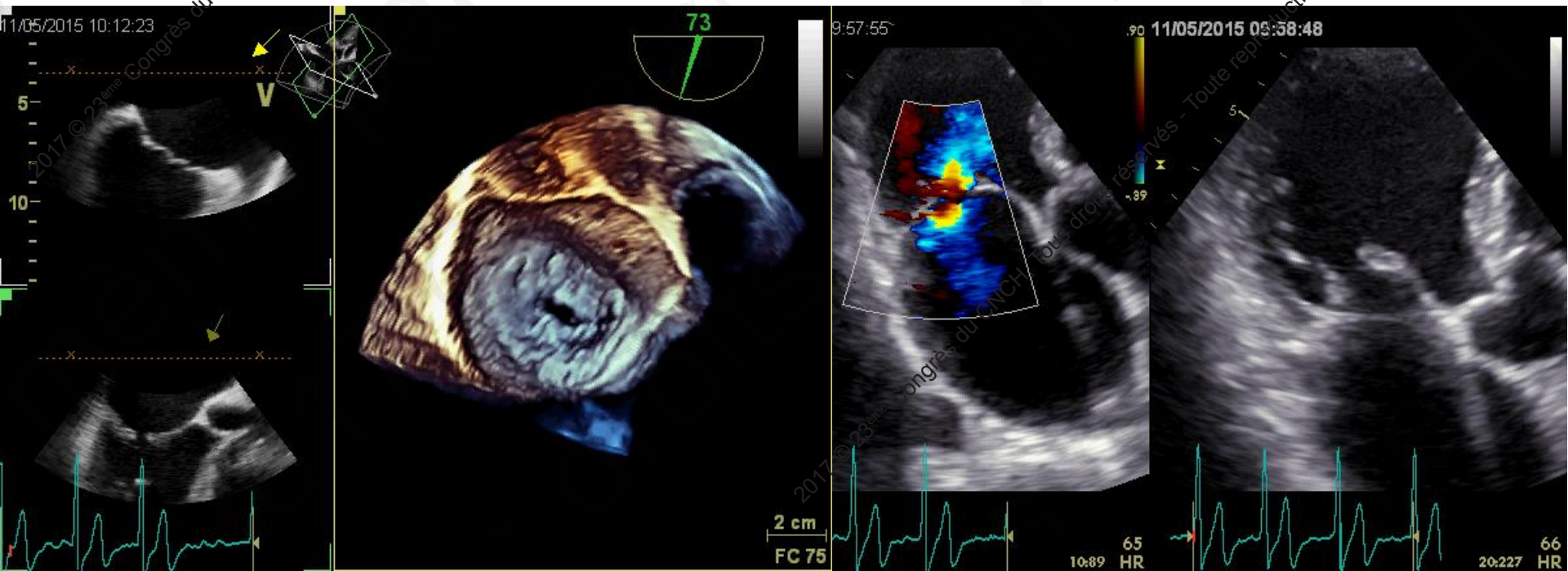
After one Clip ↓



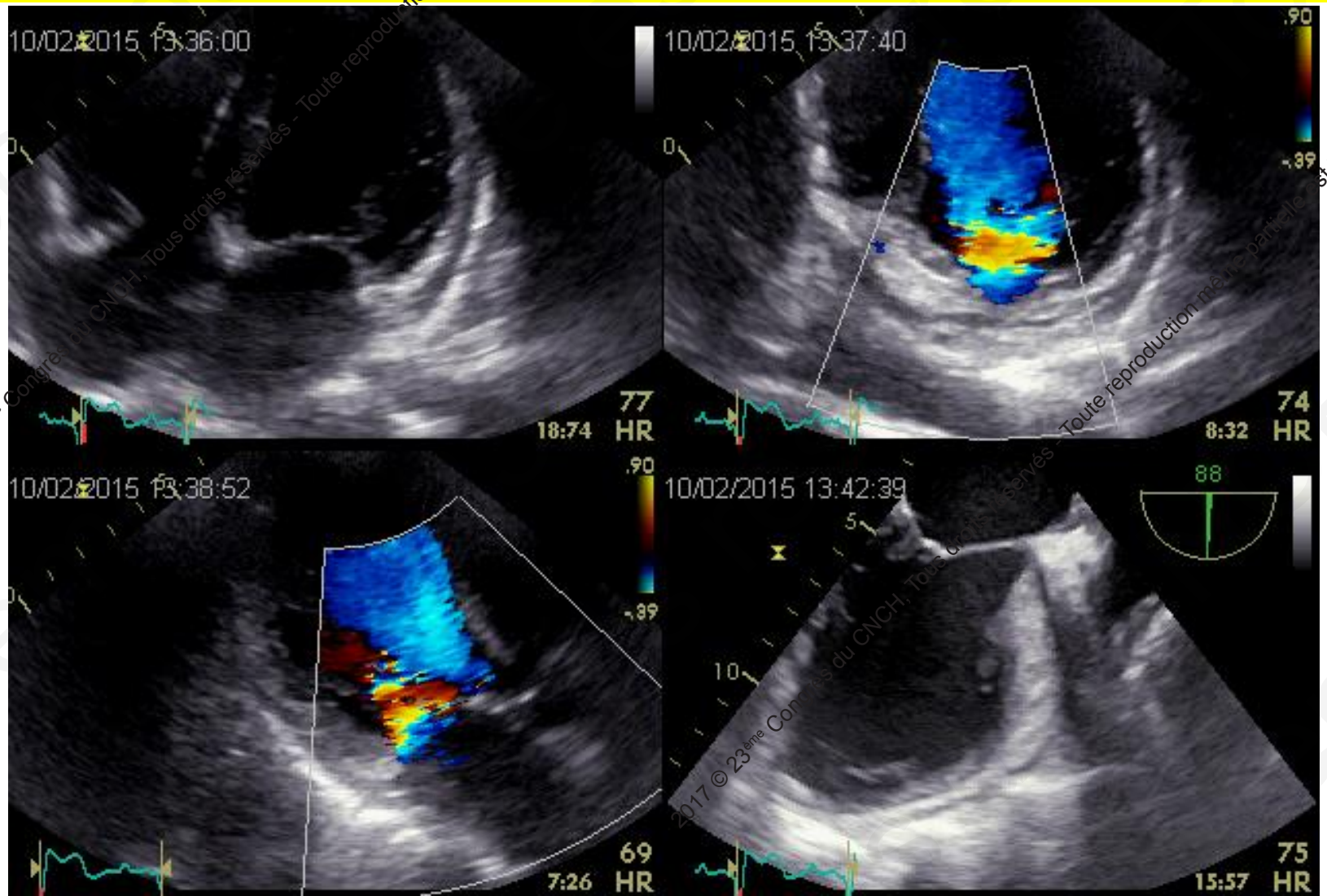
A Man, 56 yo, chronic Afib, ischemic heart disease, past endocarditis

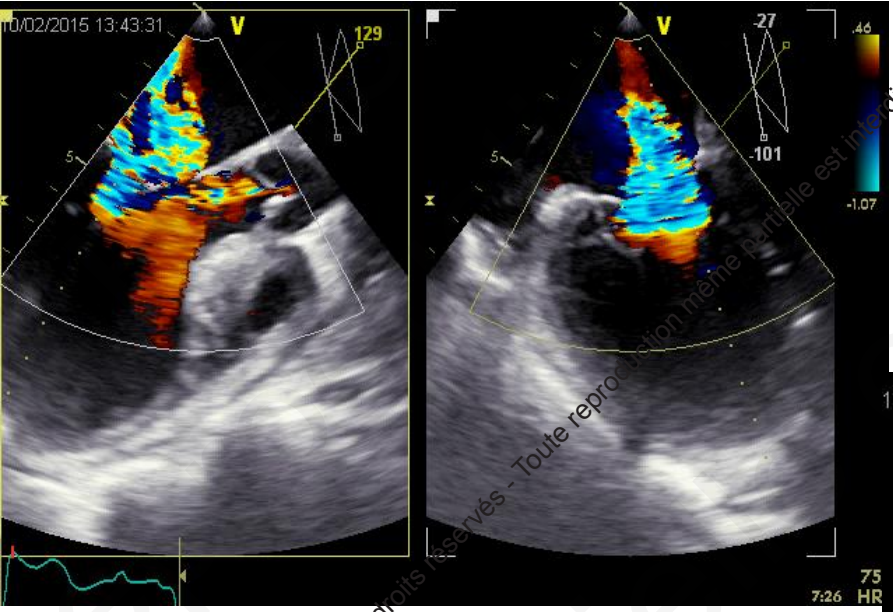


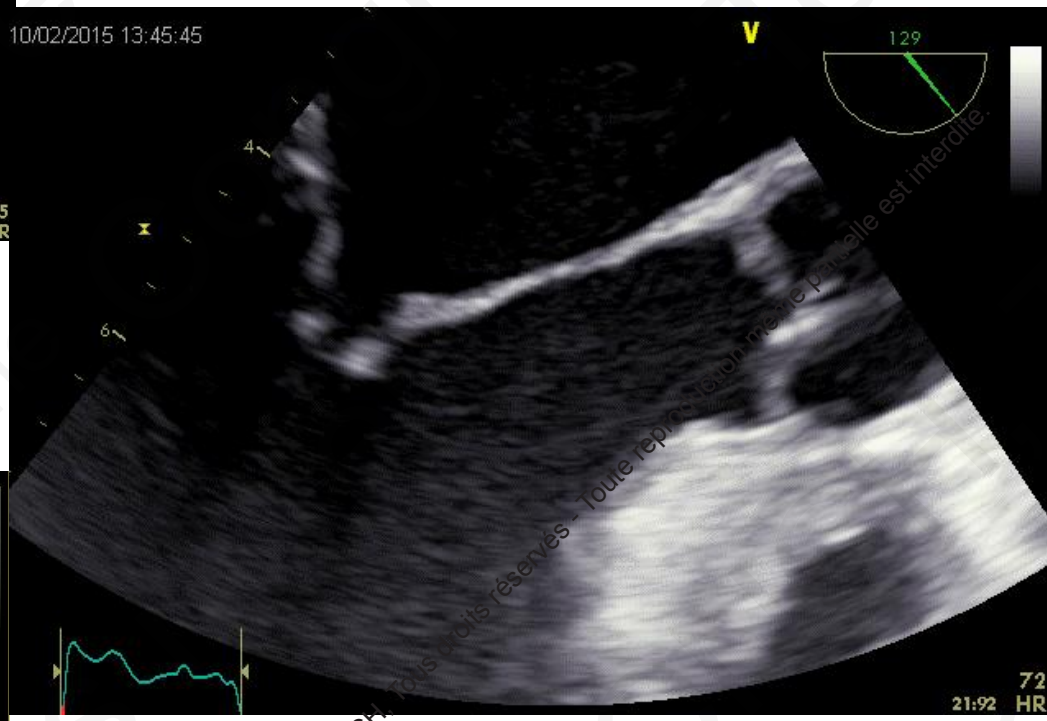


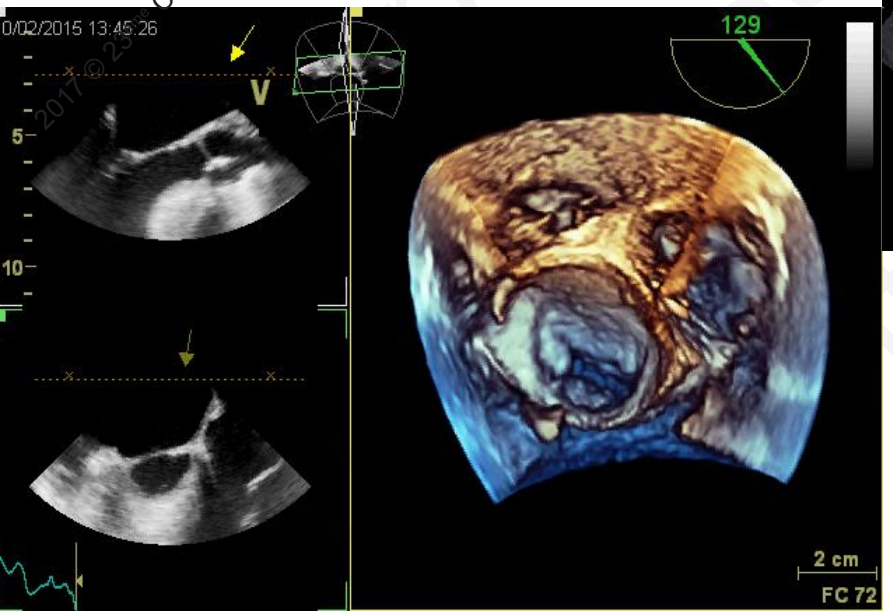


A 65 yo woman, post radio-chemotherapy for a Hodking lymphoma 30 years ago
Hospitalization for a 3rd acute pulm. oedema in 6-months

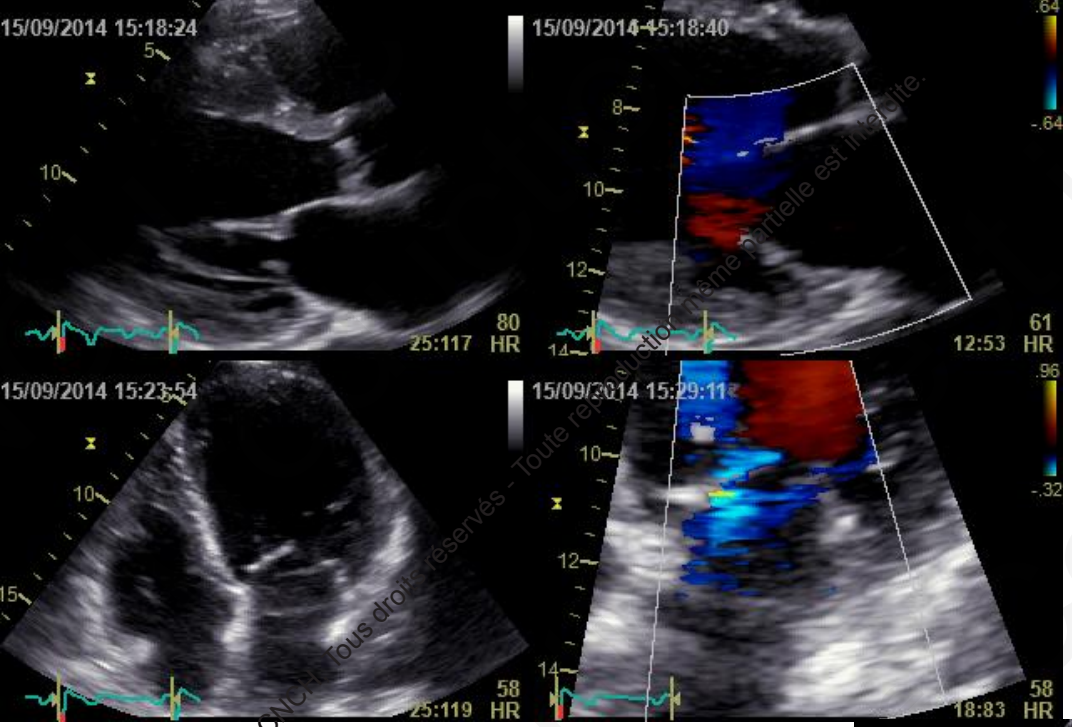








A good case : woman 60 yo, ischemic CM, optimal medical therapy but still NYHA II+ and recently hospitalized for acute HF
CMR: no viability, No indication for CABG



