Amicale des Cardiologues de la Côte d'Azur

A.C.C.A.

La sténose aortique: situations complexes

F Levy

9 janvier 2024

Nice

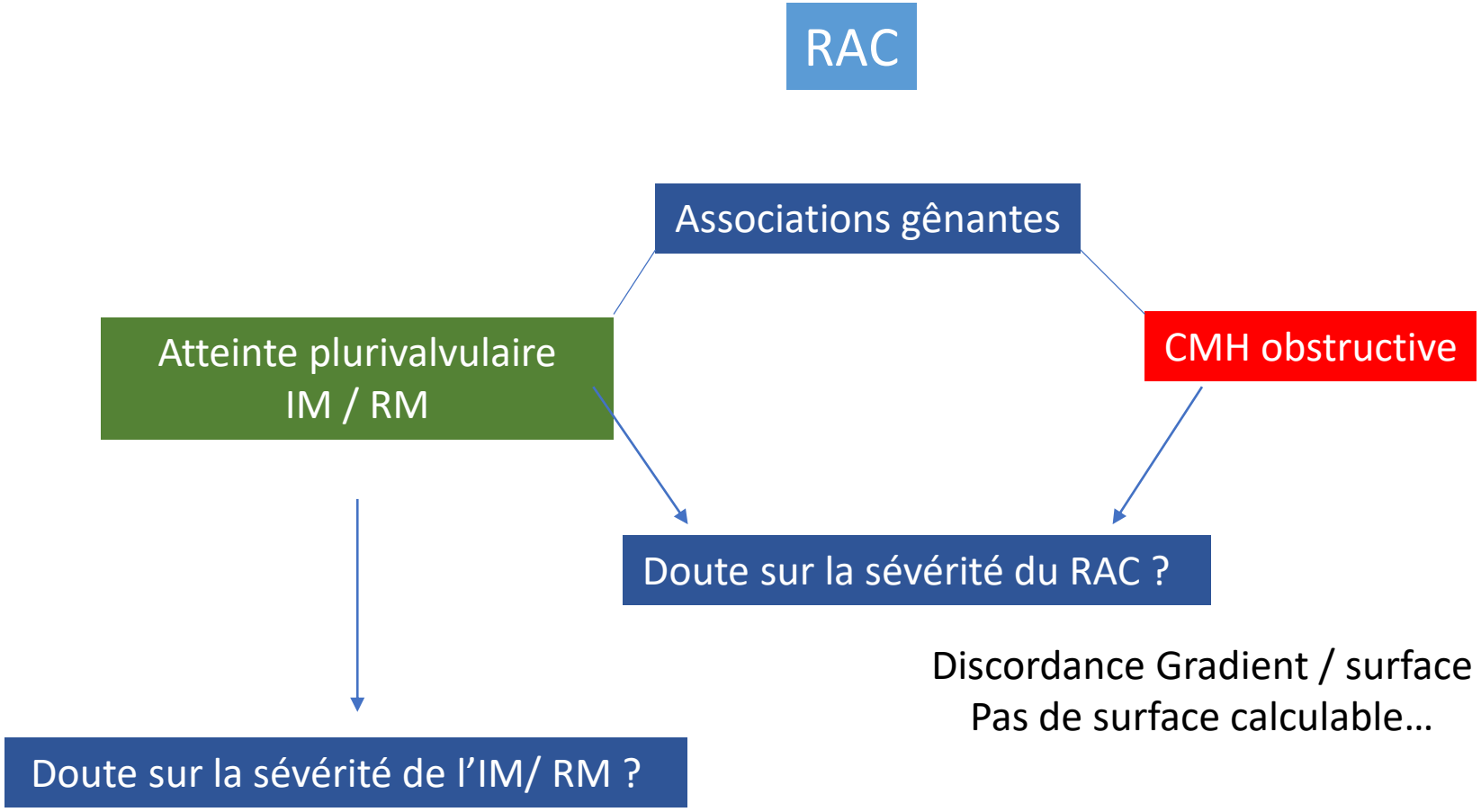
Objectifs pédagogiques 9 janvier 2024

- Connaitre la problématique des associations de valvulopathies
- Evaluation du RAC en situation hémodynamique complexe
- Mieux connaitre la problématique des calcifications mitrales
- Connaitre les stratégies de prise en charge

  (chir vs percutané, par étape ou complète…)
- Connaitre le déroulement d'une procédure de TAVI en 2023

A.C.C.A.

Situations complexes?



Atteinte plurivalvulaire

- Situation complexe (diagnostic / thérapeutique)

- Fréquente
  - 20% des valvulopathies sur valve native
  - 15% des patients opérés d'une chir valvulaire (Euroheart Survey)

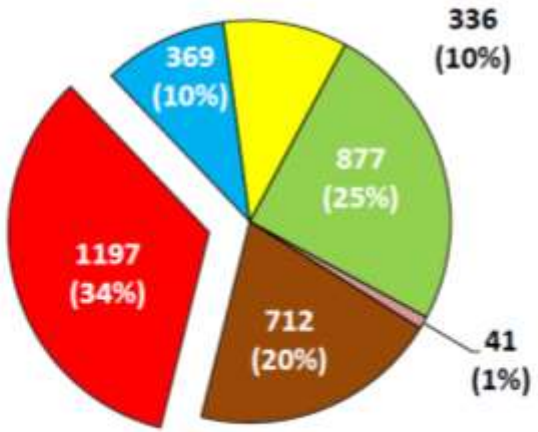
- Combinaison
  - Sténose + Fuite
  - valvulopathies primaires et secondaires

  ➔ Situations hémodynamiques/ echo complexes

Distribution of Native Valve Disease

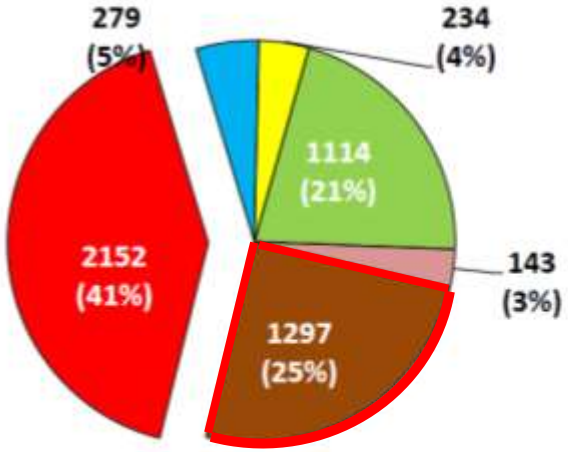
Euro Heart Survey (2001)

Native valve disease 5219 (72%)



VHD II (2017)

3532 (72%)



RAC 34% → 41%

MVD 20% → 25%

Aortic stenosis | Aortic regurgitation | Mitral stenosis | Mitral regurgitation | Isolated right-sided | Multiple left-sided