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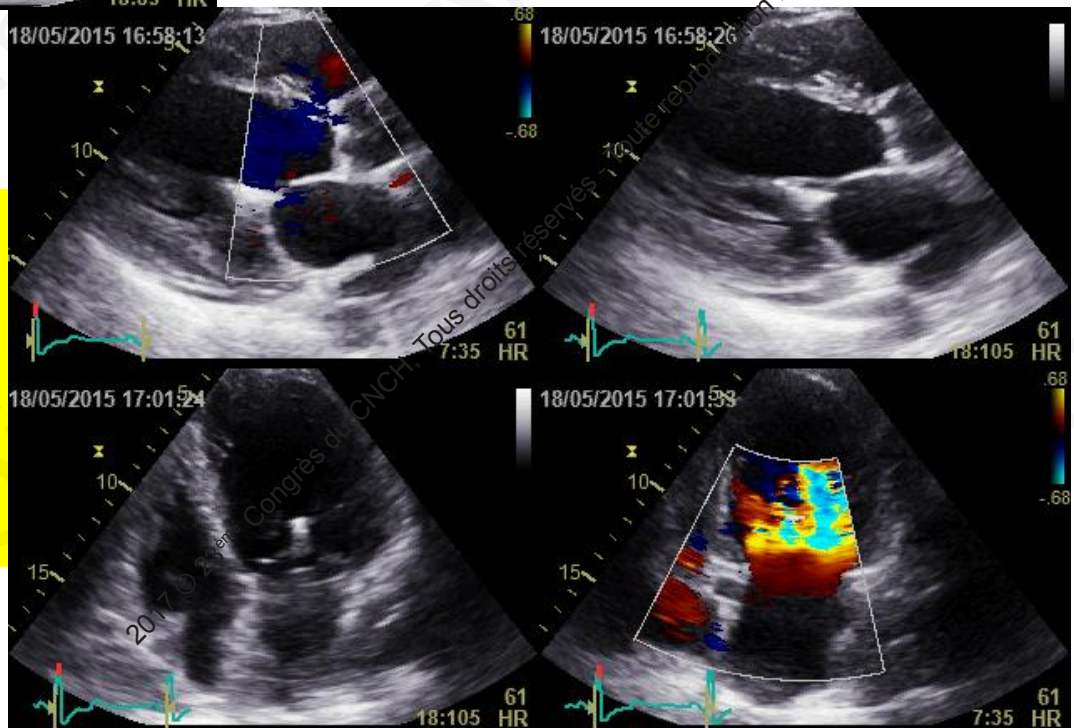
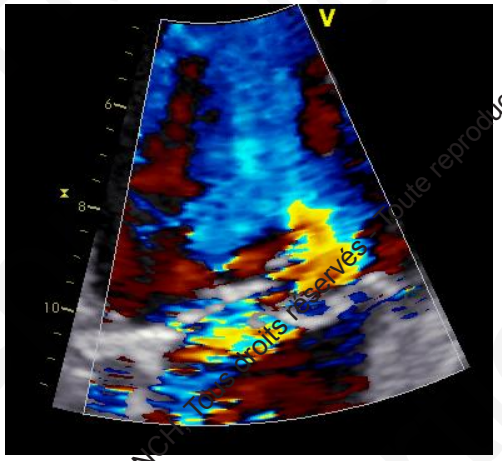
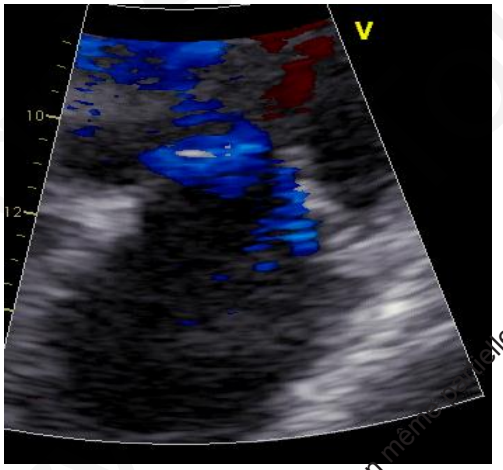


Primary MR



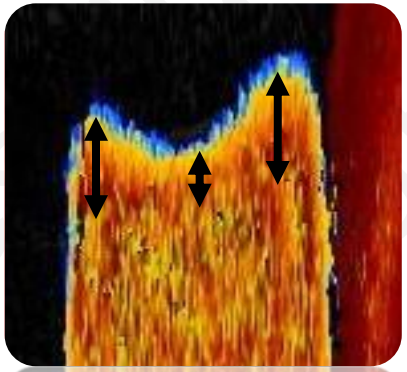
Secondary MR



Defining “Severe” Secondary MR

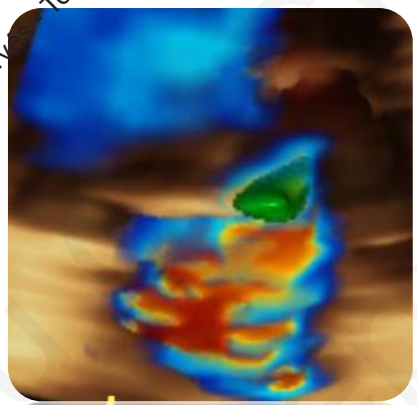
Primary MR :

- “this is the abnormal valve that makes the heart sick”
- Mitral valve repair =>correction of LV volume overload allowing normal lifespan



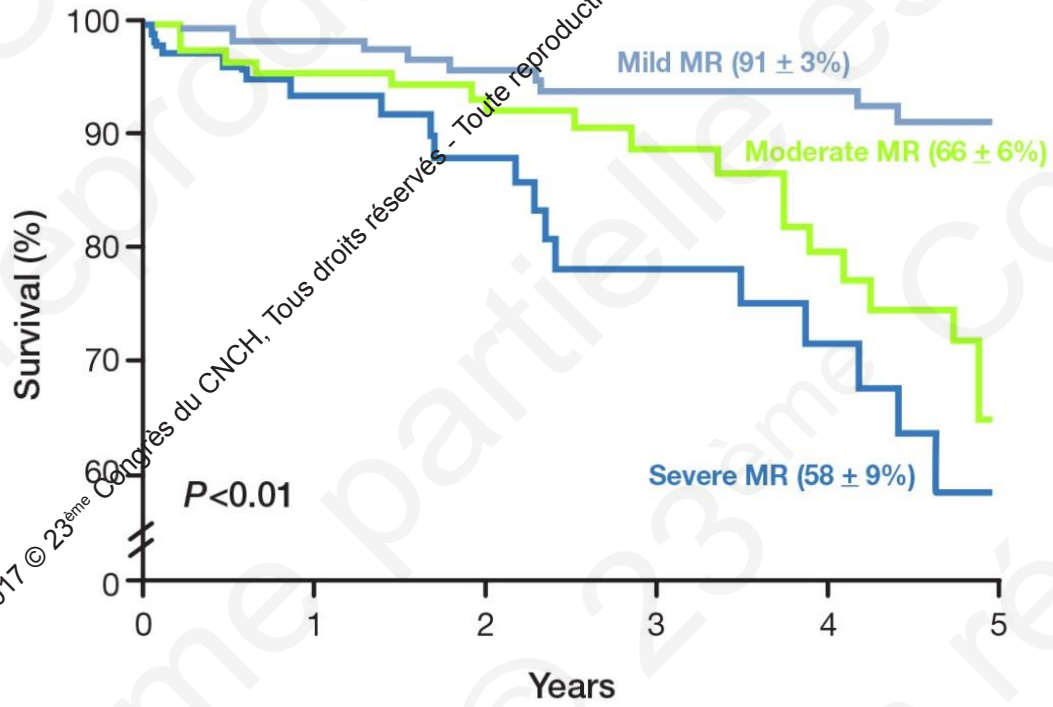
Secondary MR: due to systolic restriction of mitral leaflet motion by tethering and/or annular dilation

Defining “severe” secondary MR is problematic because LV is already damaged



Grayburn et al. JACC 2014; 64: 2792
Patel et al. J Cardiac Fail 2004; 10: 285
Dujardin et al. Circulation 1997; 96: 3409

Survival Decreases With Increased Severity in Primary MR



Study	Mortality risk increased with severe MR vs less severe MR
Rusinaru 2011[2]	HR = 1.78 (95% CI, 1.19-2.67) *P* = .005

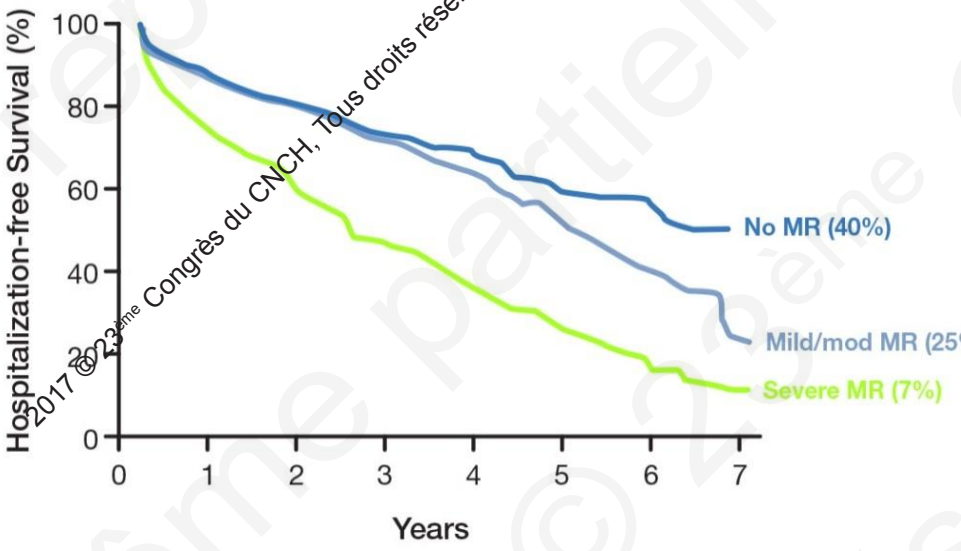
Enriquez-Sarano 2005[1]: Survival decreases with increasing severity of degenerative MR

Mortality risk increases as MR becomes more severe, making referral for further evaluation and potential intervention an important consideration

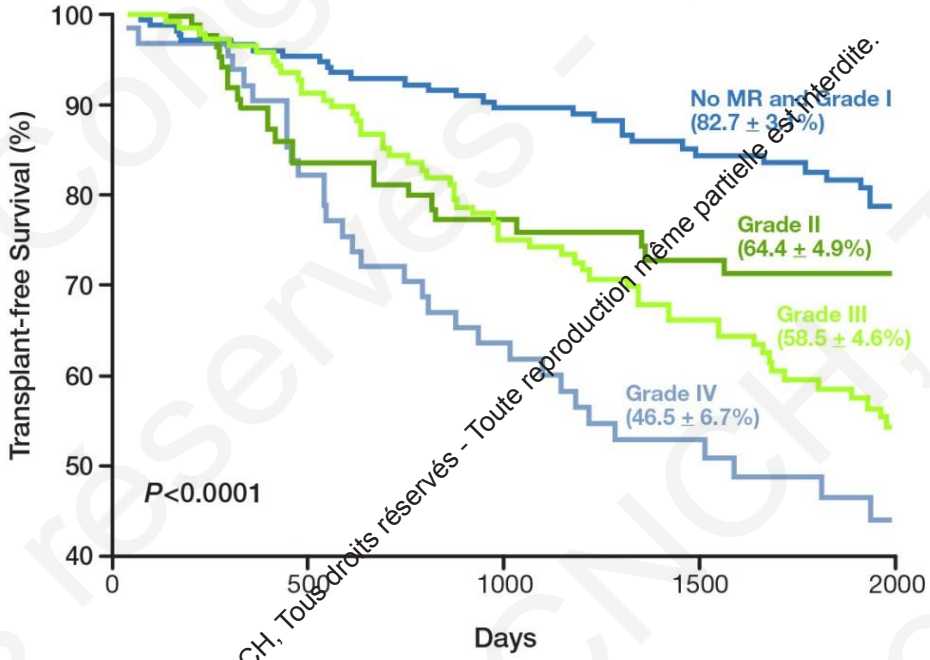
1. Enriquez-Sarano M, Avierinos J-F, Messika-Zeitoun D, et al. Quantitative determinants of the outcome of asymptomatic mitral regurgitation. *N Eng J Med.* 2005;352(9):875-883.
2. Rusinaru D, Tribouilloy C, Grigioni F, et al. Left atrial size is a potent predictor of mortality in mitral regurgitation due to flail leaflets: results from a large international multicenter center. *Circ Cardiovasc Imaging.* 2011;4(5):473-481.

Increased Severity = Increased Morbidity in Secondary MR

Clinical studies show that patient outcomes worsen with increasing MR severity, highlighting the importance of early intervention



Rossi 2011[1]: Hospitalization-free survival decreased with increased MR severity.



Bursi 2010[2]: Transplant-free survival decreased with increased MR severity.