Euro heart survey II ESC 2018

Distribution des MVD

Valvulopathie Aortique + mitrale surtout

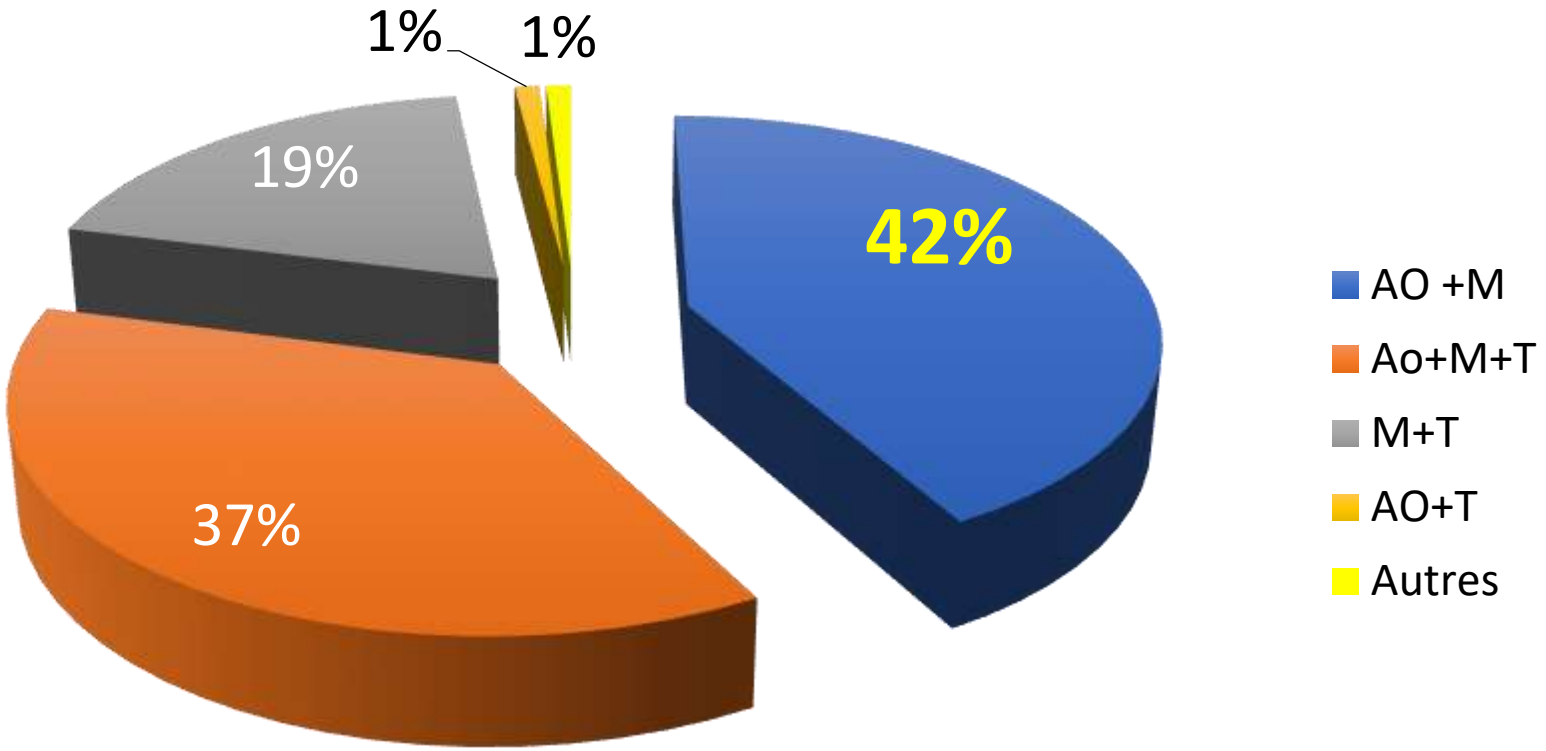


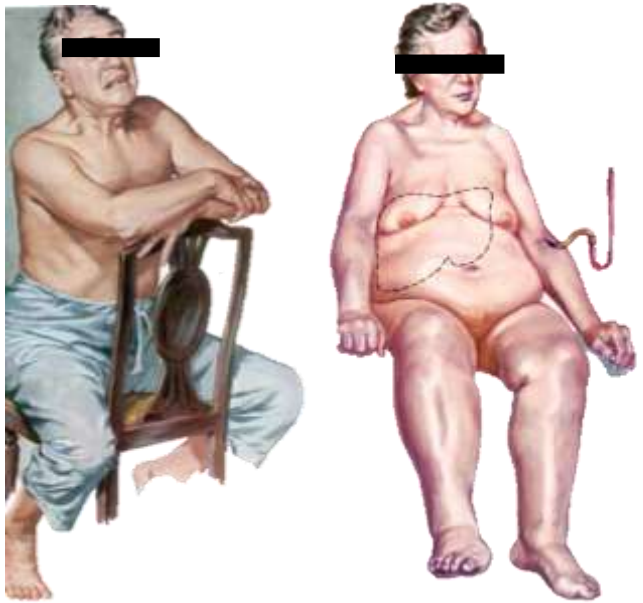
Tableau clinique

- Effet combiné de chacune des valvulopathies.

- Signes en amont de la lésion dominante

  ex: IM/RM + IT: signes droits ++

  RM + Iao: FA, Oap, hemoptysie, embole



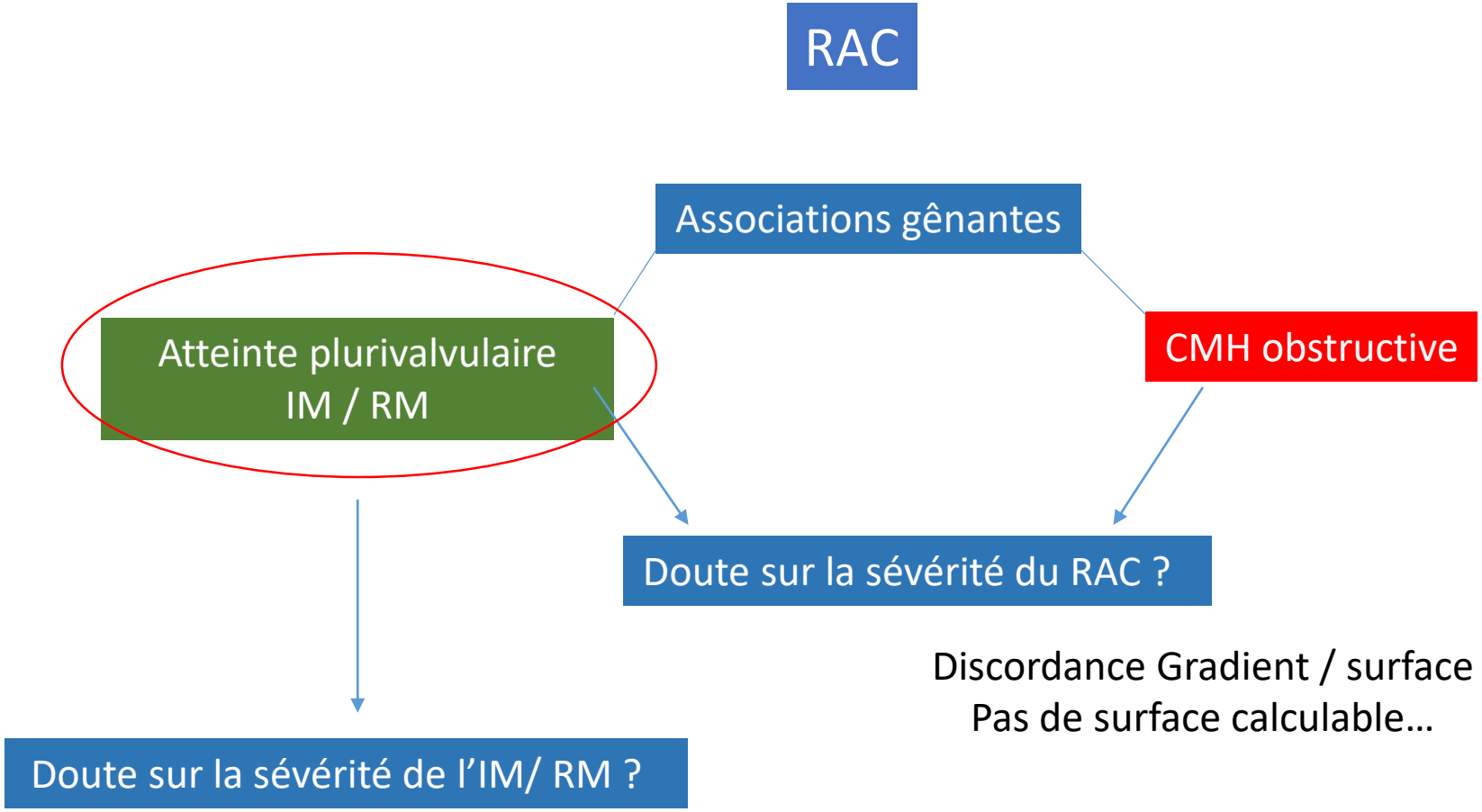
Evaluation

- Echocardiography is the preferred method.

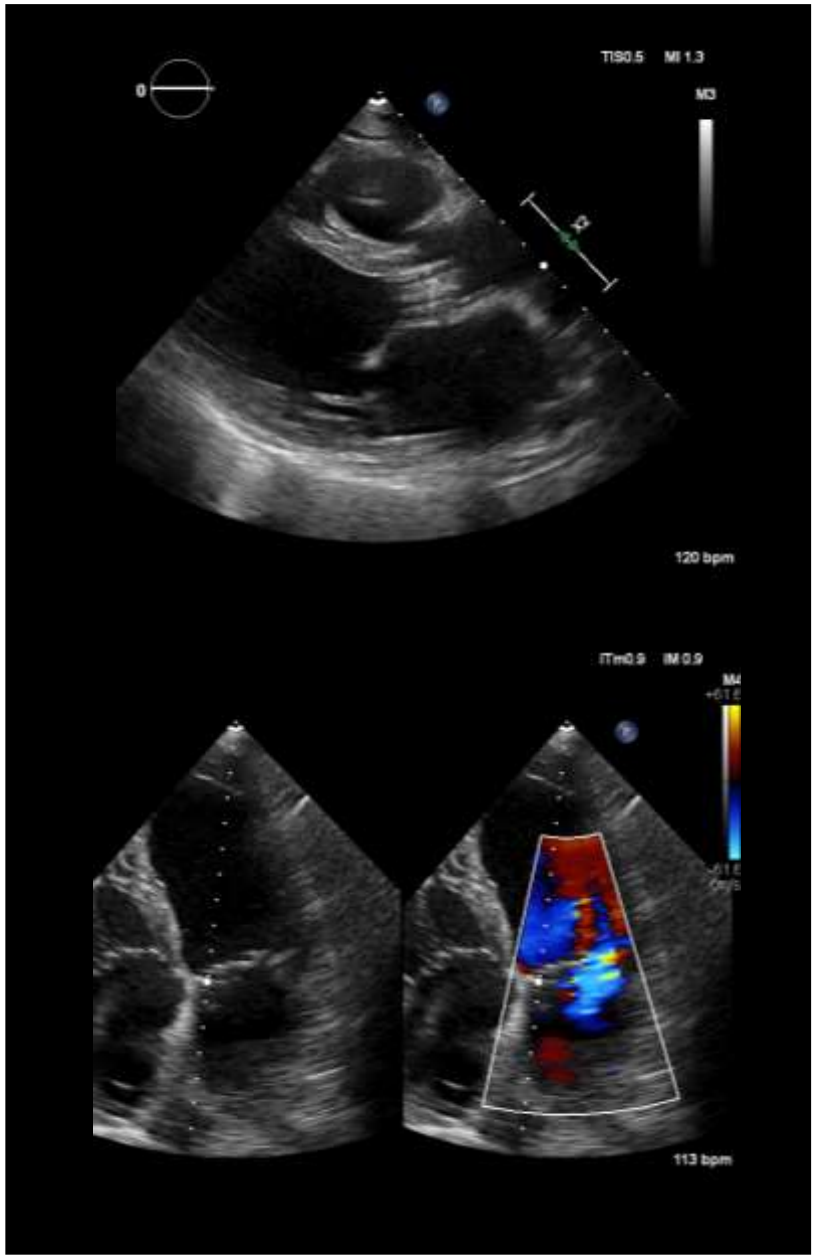
- Pitfalls and limitations
  - Haemodynamic interactions between valve lesions
  - Indices validated in single-valve disease