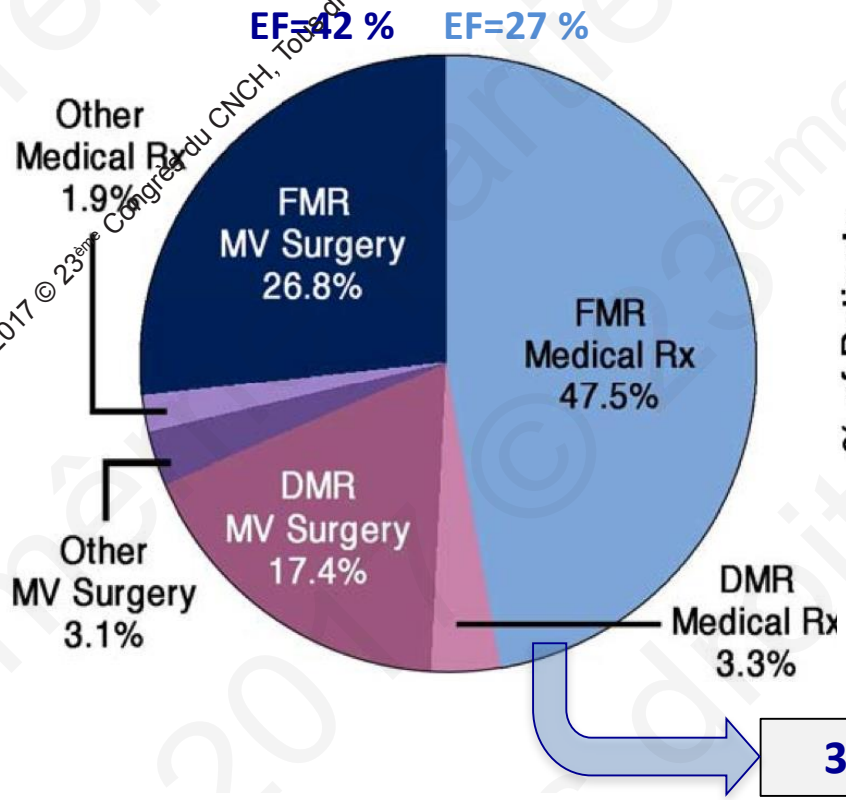
1. Rossi A, Dini FL, Faggiano P, et al. Independent prognostic value of functional mitral regurgitation in patients with heart failure: a quantitative analysis of 1256 patients with ischemic and non-ischaemic dilated cardiomyopathy. *Heart.* 2011;97(20):1675-1680.
2. Bursi F, Barbieri A, Grigioni F, et al. Prognostic implications of functional mitral regurgitation according to the severity of the underlying chronic heart failure: a long-term outcome study. *Eur J Heart Fail.* 2010;12(4):382-388.

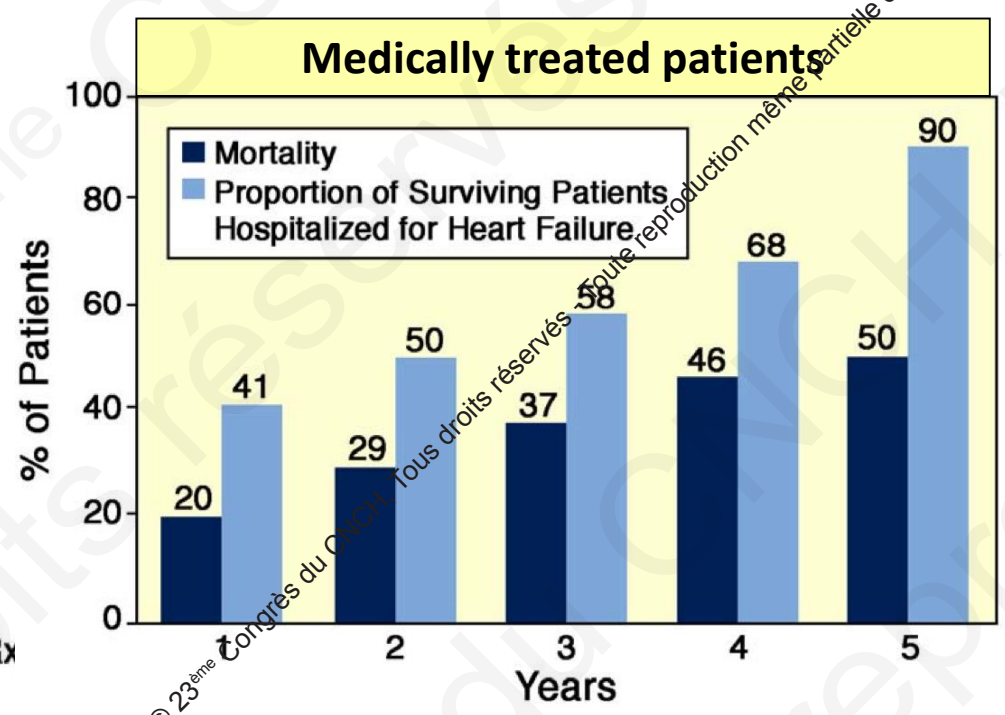
Prevalence and Outcomes of Unoperated Patients with Severe Symptomatic Mitral Regurgitation and Heart Failure: Comprehensive Analysis to Determine Potential Role of MitraClip for this Unmet Need.

5737 MR >2 were identified between 1/1/2000 and 12/31/2008

1095 MR >2 + IC ➔ Surgery 53 %

➔ OMM 47 %



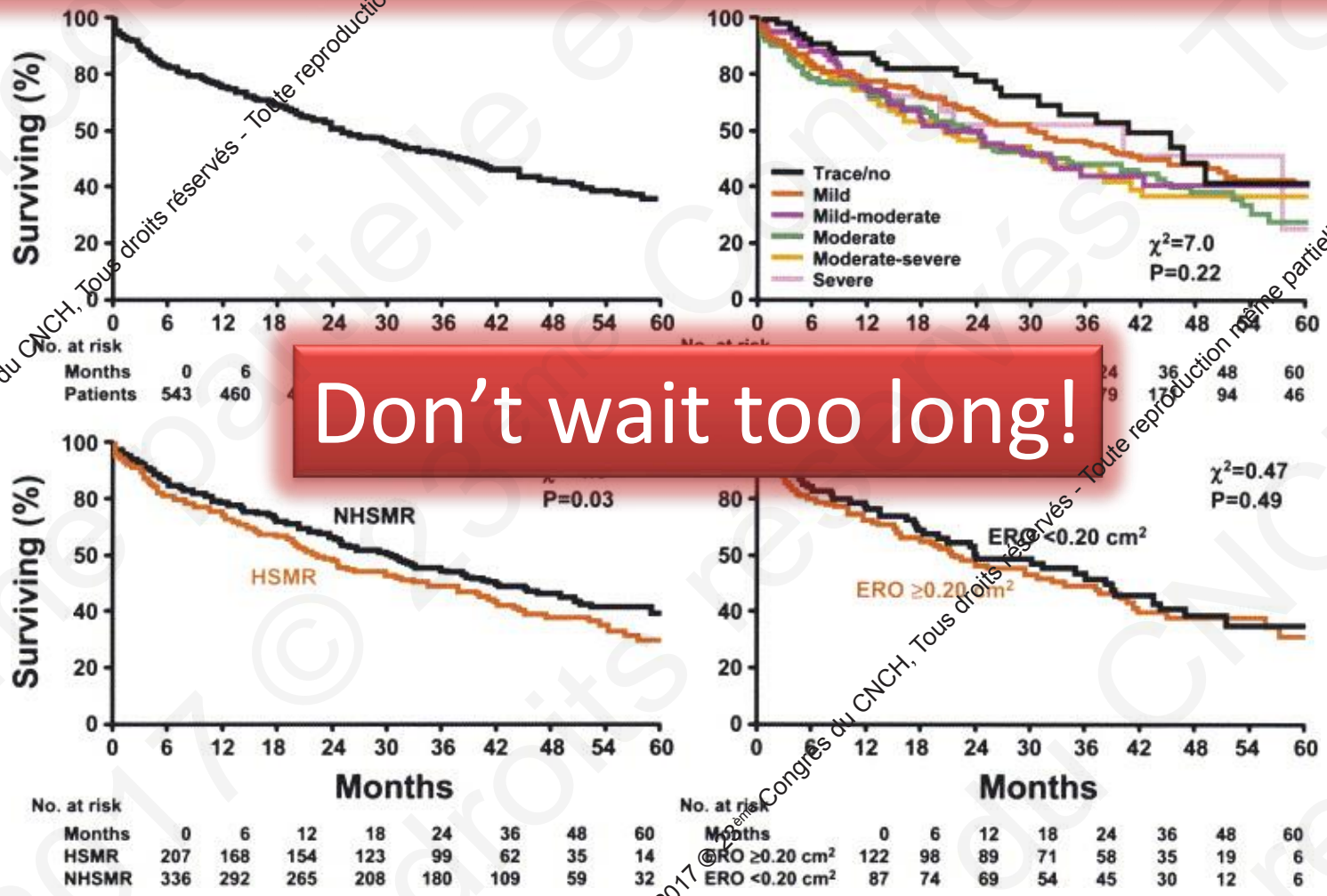


36 % eligible for Mitraclip

Goel et al. JACC 2013

2ndary MR is associated with a worse prognosis

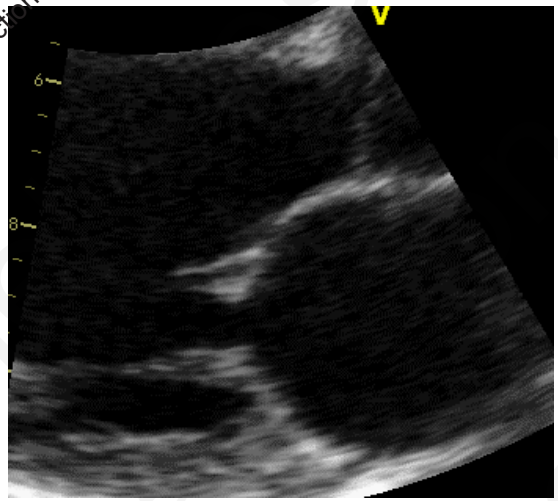
But: values defining severe MR in individual patients depend on multiple factors including: LVEDV, LVEF, Pressure gradient LA/LV…



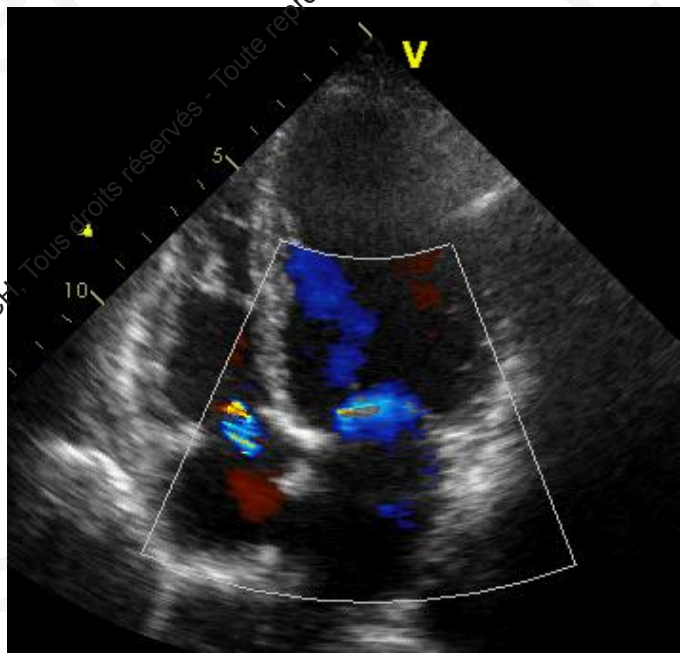
Patel et al. Mitral regurgitation in patients with advanced systolic heart failure

Journal of Cardiac Failure, Volume 10, Issue 4, 2004, 285 - 291

Think at this new treatment strategy in Secondary MR > 2/4

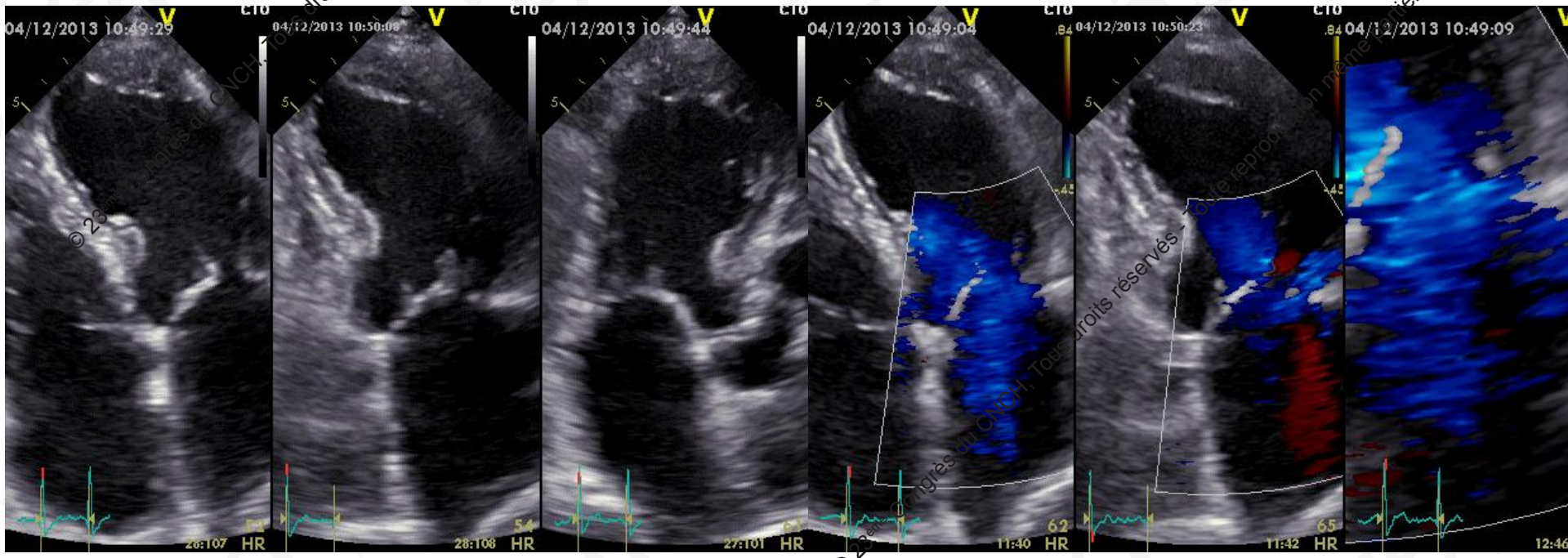


In cardiomyopathies if the patient is symptomatic and has a significant MR: *of course surgery is unlikely* but percutaneous treatments of the MR might help (considerably)