- Indices less dependant on loading conditions
  - Direct planimetry, ERO, VC

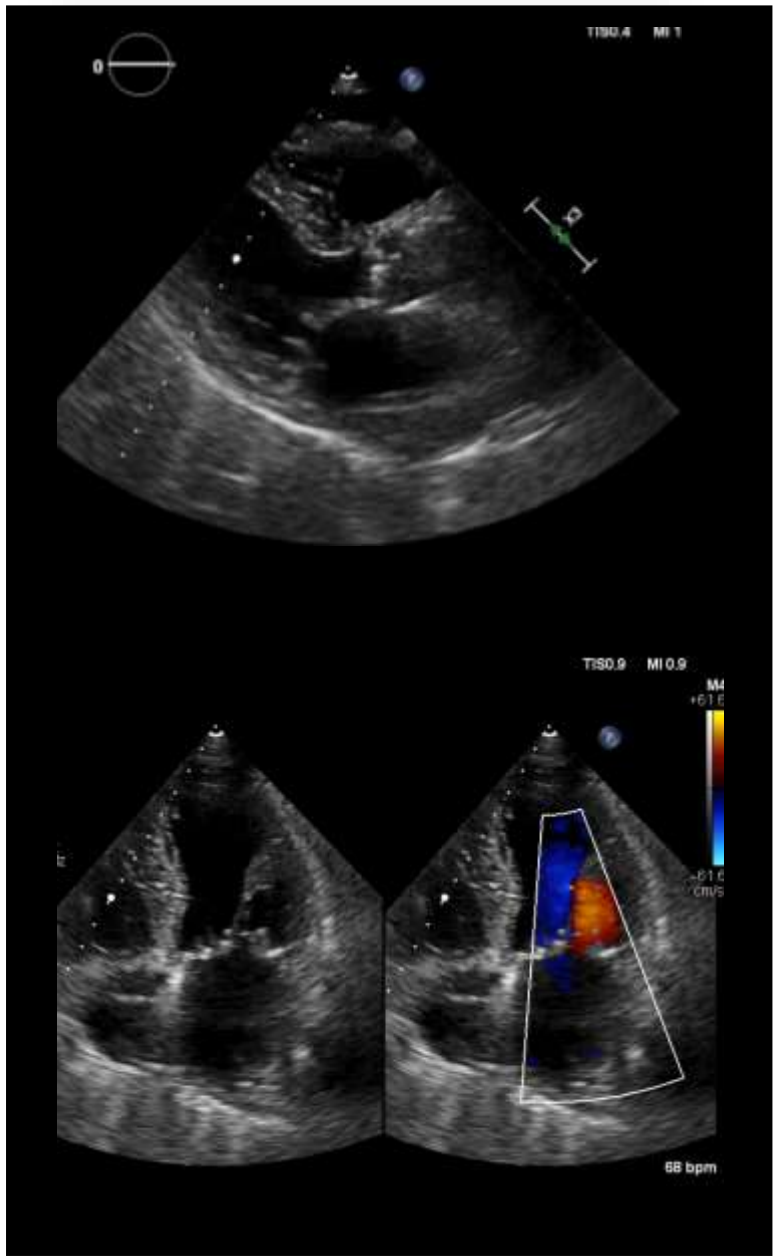
Situations complexes?



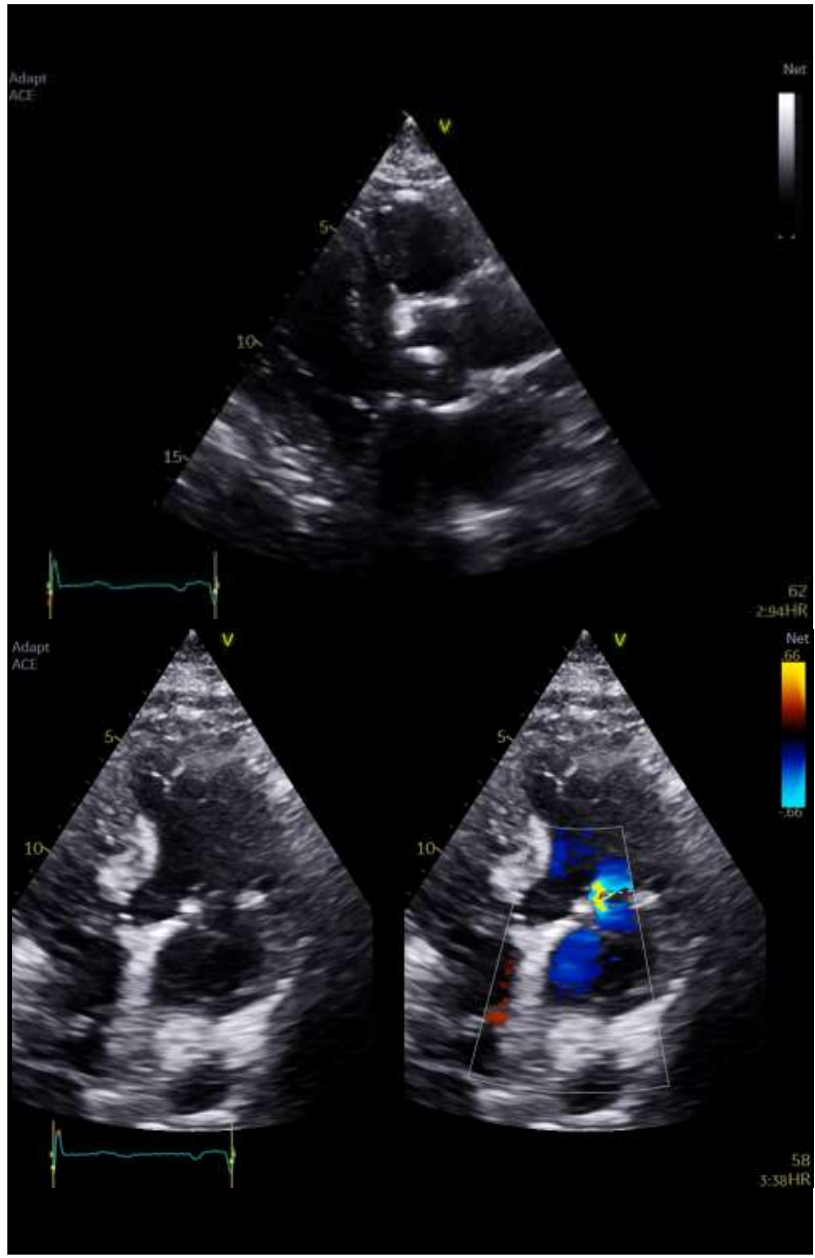
1


TIS0.5 MI 1.3
120 bpm
113 bpm

2

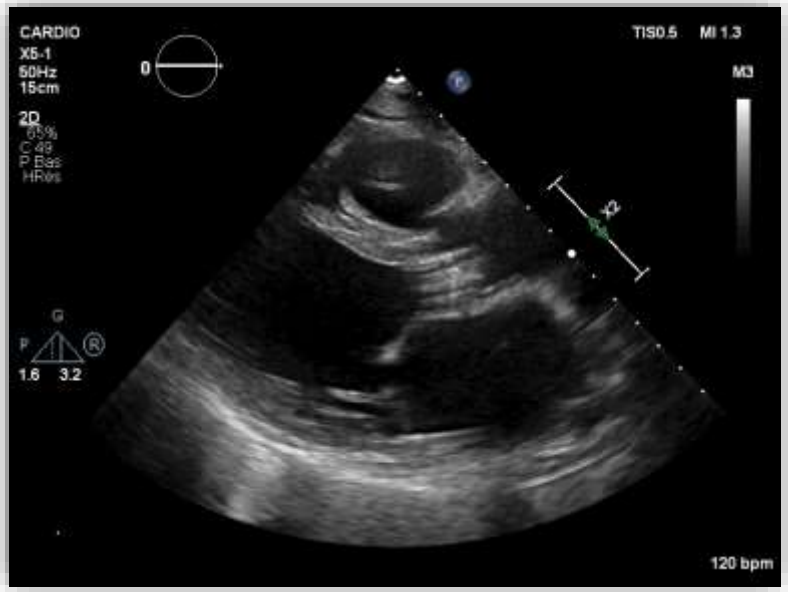

TIS0.9 MI 0.9
68 bpm

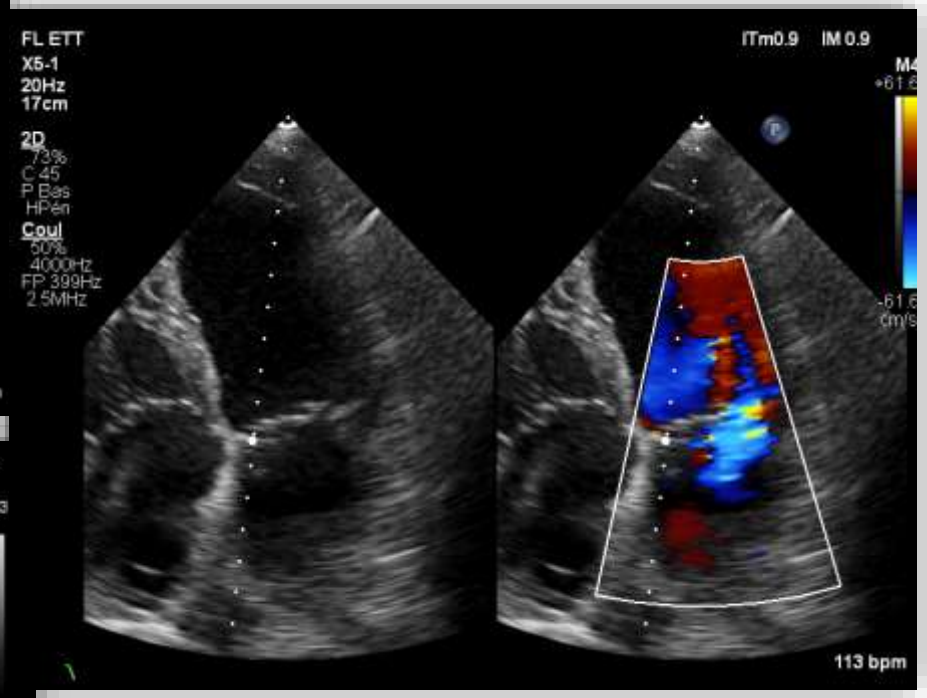
3

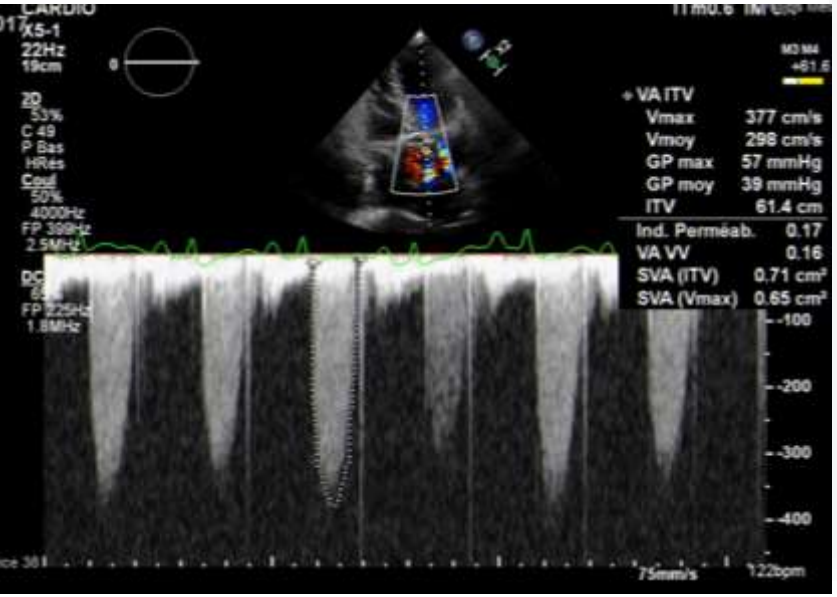

Adapt
ACE
Net
62
2:94HR
58
3:58HR

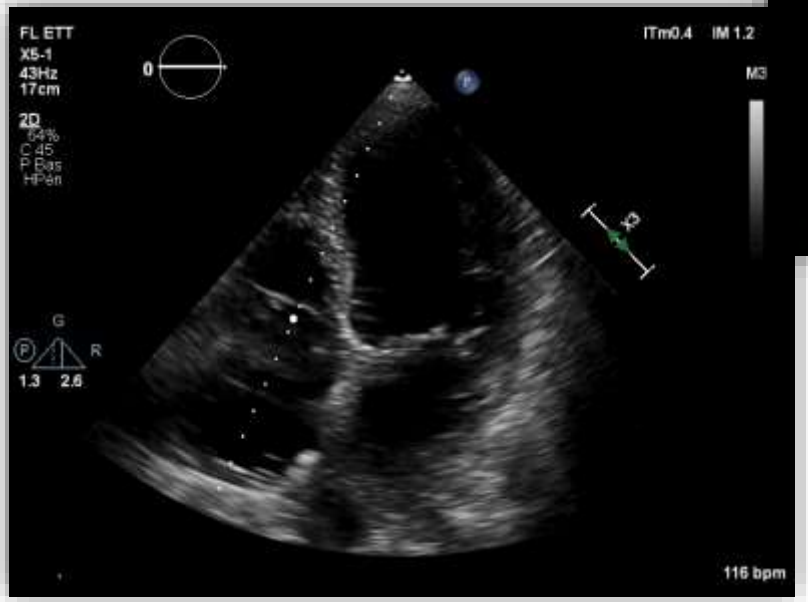
Cas clinique 1

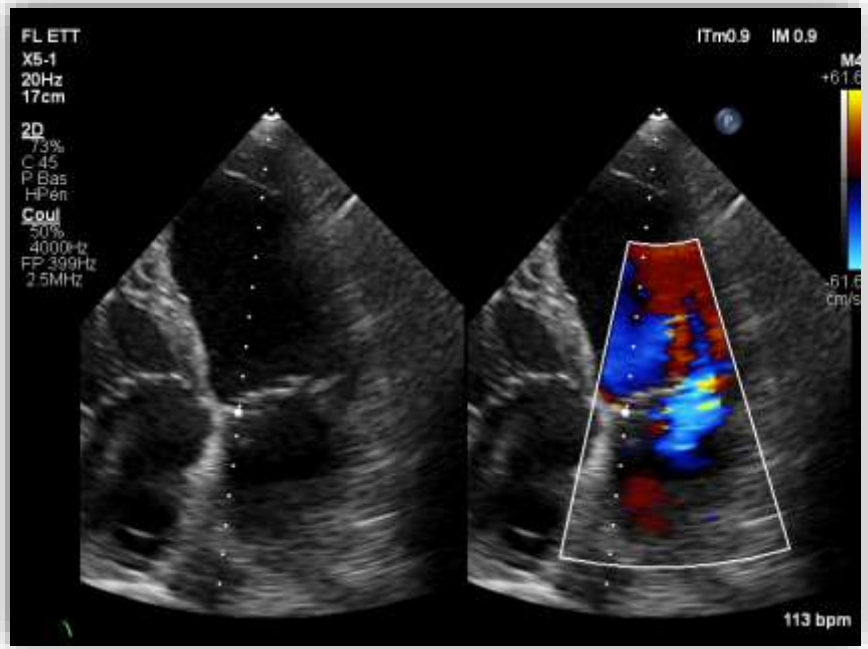
Patiente de 82 ans porteuse d'un RAC, refus de rva depuis 5ans