Importance of the TTE

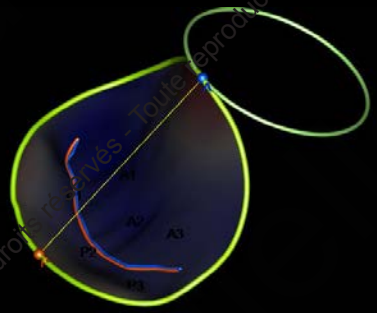
- LV dysfunction : LVEF < 40%: **unsuitable for conventional surgery**
- LA enlargement but not too large
- LA annulus size
- Thickness, calcification, localization of the regurgitant jet
- Tricuspid regurg, sPAP…**Don't wait that the disease is too advanced!**



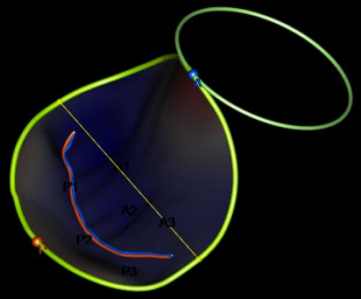
Offline 3D MV analysis

Quantitative semi-automated analysis in mid-systolic frame

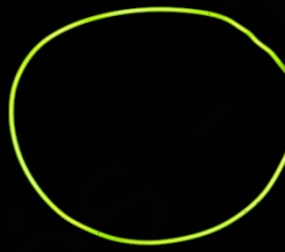
A-P diameter



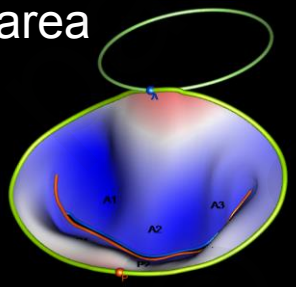
AL-PM diameter



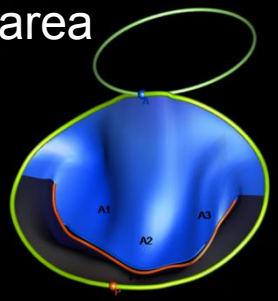
Sphericity



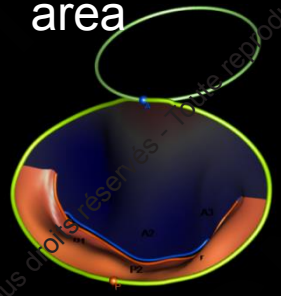
Annulus 3D area



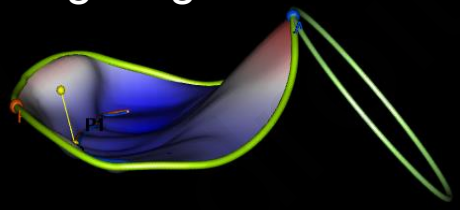
Anterior leaflet area



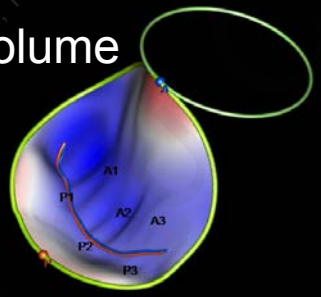
Posterior leaflet area



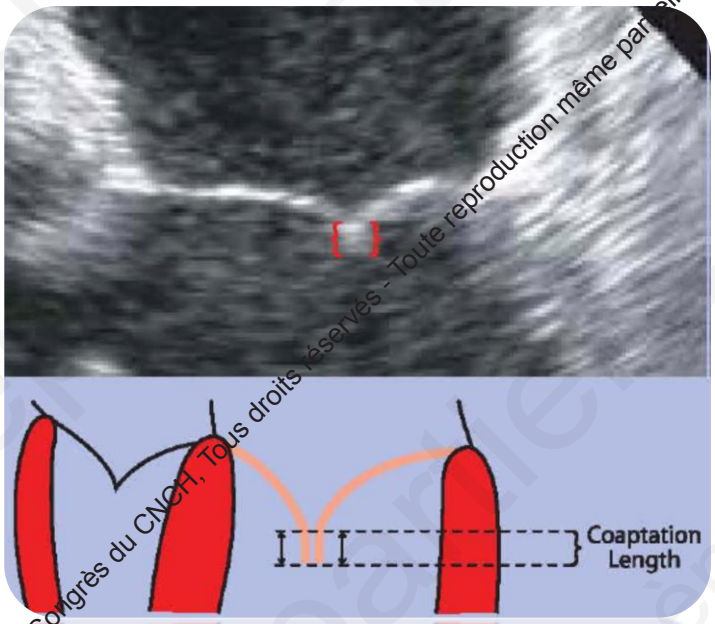
Tenting height

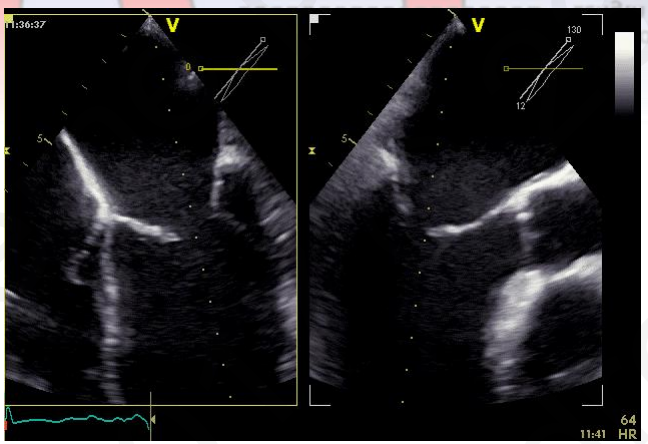


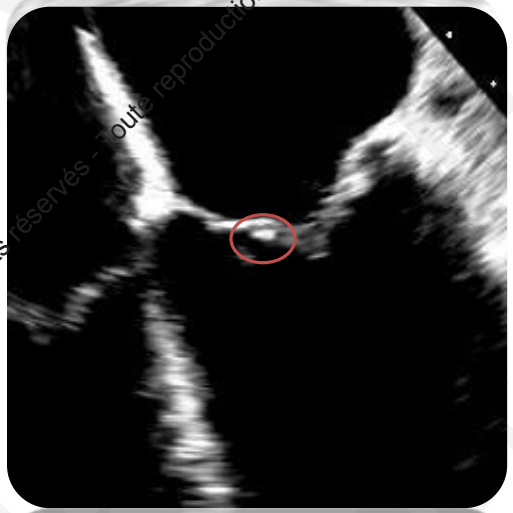
Tenting volume



Vertical Coaptation Length (FMR)



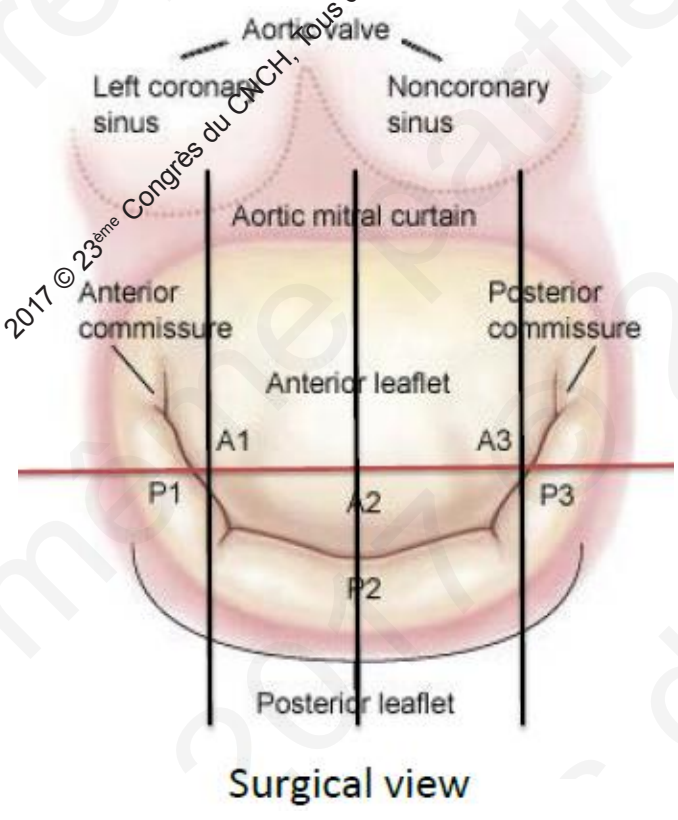




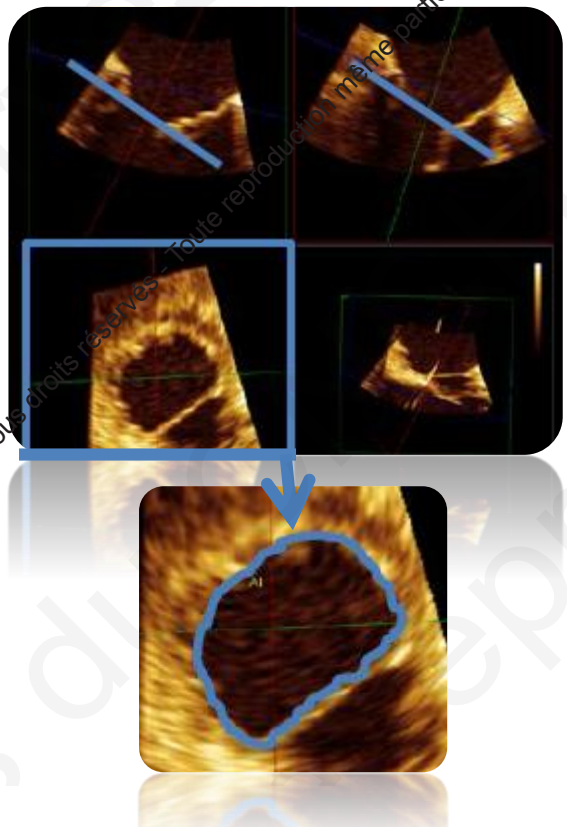
Calcification in the Grasping Area

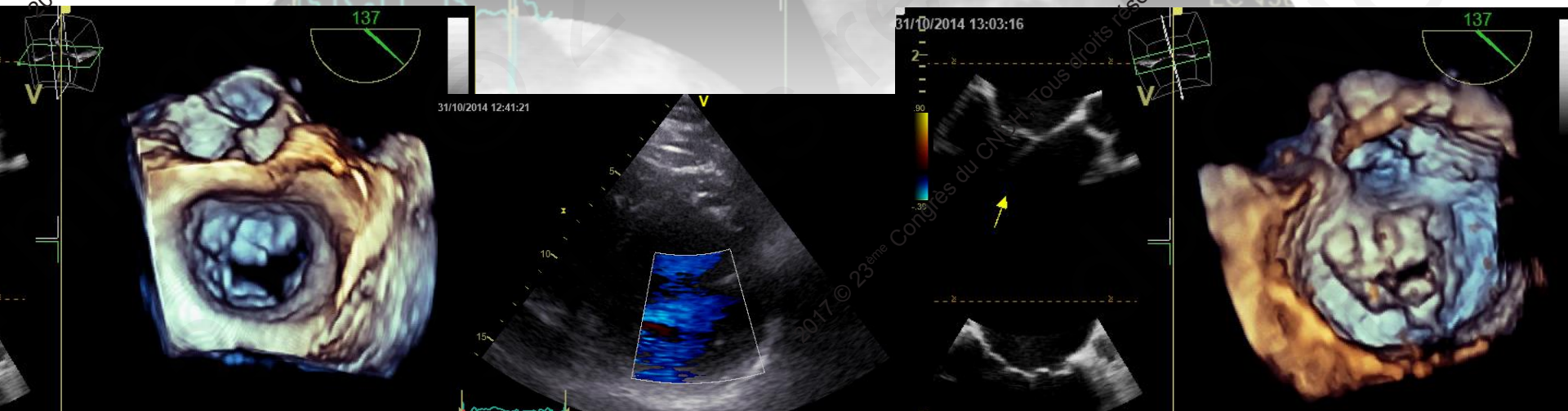
For 2nd MR:

- Systolic coaptation, depth < 10 mm
- Systolic coaptation length ≥ 2mm
- Mitral valve area > 4 cm²