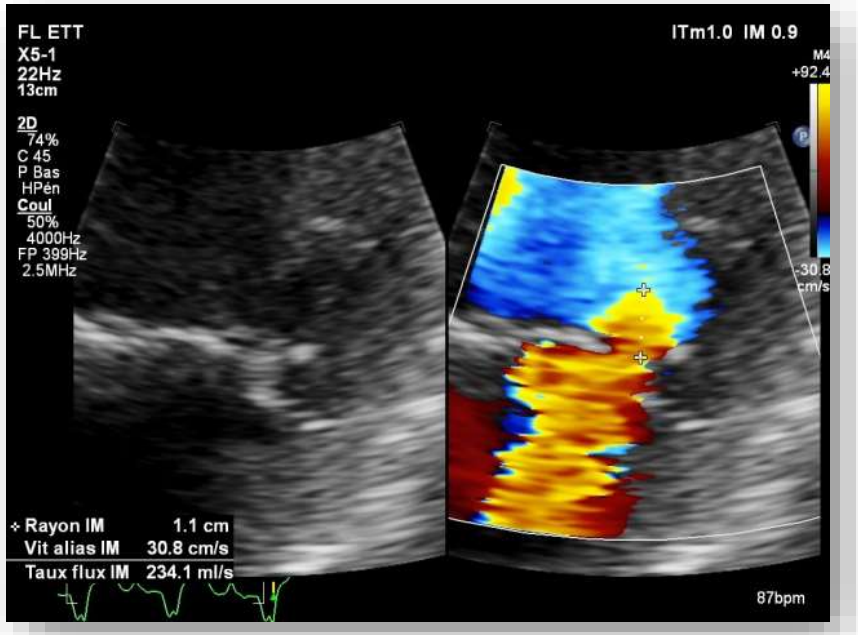




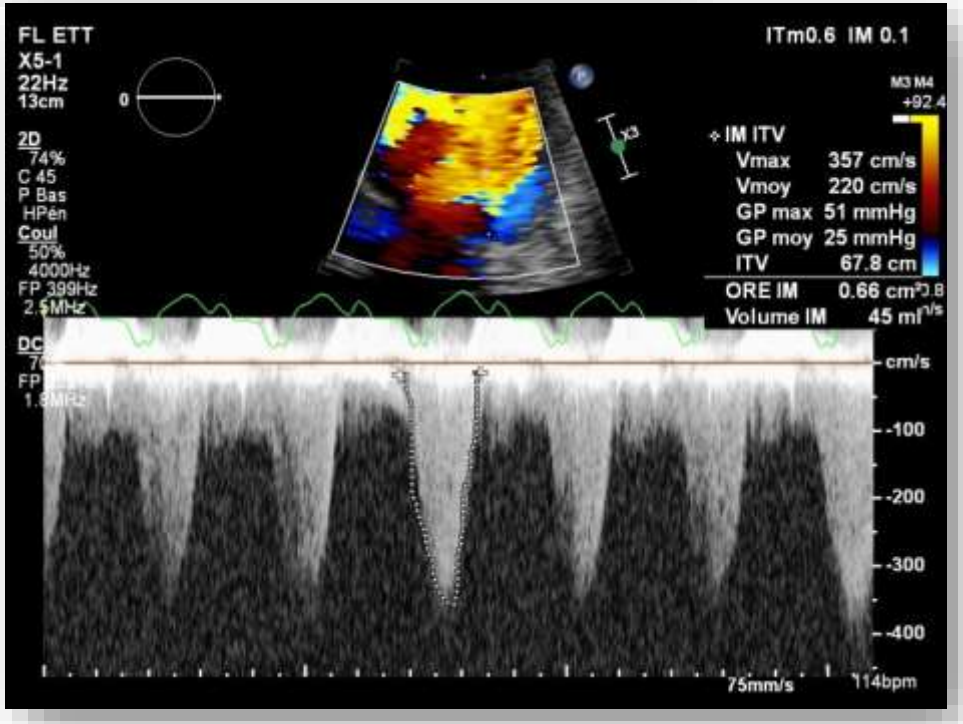






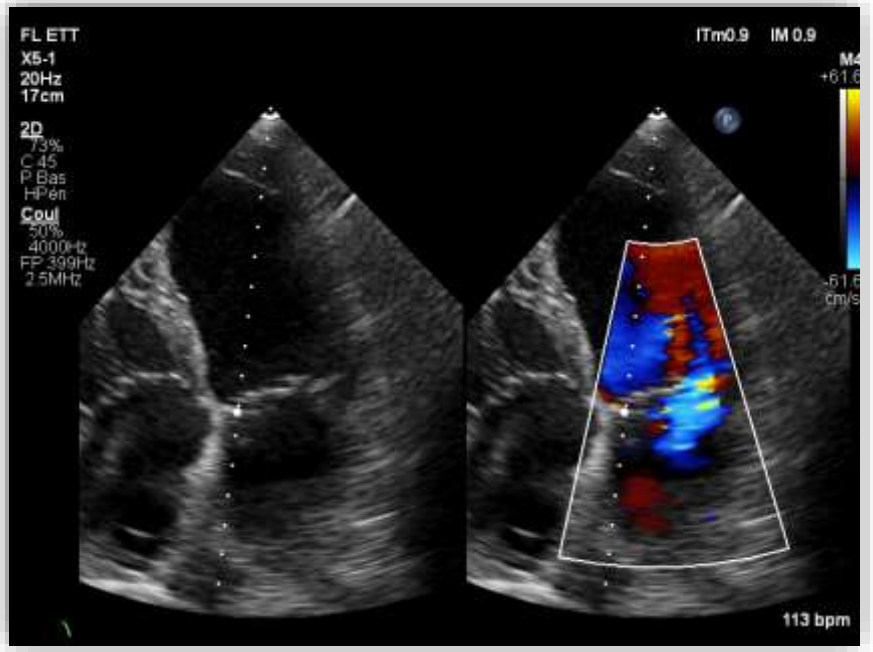


SOR 0,6cm²
V max 3,7m/s



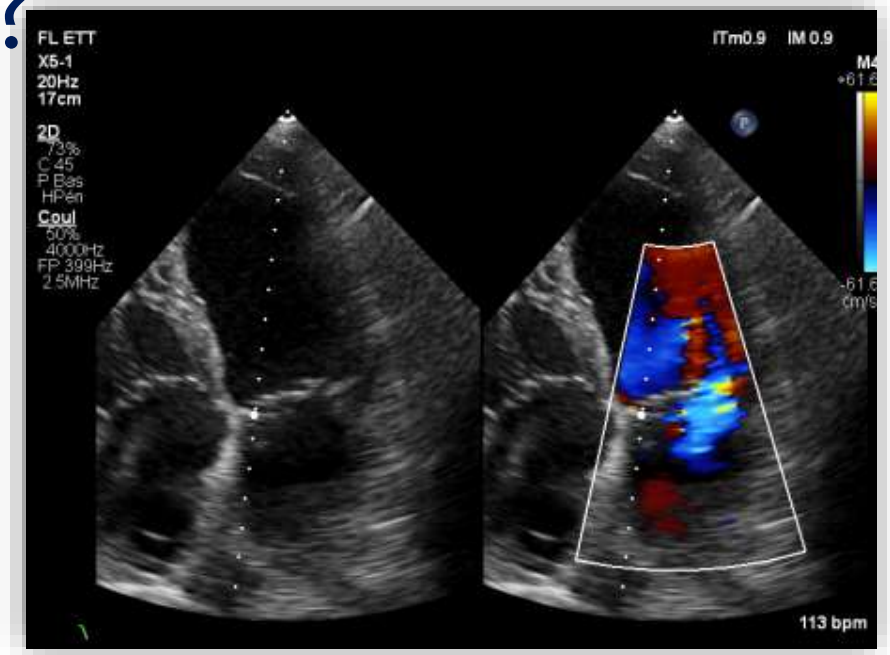
Que pensez-vous de cette IM?

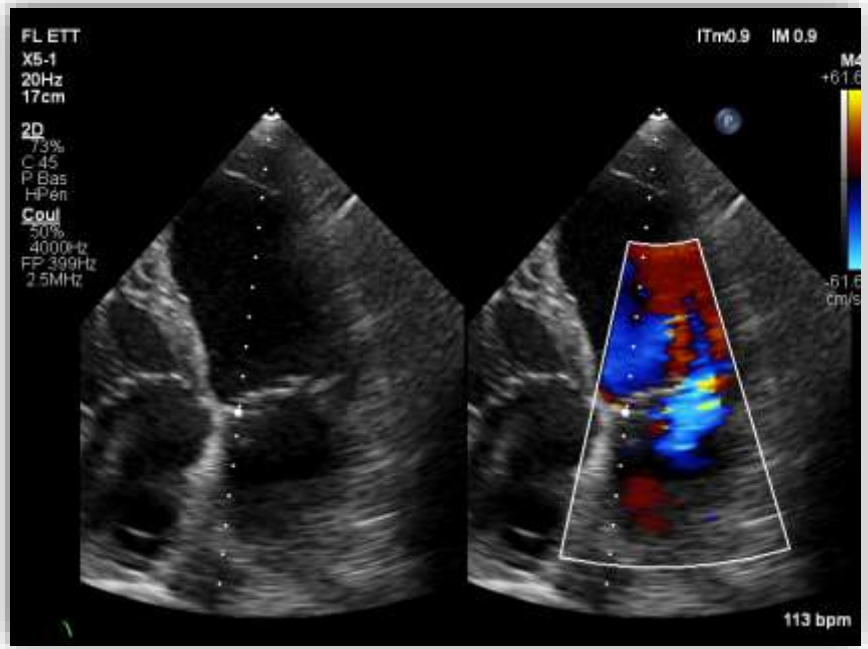
- Mecanisme ?
- IM sévère ou non ?
- Que faire ?