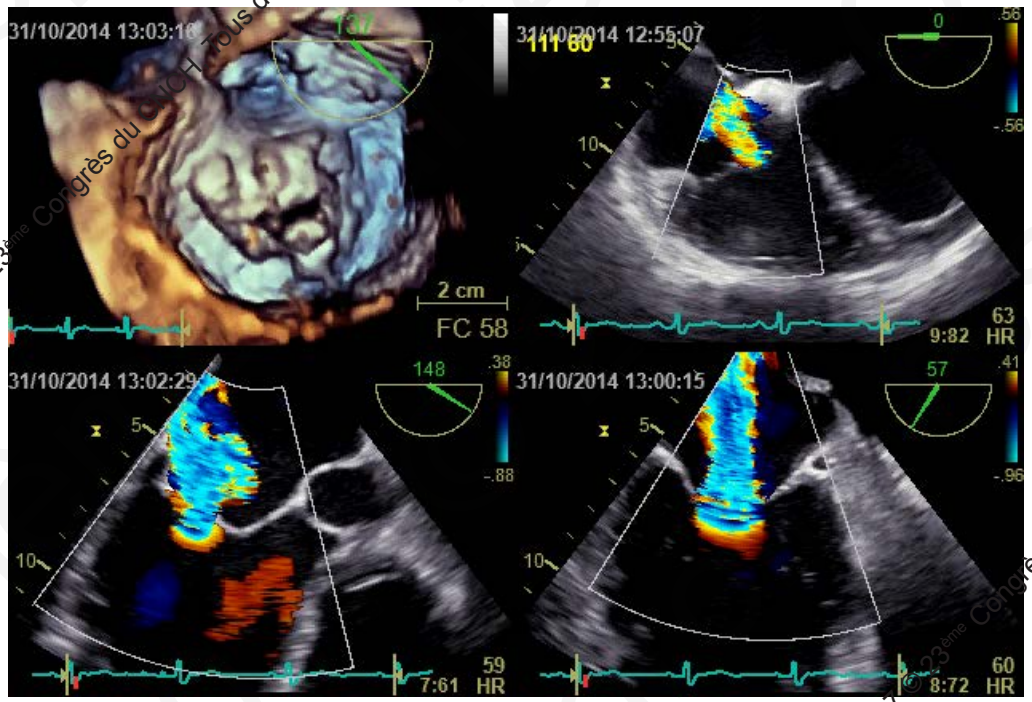


Surgical view



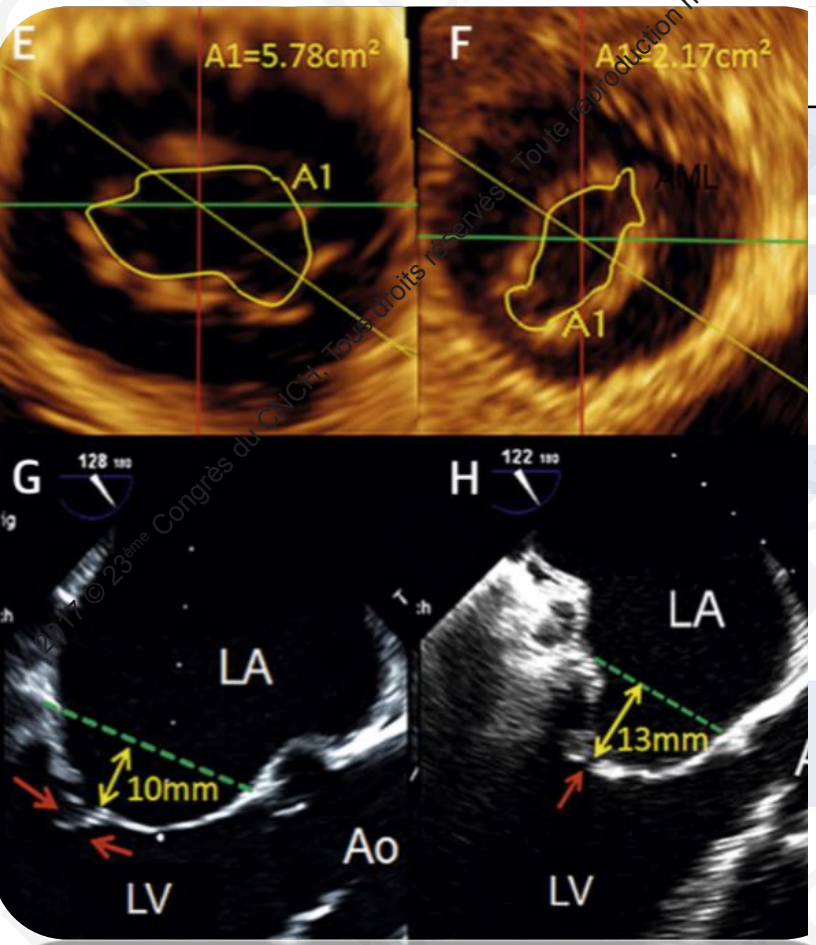


- 3-D analysis form one to the other commissure
- Checking for:
  - the Length of posterior leaflet > 8mm
  - the Thickness of the valve <5mm



Suitable ≠ Unsuitable

Secondary MR : EROA > 200mm²



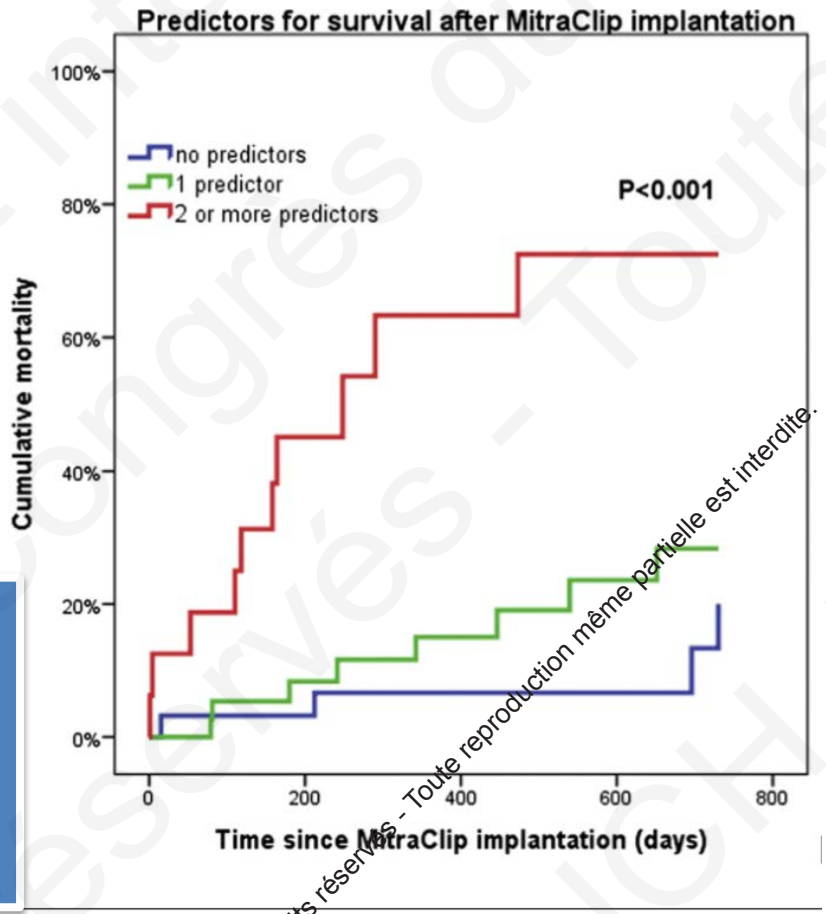
Criteria Suggesting Patient Suitability	Criteria Suggesting Patient Might Not Be Suitable
Nonrheumatic etiology	Rheumatic etiology, endocarditis-related valve disease, or prior MV surgery
Central mitral regurgitation jet	Cleft or perforated mitral leaflets
MV orifice area ≥40 mm²	Lack of secondary chordal support
If a flail leaflet is present	Posterior leaflet length <7 mm
Flail gap* <10 mm	
Flail width* <15 mm	
Posterior leaflet length ≥10 mm	Leaflet gap >2 mm
If leaflet tethering present	Presence of severe calcifications in the grasping area
Coaptation depth <11 mm	
Coaptation length† <10 mm	
Absence of calcifications in the grasping area	Transmitral pressure gradient ≥4 mm Hg‡
	Effective regurgitant orifice area >70.8 mm²‡
	MV orifice area <30 mm²‡
	Evidence of intracardiac mass, thrombus, or vegetation, or evidence of an inferior vena cava or femoral venous thrombus

JACC 2014; 64:2688

Predictors of outcome in patients undergoing MitraClip therapy

-84 patients, 76±10yp
-2 years follow-up
- Survival 81% at 2-years

1) Nt-proBNP > 5000µg/L
2) Previous valve surgery
3) TR≥3/4
4) Lack of reduction of MR by the clip



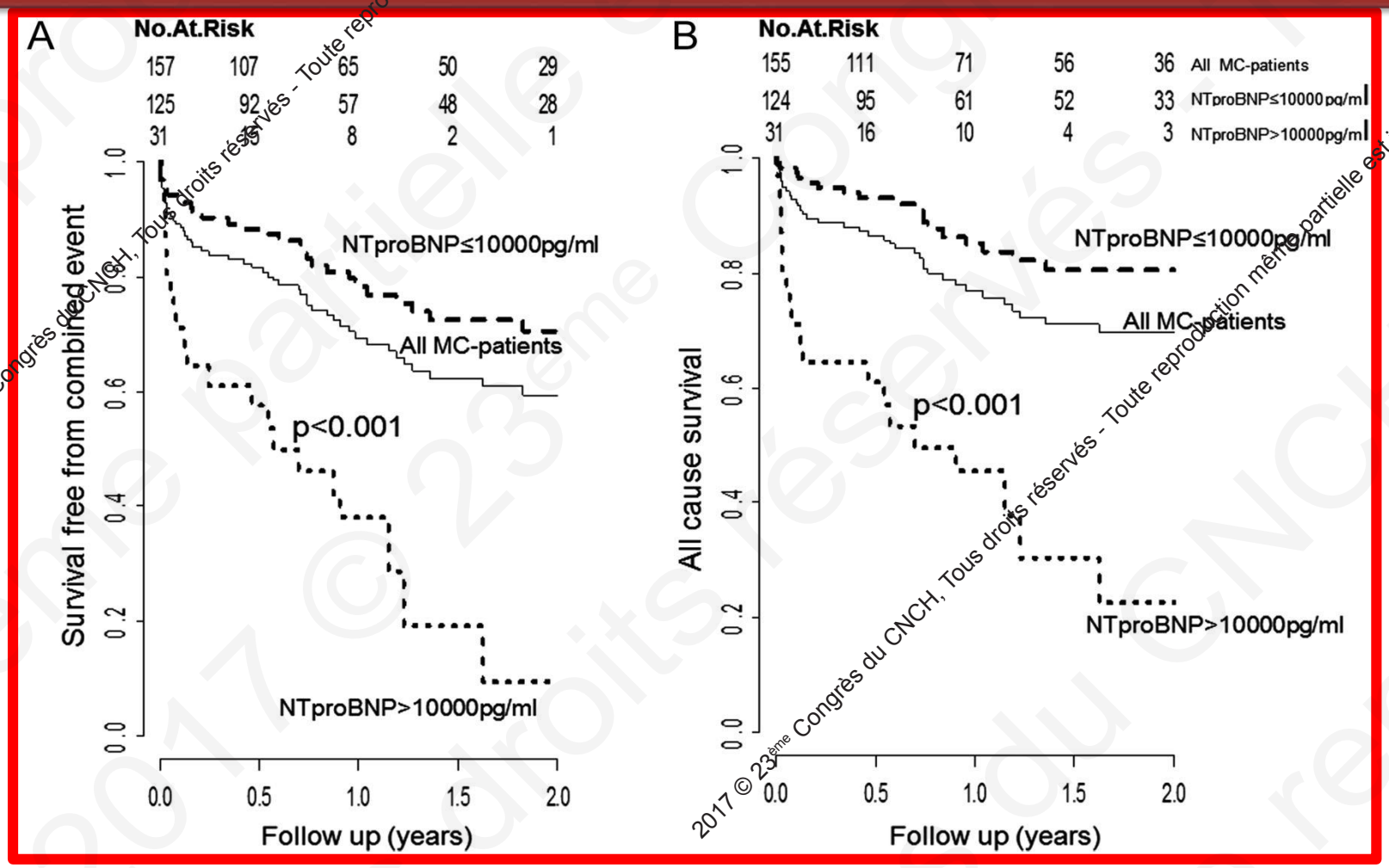
	Outcome		Univariate analysis		Multivariate analysis	
	n	Death, %	HR (95% CI)	p-value	HR (95% CI)	p-Value
Male gender	43	33	1.7 (0.7–4.2)	0.2		
Age > 80 years	39	31	1.6 (0.7–3.6)	0.3		
NYHA functional class IV	12	42	2.2 (0.8–6.0)	0.1		
LVEF < 30%	24	29	1.2 (0.5–2.8)	0.7		
Functional etiology	45	24	0.8 (0.3–1.8)	0.6		
NT-proBNP >5000 µg/L	10	50	3.4 (1.2–9.2)	0.02	5.4 (1.8–16.2)	0.003
Previous valve surgery	8	75	4.8 (1.9–12.2)	0.001	4.5 (1.7–12.2)	0.003
TR > grade 2	24	42	2.6 (1.1–6.0)	0.03	2.8 (1.2–6.8)	0.02
Absence of MR reduction (graded)[a]			1.9 (1.1–3.3)	0.03	2.1 (1.2–3.8)	0.01

HR: hazard ratio; CI: confidence interval; NYHA: New York Heart Association; LVEF: left ventricular ejection fraction; TR: tricuspid regurgitation; MR: mitral regurgitation.
[a] Graded by 0 grade/1 grade/2 grade/3 grade reduction of MR after MitraClip implantation.

Boerlage-vanDijk et al. Int J Cardio 2015; 189: 238

We treat secondary MR, so with some degree of LV dysfunction but do not wait that the

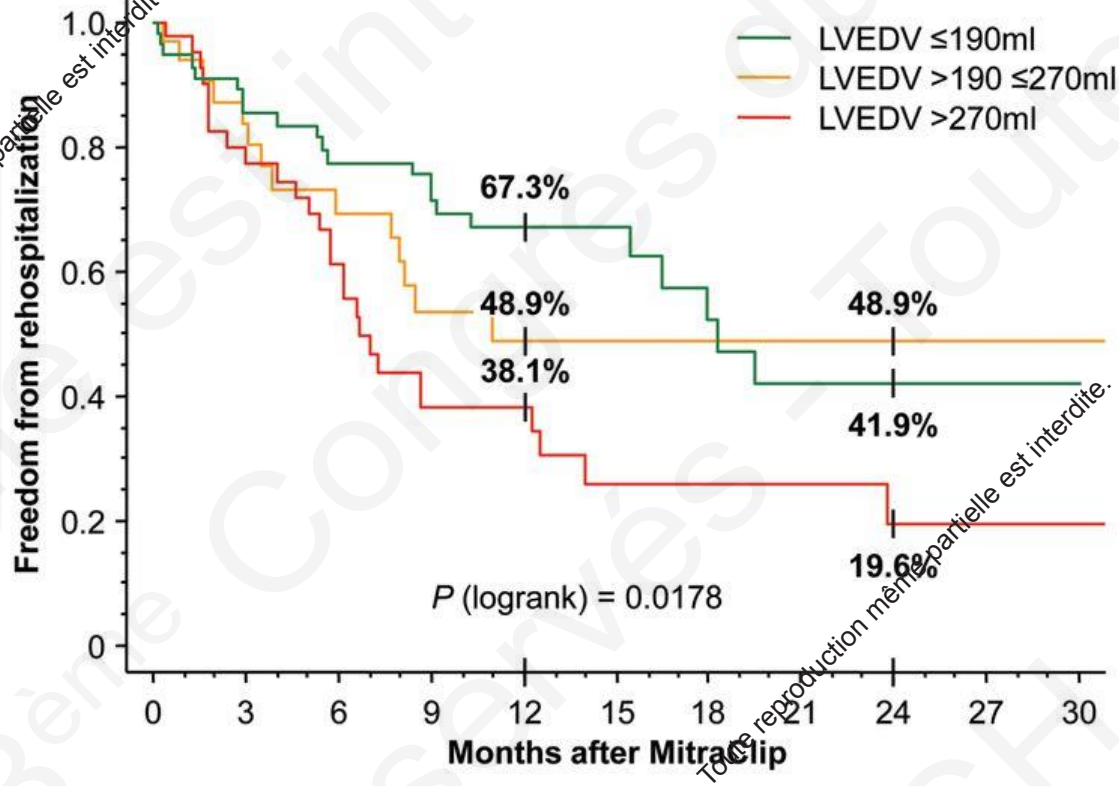
- ✓ heart is too remodeled and
- ✓ the Heart failure too severe



Neuss M et al. Eur J Heart Fail 2013;15:786-795

Not a good idea to wait

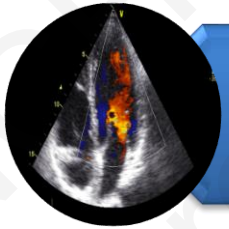
LV enlargement > 270 ml



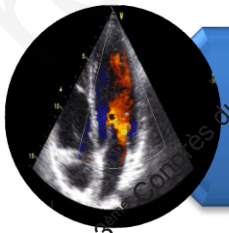
Patients at risk						
≤190ml	57	39	24	24	10	2
>190 ≤270ml	33	19	9	7	5	1
>270ml	45	22	11	5	2	1

Freedom from heart failure rehospitalization in successfully treated patients with secondary mitral regurgitation, differentiated by size ranges of left ventricular end-diastolic volume (LVEDV).

Rudolph V et al. Eur J Heart Fail 2013;15:796-807



Clinical state point



Imaging State point

Heart valve clinic
Multidisciplinary decision making process

1. Neuss et al. Eu J Heart Fail 2013; 15: 789
2. Lancellotti et al. Eur H J 2013; 34: 1597
3. Cavalcante et al. JACCim 2012; 5:733

ESC/EACTS GUIDELINES

	class	level
Percutaneous edge-to-edge procedure may be considered in patients with symptomatic severe ***PRIMARY MR*** who fullfil the echo criteria of eligibility, are judged inoperable or at high surgical risk by a 'heart team', and have a life expectancy greater than 1 year.	**IIb**	**C**
Percutaneous edge-to-edge procedure may be considered in patients with symptomatic severe ***SECONDARY MR*** who fullfil the echo criteria of eligibility, are judged inoperable or at high surgical risk by a 'heart team', and have a life expectancy greater than 1 year.	**IIb**	**C**

EHJ 2017

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Aortic Stenosis and TAVI

EACVI/ASE reco / ESC guidelines

Recommendations for grading of AS severity

	Aortic sclerosis	Mild	Moderate	Severe
Peak velocity (m/s)	≤2.5 m/s	2.6–2.9	3.0–4.0	≥4.0
Mean gradient (mmHg)	–	<20	20–40	≥40
AVA (cm^2)	–	> 1.5	1.0–1.5	<1.0
Indexed AVA (cm^2/m^2)	–	>0.85	0.60–0.85	<0.6
Velocity ratio	–	> 0.50	0.25–0.50	<0.25

Baumgartner et al
EACVI/ASE. EHJ im 2017

ESC European Society of Cardiology
European Heart Journal (2017) 00, 1–53
doi:10.1093/eurheartj/ehx391

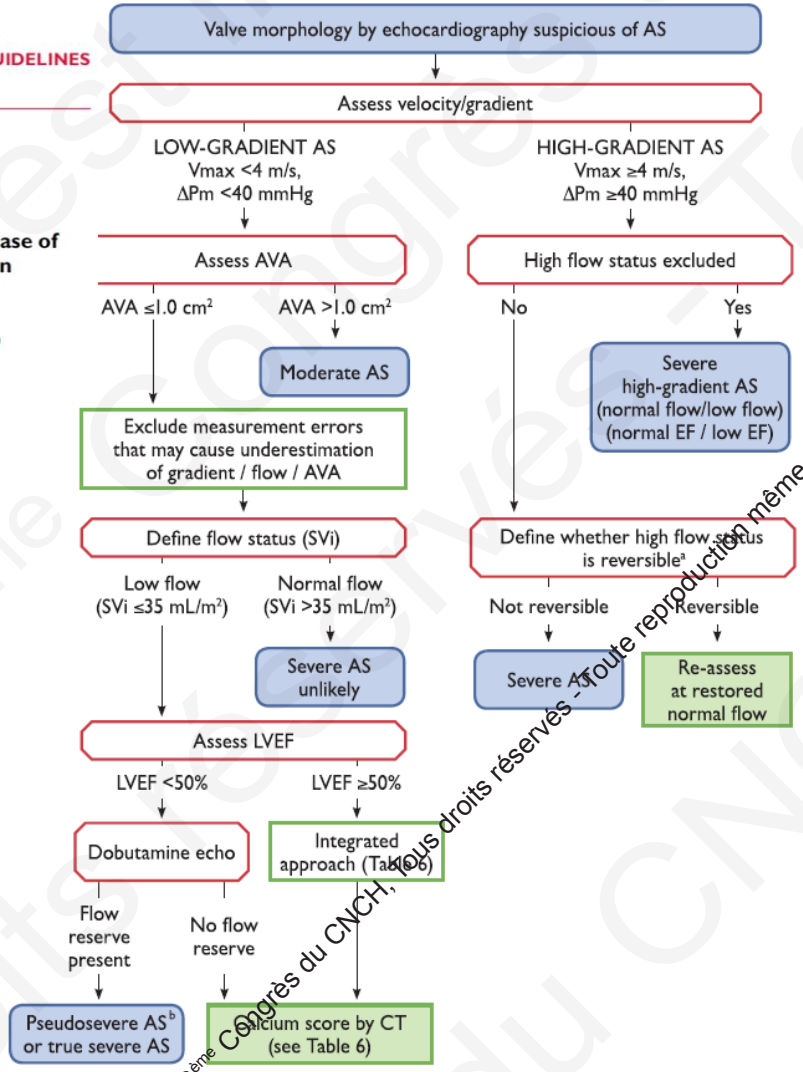
ESC/EACTS GUIDELINES

2017 ESC/EACTS Guidelines for the management of valvular heart disease

The Task Force for the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

Authors/Task Force Members: Helmut Baumgartner* (ESC Chairperson)

1) Vmax
2) Mean Pressure Gradient
3) AVA
4) Indexed Stroke Volume
5) LV EF



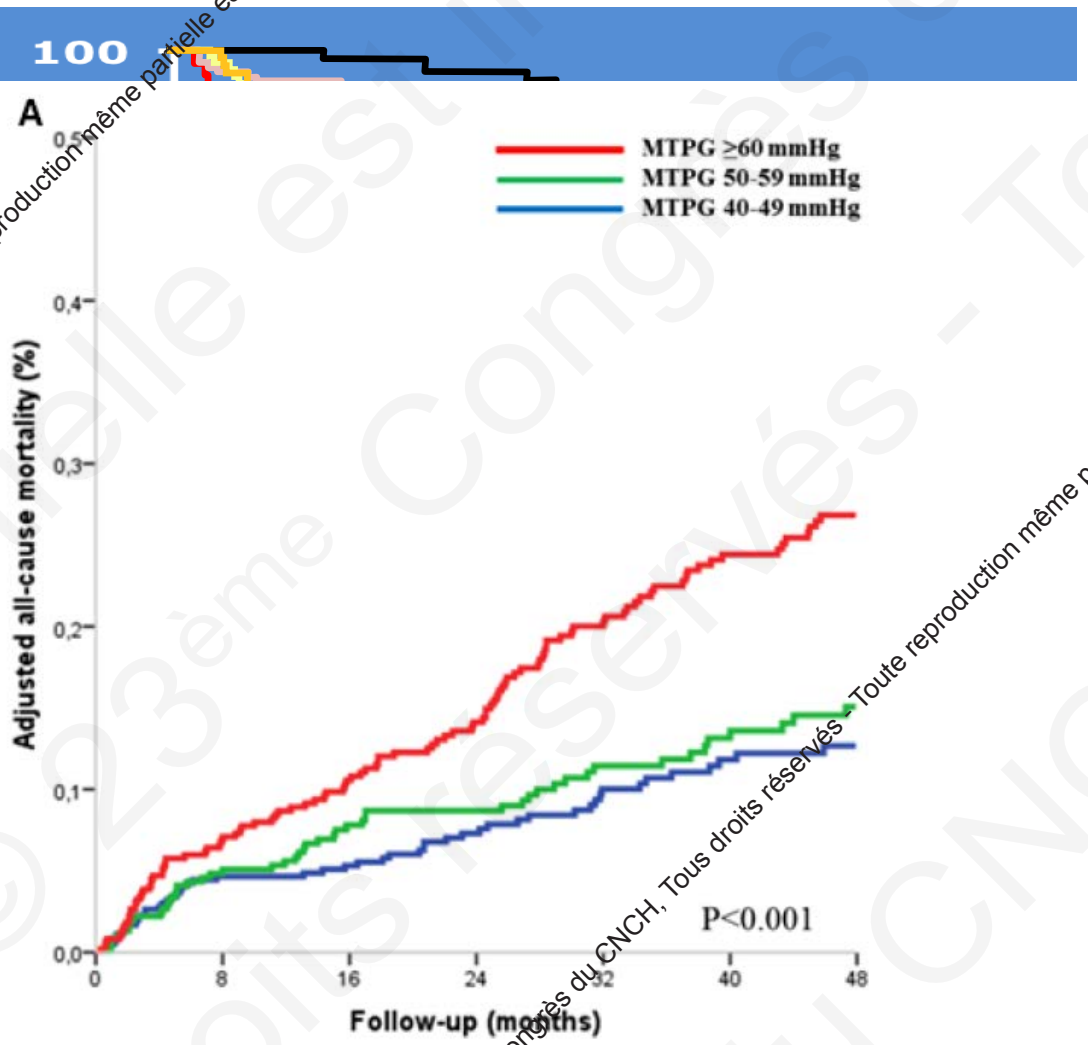
How do we define the prognosis in AS?

Vmax

Rosenhek et al
NEJM & Circulation

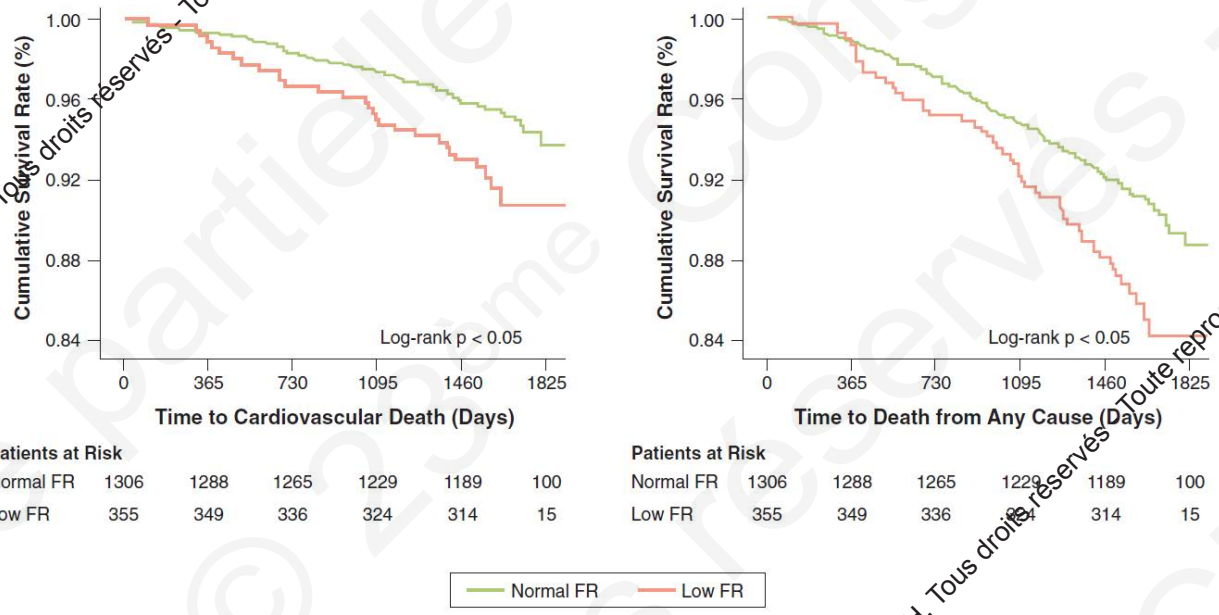
Gradient

Bohbot et al. JAHA 2017



Lower Transaortic Flow Rate Is Associated With Increased Mortality in Aortic Valve Stenosis

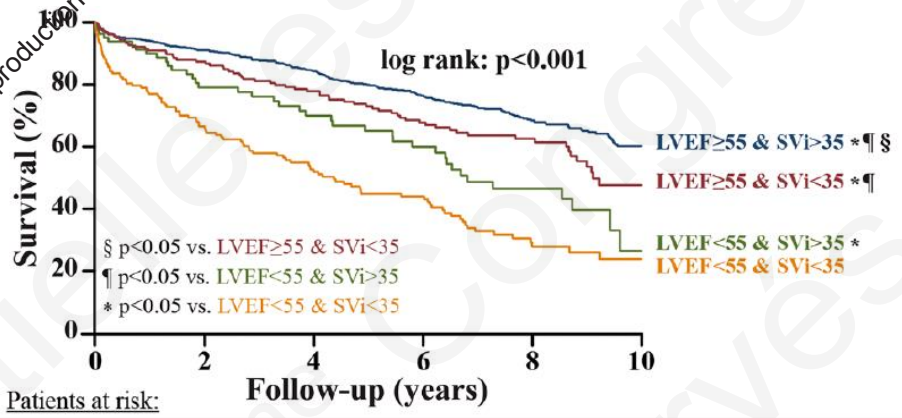
Sahrai Saeed, MD, PhD,[a] Roxy Senior, MD,[b] Navtej S. Chahal, MBBS, PhD,[b] Mai Tone Lønnebakken, MD, PhD,[a,c] John B. Chambers, MD, PhD,[d] Edda Bahlmann, MD, PhD,[e] Eva Gerdts, MD, PhD[c]



CONCLUSIONS In patients with AS without known cardiovascular disease or diabetes, low transaortic FR was independently associated with higher rates of cardiovascular and all-cause mortality. (An Investigational Drug on Clinical Outcomes in Patients With Aortic Stenosis (Narrowing of the Major Blood Vessel of the Heart) (MK-0653A-043 AM4); NCT00092677) (J Am Coll Cardiol Img 2017;10:912–20)

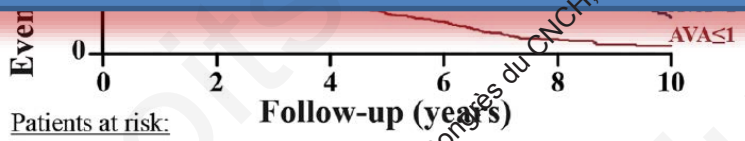
How do we define the prognosis in AS?