Que pensez vous de cette IM?

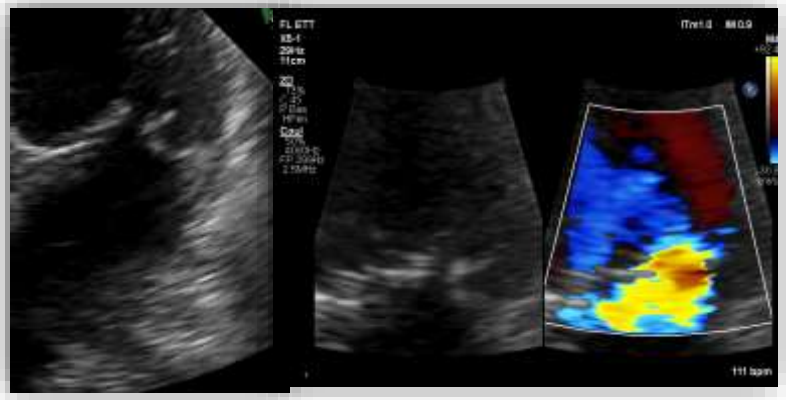
- secondaire
- IM sévère
- A réévaluer après traitement diurétique



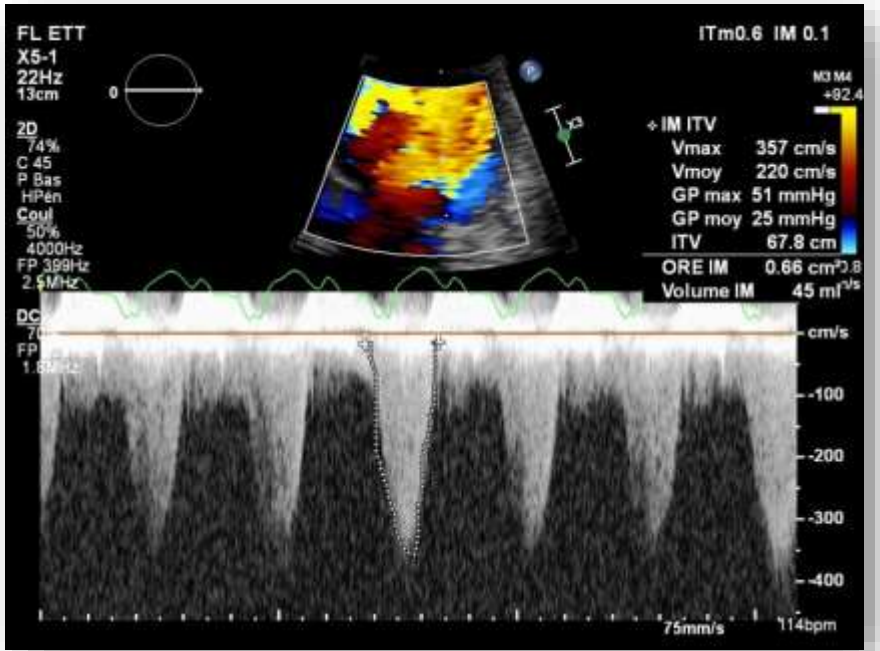


OAP

Sous dobutamine/ lasilix



SOR 0,6cm²
V max 3,7m/s



Déterminants hémodynamiques des IM

Vol Reg = SOR anat x Cd x Gdtmoy x T

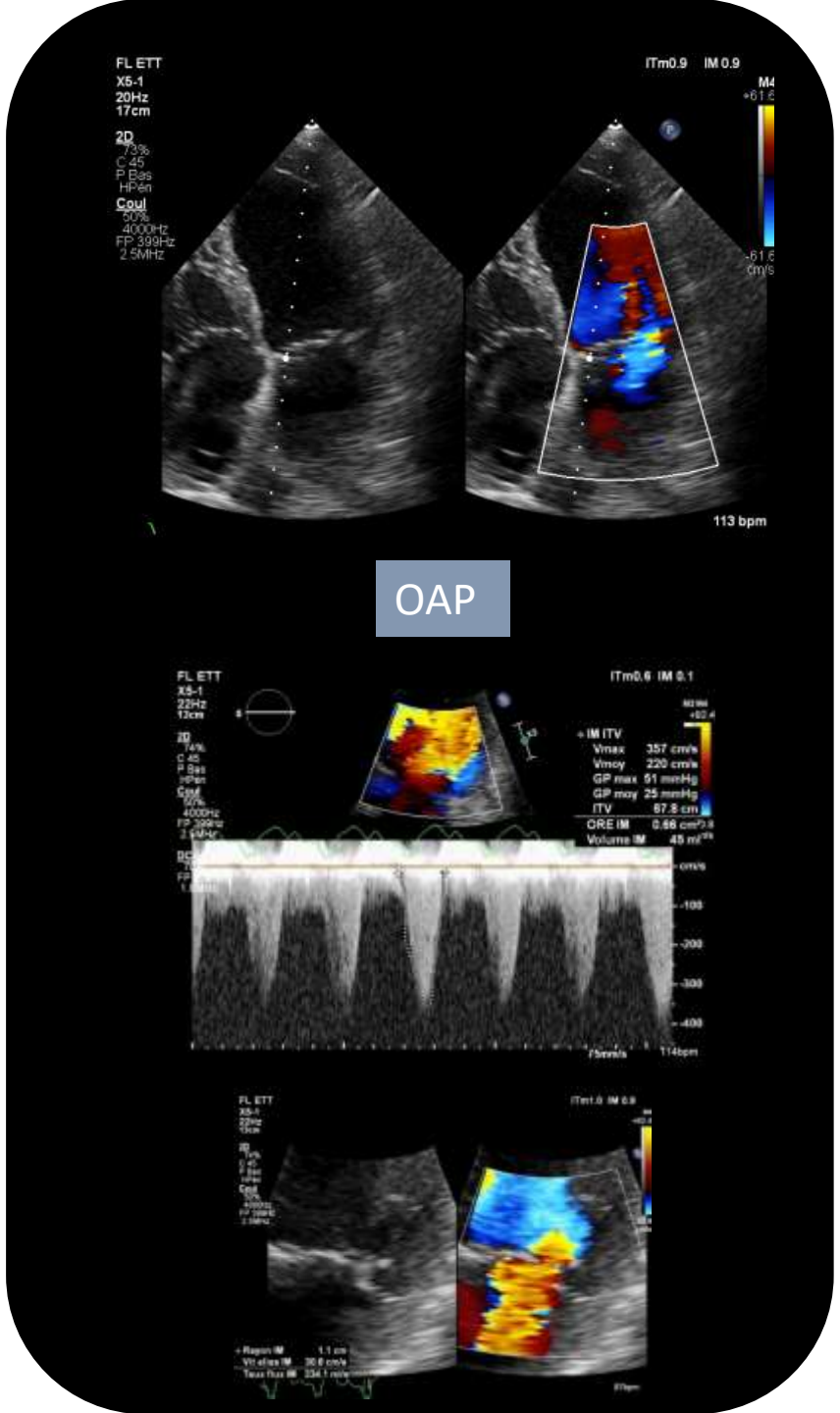
- SORanat: déterminant fondamental de l'importance de l'IM
  - +/- dynamique et charge dépendant
  - Orifice fixe dans le RAA, les calcifications sévères ; diminue en mésosystole dans les fonctionnelles, augmente en mésotélésystole dans les prolapsus...