VES



Capoulade R, et al. Heart 2016;102:934–94

The most powerful echocardiographic predictors of mortality are low LVEF and low flow, whereas AS severity parameters predict valve-related events but not overall mortality.
Hence, **low flow should be integrated in the risk stratification and therapeutic decision-making in patients with AS**.



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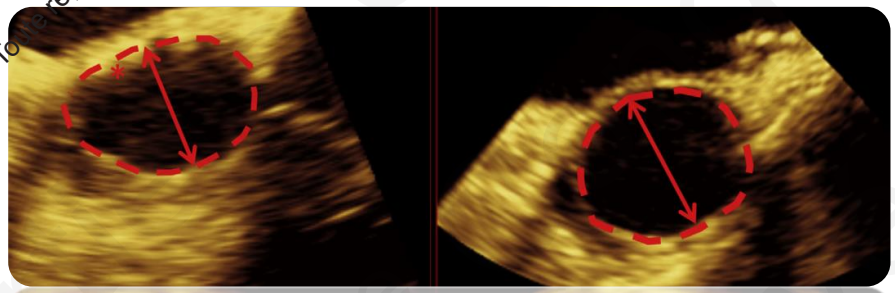
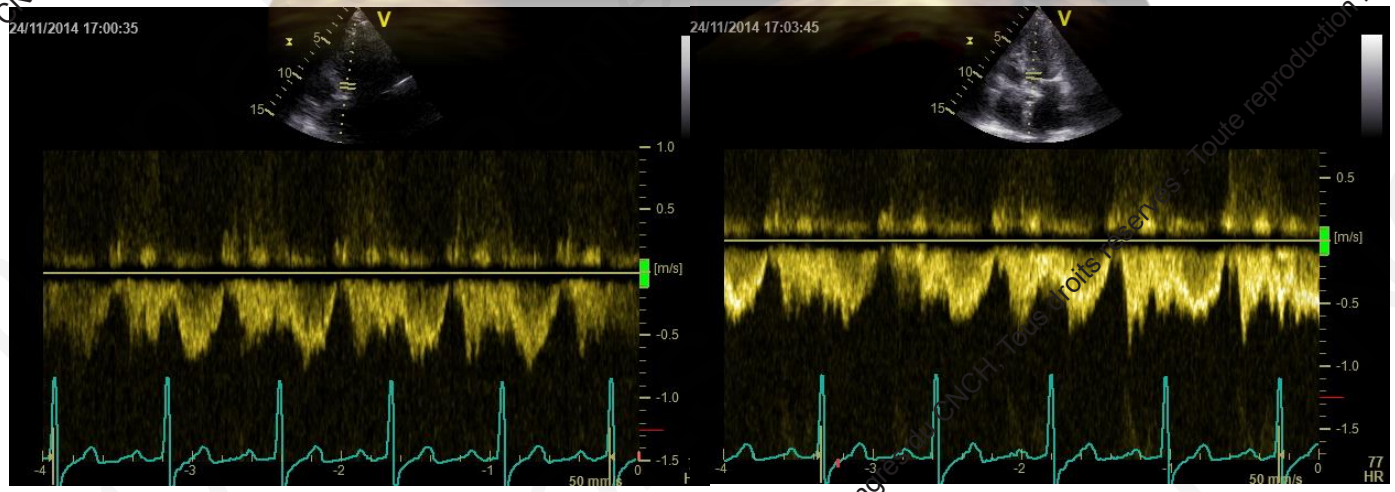
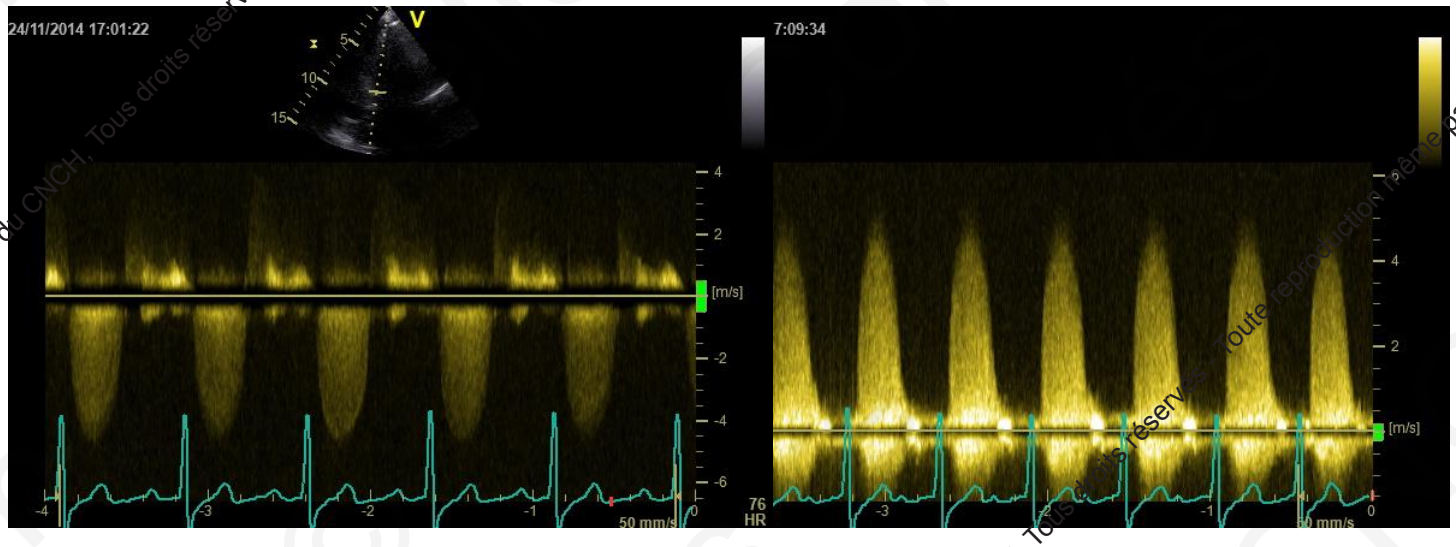
Assessment of the LVOT & its VTI

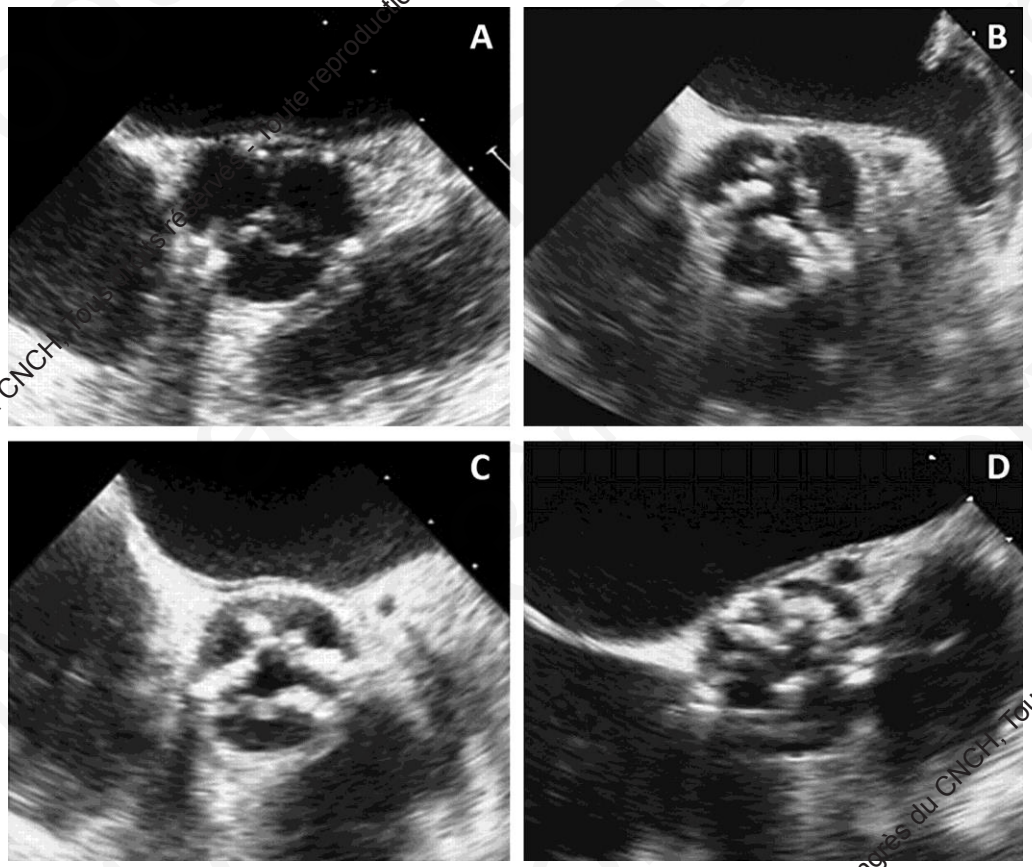




Assessment of trans Ao maximal velocity and gradient



Different degrees of aortic valve calcification assessed using a semi-quantitative score:



1= minimal (panel A),

2= mild (panel B),

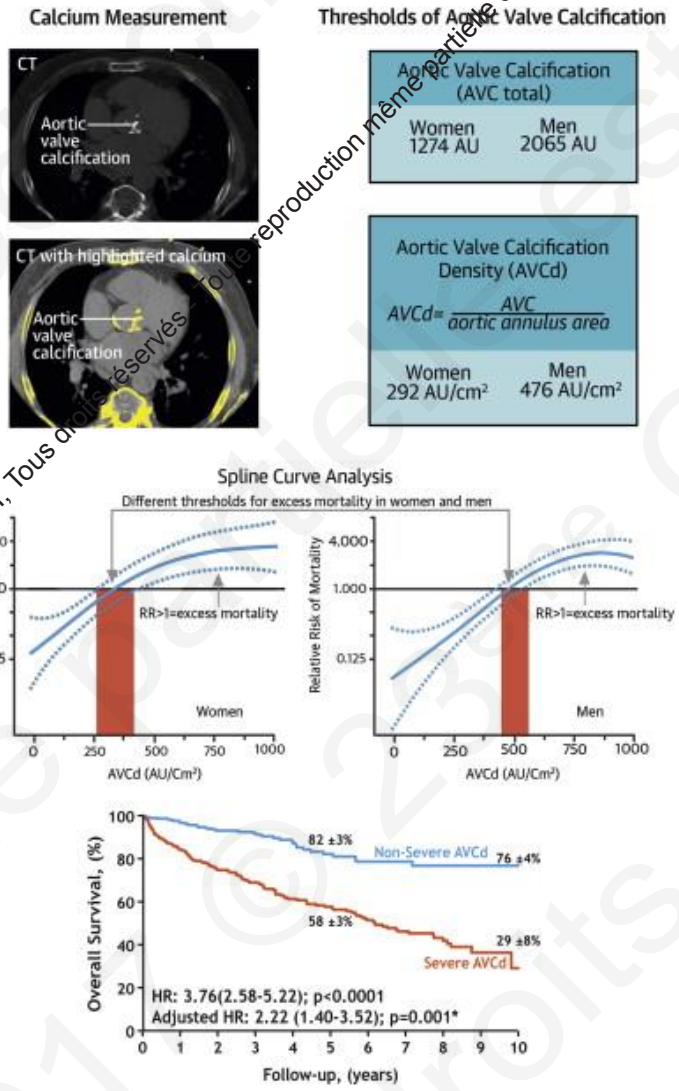
3= moderate (panel C),

4= severe calcifications (panel D).

Grigari P et al. Heart 2012;98:1229-1236

Impact of Aortic Valve Calcification, as Measured by MDCT, on Survival in Patients With Aortic Stenosis :

Results of an International Registry Study



Severe AVC ≥1,274 AU in women and ≥2,065 AU in men

Clavel et al. J Am Coll Cardiol 2014;64: 1202 - 1213

SAVR should be considered in asymptomatic patients with normal ejection fraction and none of the above-mentioned exercise test abnormalities if the surgical risk is low and one of the following findings is present: – very severe aortic stenosis defined by a V_{max} >5.5 m/s, – severe valve calcification and a rate of V_{max} progression ≥0.3m/s/year, – markedly elevated BNP levels (>threefold age- and sex-corrected normal range) confirmed by repeated measurements without other explanations, – severe pulmonary hypertension (systolic pulmonary artery pressure at rest >60 mmHg confirmed by invasive measurement) without other explanation.	IIa	C

- Calcium score by MSCT:
  - Severe aortic stenosis very likely: men ≥3000; women ≥1600,
  - Severe aortic stenosis likely: men ≥2000; women ≥1200,
  - Severe aortic stenosis unlikely: men <1600; women<800.