- Cd: coefficient de contraction du flux, passage à travers l'orifice anat, dépend de la géométrie, du flux, de la viscosité ; en général entre 0,80 et 0,85
  - SOR effective 15 à 20% plus petite que SOR anatomique

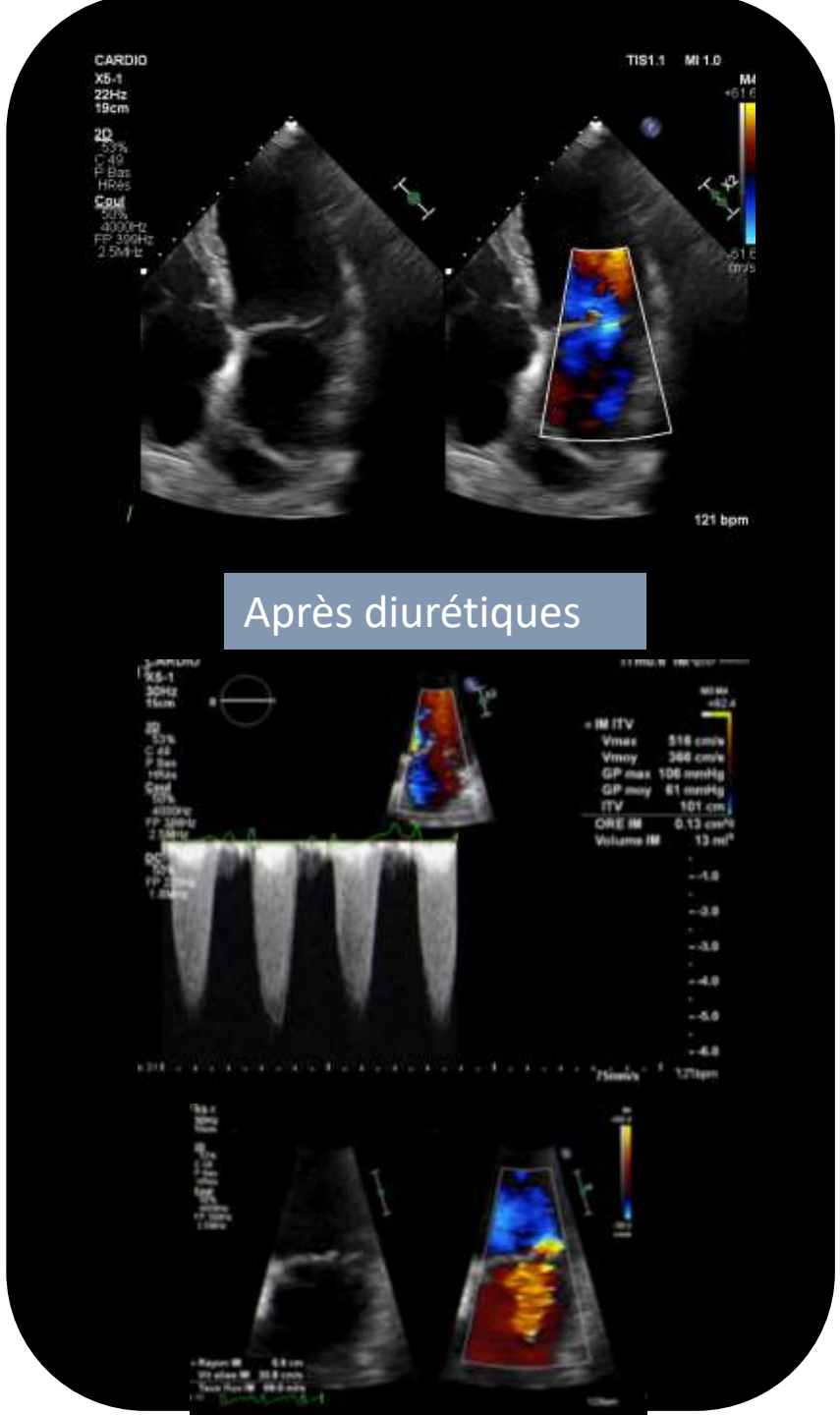
- Gdt moyen systolique: déterminant de la sévérité, surtout pour les valeurs extrêmes de Pression Artérielle ; PA à mesurer pendant écho
- Pour l'IM, PVGsyst-POGsyst

- T: durée de la fuite, important dans les prolapsus avec fuite mésotélésystolique

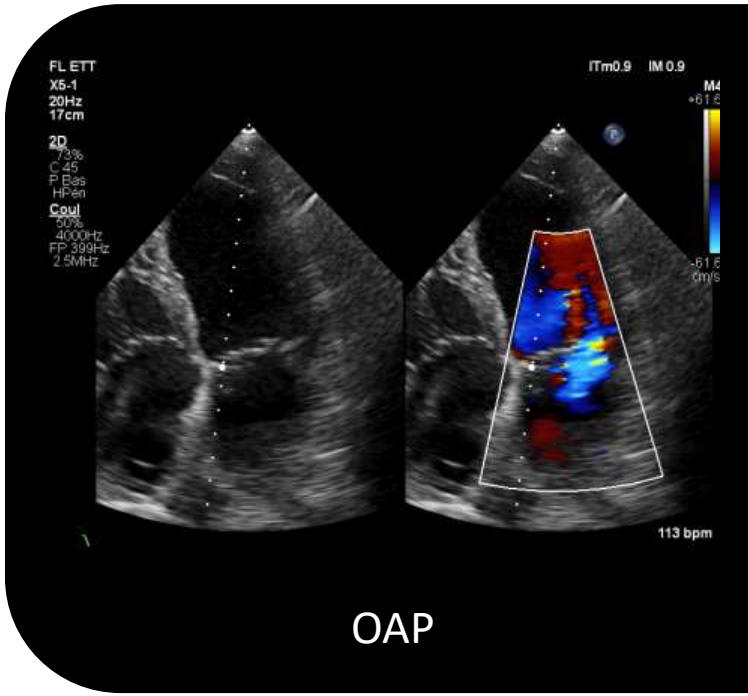
Grayburn PA Circulation 2012;126:2005



OAP



Après diurétiques



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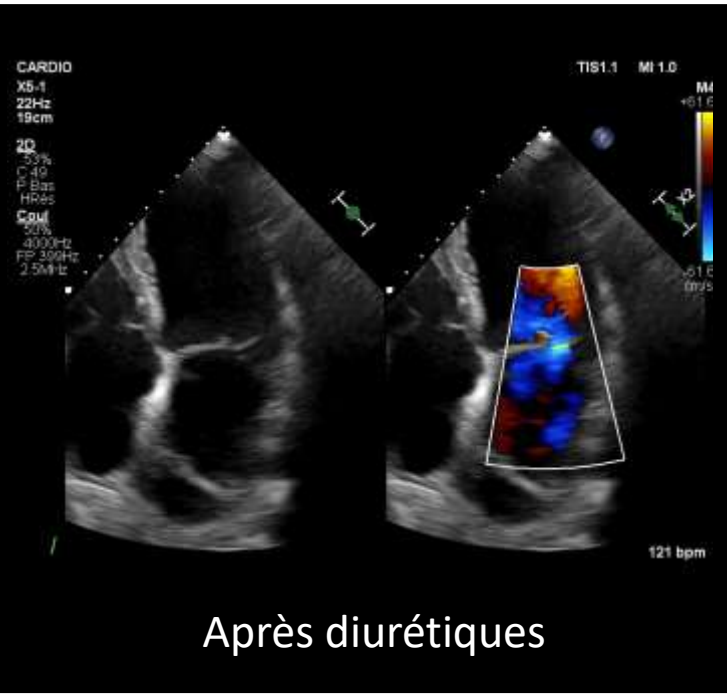
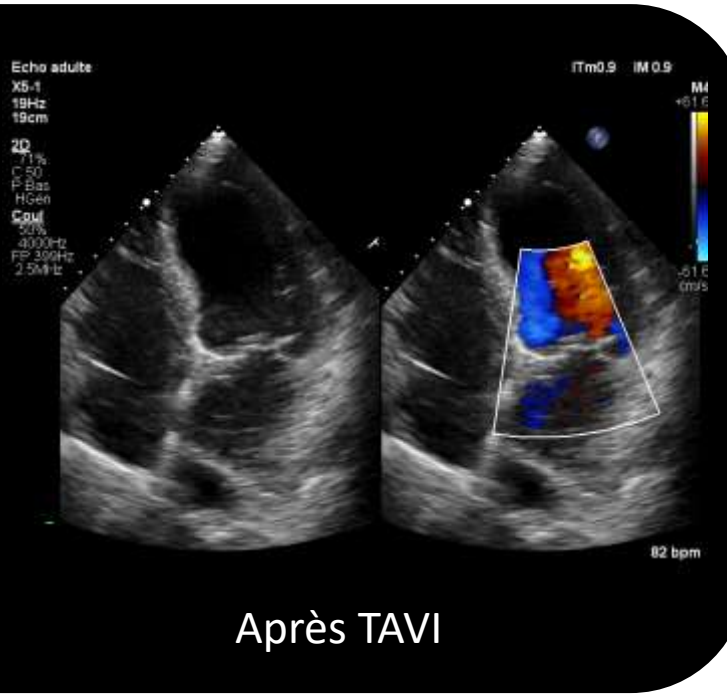
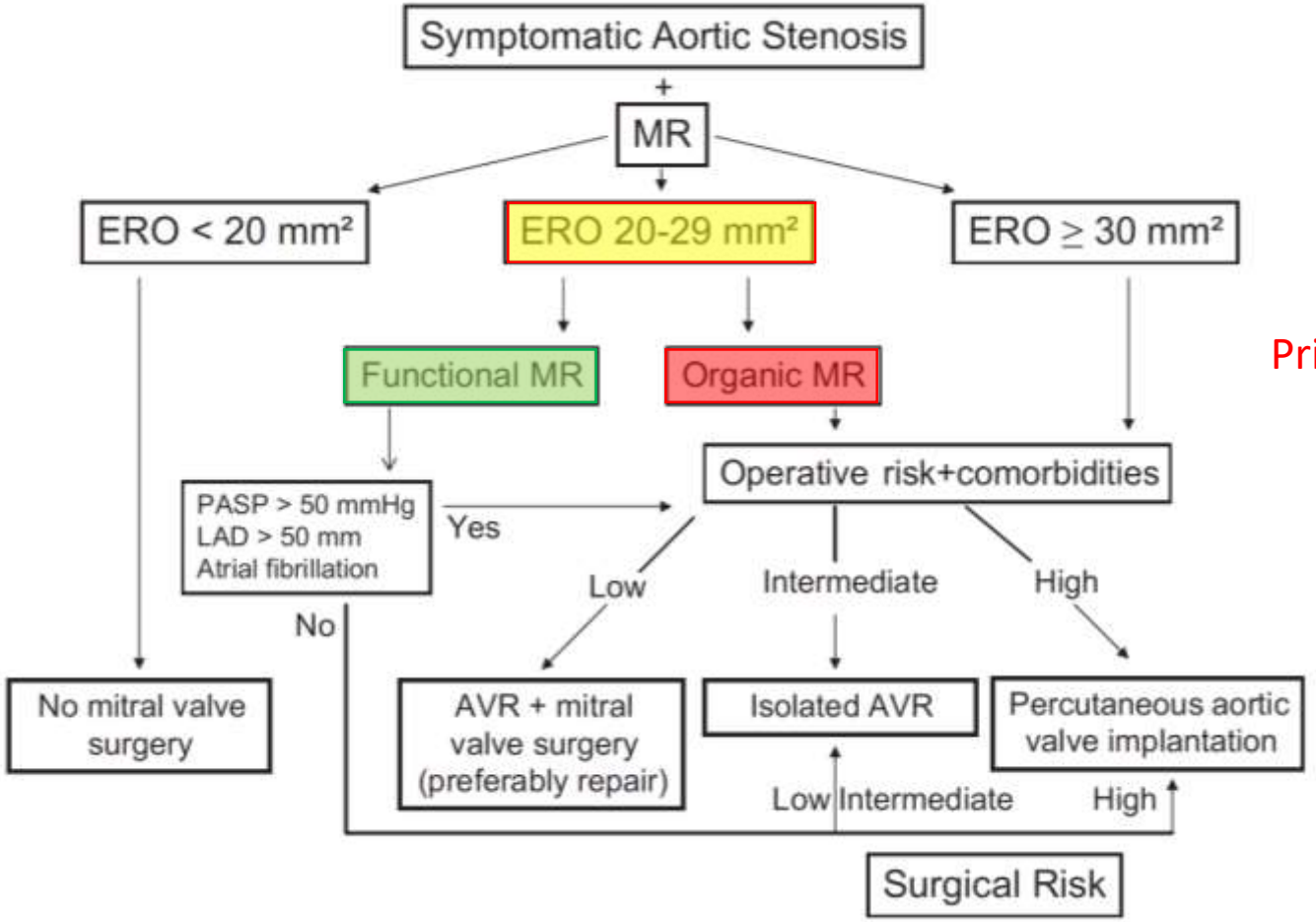