2017 ESC/EACTS Guidelines for the Management of Valvular Heart Disease (European Heart Journal 2017 - doi:10.1093/eurheartj/ehx391)

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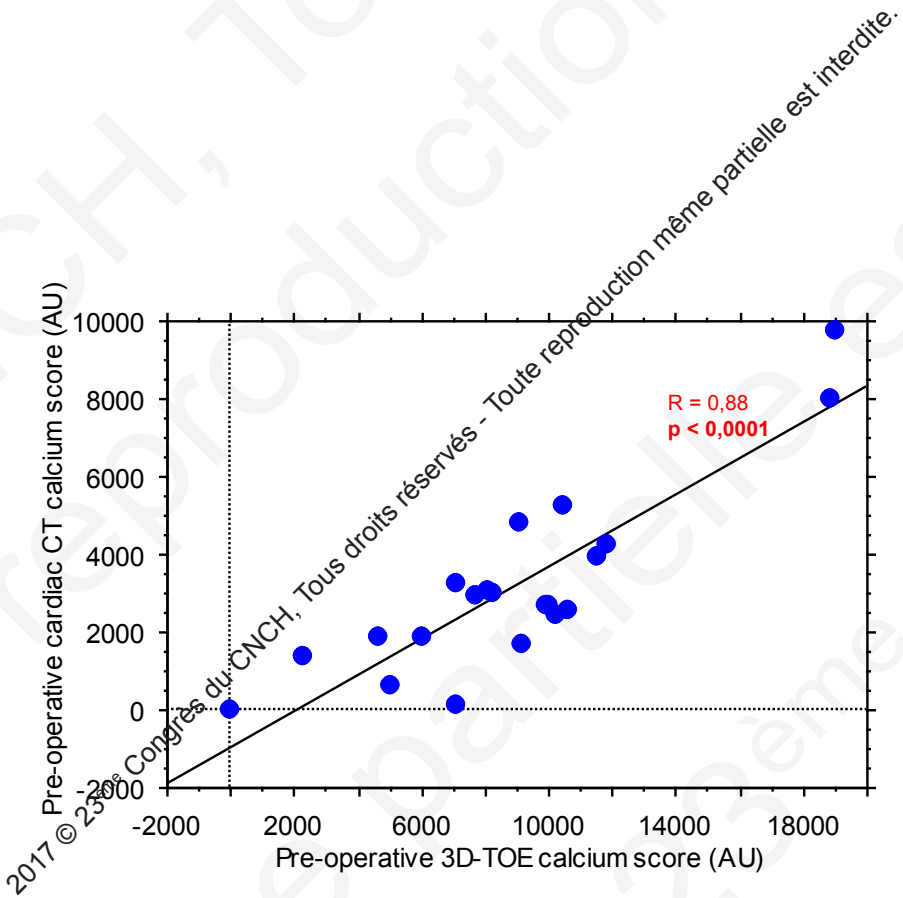
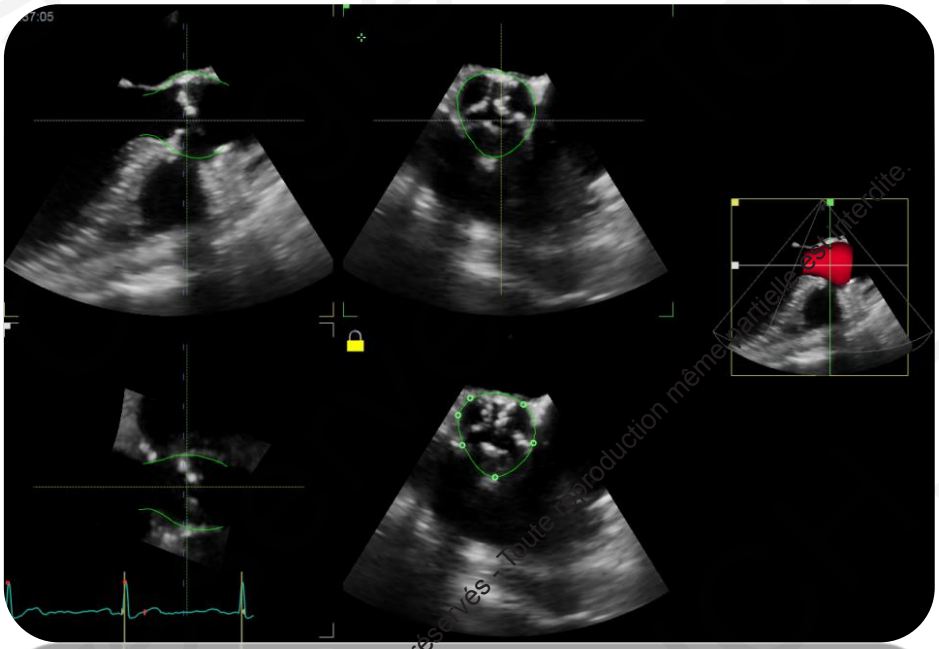
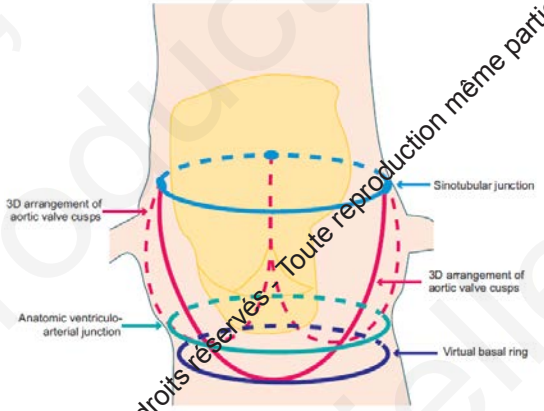


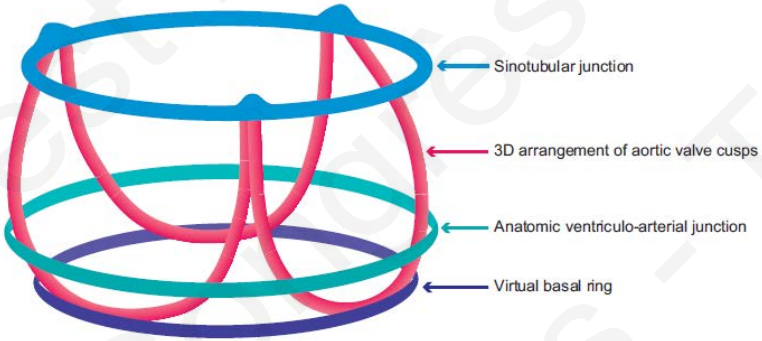
Regression plot for the correlation between pre-operative 3D-TOE calcium score and pre-operative cardiac CT calcium score.

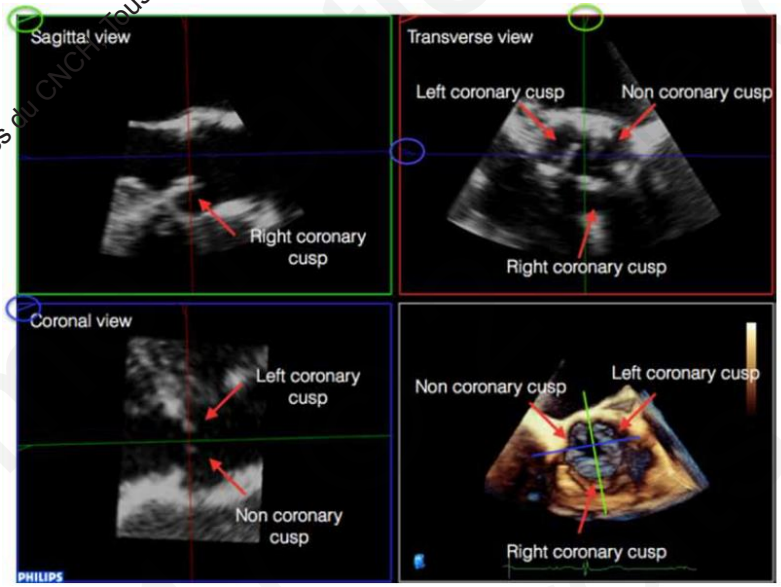


EchoPAC® (GE Healthcare®) processing view. The green lines are the automatic segmentation of the aortic annulus and can be manually adjusted.

Courtesy to P Lim







KEY Importance of the LVOT
KEY importance of the stroke volume

Also
Key Importance of the diagnosis of bicuspid valves and very asymmetric calcifications

echoresearch and practice | C Bleakley and others | 3D TOE in TAVI sizing | ID: 16-0041; March 2017 DOI: 10.1530/ERP-16-0041

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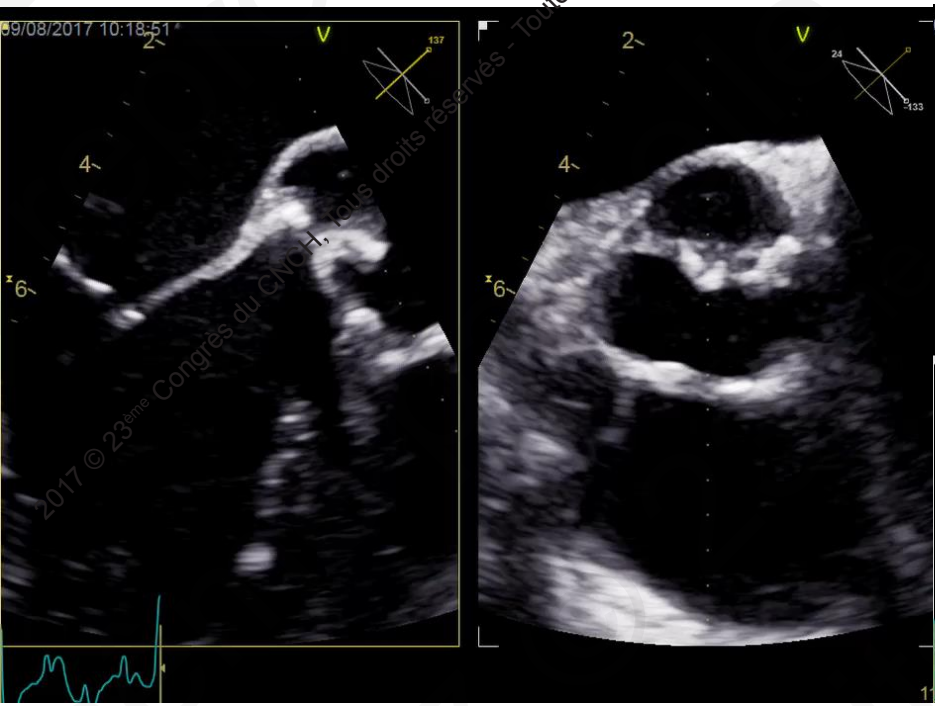
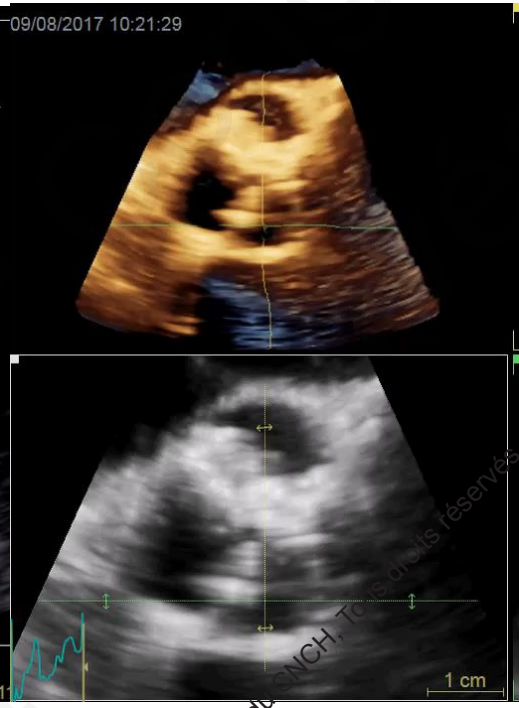
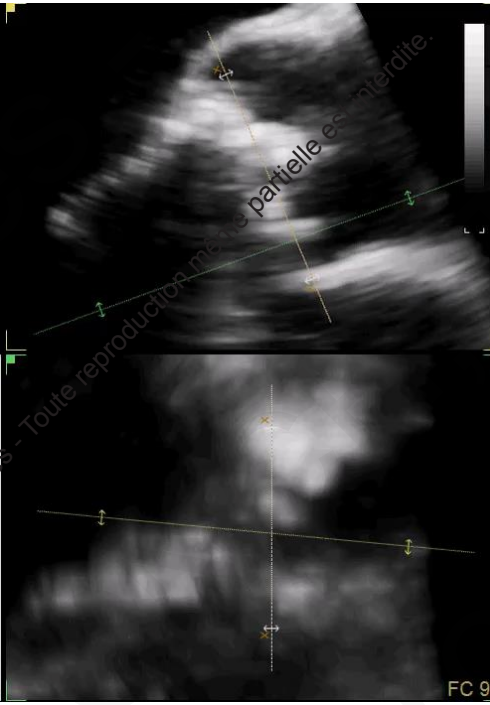
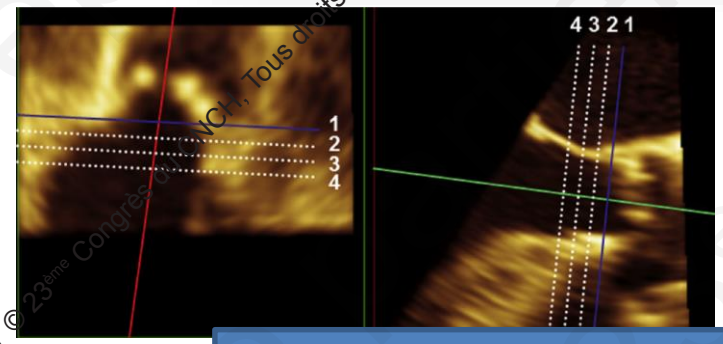






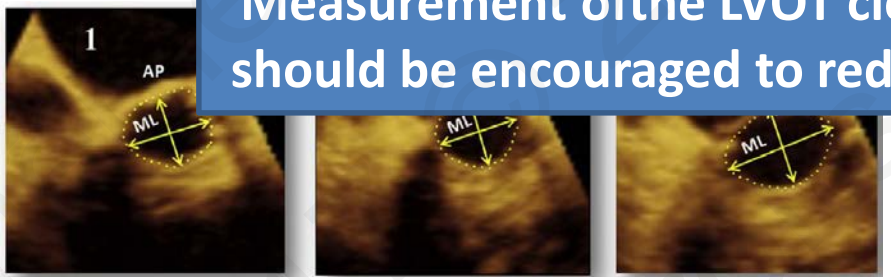
Three-Dimensional Morphology of the Left Ventricular Outflow Tract: Impact on Grading Aortic Stenosis Severity

Luis Caballero, MD, PhD, Daniel Saura, MD, PhD, María José Oliva-Sandoval, MD, PhD, Josefa González-Carrillo, MD, PhD, María Dolores Espinosa, MD, Miguel García-Navarro, MD, PhD, Mariano Valdés, MD, PhD, Patrizio Lancellotti, MD, PhD, and Gonzalo de la Morena, MD, PhD, *Murcia, Spain; Liège, Belgium; and Lugo, Italy*



1) **A large portion of AS patients have funnel-shaped and elliptical LVOTs,**
2) **This is more pronounced in the region farther from the annular plane.**
3) **2D LVOT measurement closer to the annular plane has the best correlation with 3D measurements.**

Measurement ofthe LVOT closer to the annular plane should be encouraged to reduce measurement errors.



(J Am Soc Echocardiogr 2017;30:28-35

Take home messages

Percutaneous Approaches are part of the treatments available for the Heart Team : **THINK about these new approaches !**

Potential candidate have to be referred to a heart team (imaging, interventionist, surgeon, anesthesiologist)

Echo is specific and has to include a real 3D in TTE and **TOE+++ and Standardisation.**

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