Après diurétiques



Après TAVI

RAC +IM



SOR ?

Primaire ou secondaire?

Unger et al

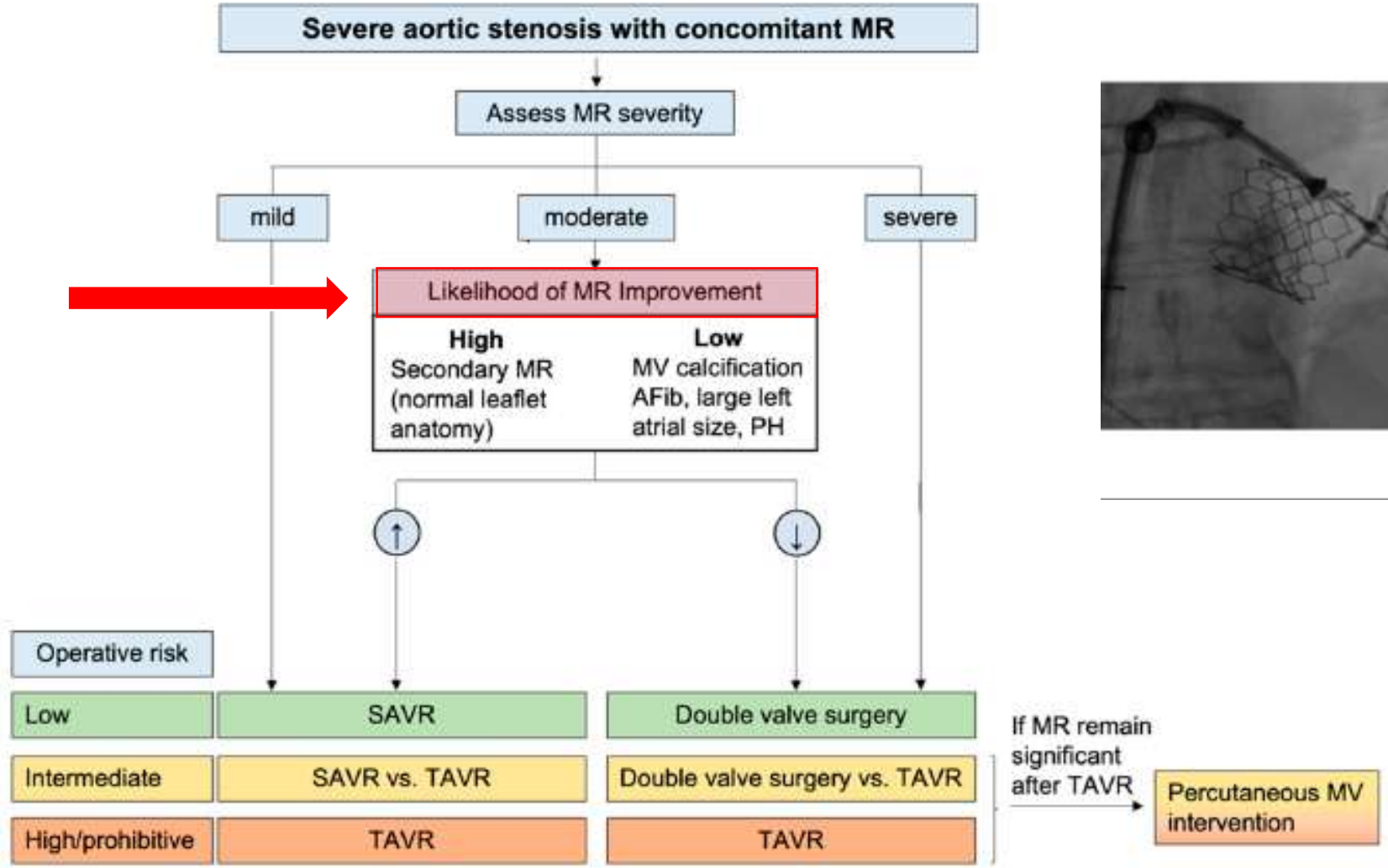


Figure 3. Proposed algorithm for the management of severe aortic stenosis with concomitant mitral regurgitation. MR—mitral regurgitation; MV: mitral valve; AF: atrial fibrillation; PH: pulmonary hypertension; SAVR: surgical aortic valve replacement; TAVR: transcatheter aortic valve replacement. Adapted from Unger 2016 and Kiriyama 2022 [85,86].

Sévérité de l'IM secondaire

Difficile

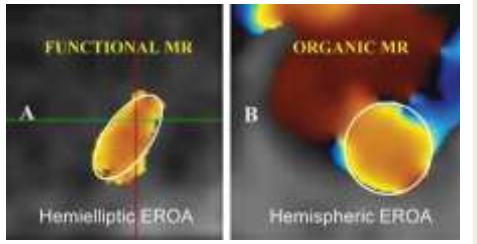
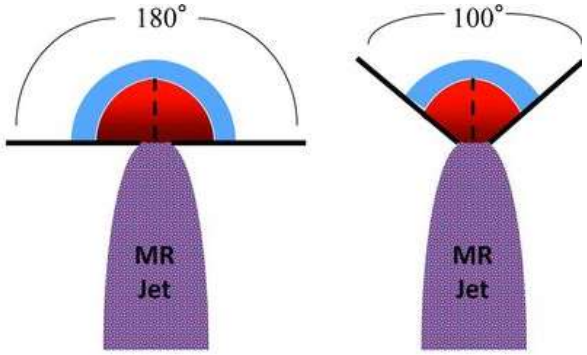
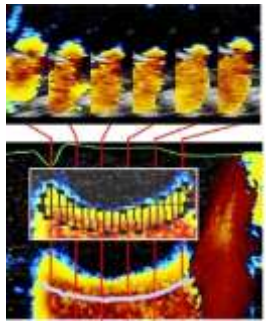


Figure 23 3D shape of the flow convergence in functional (*A*) (hemielliptic) and organic mitral regurgitation (*B*) (hemispheric).





Variable

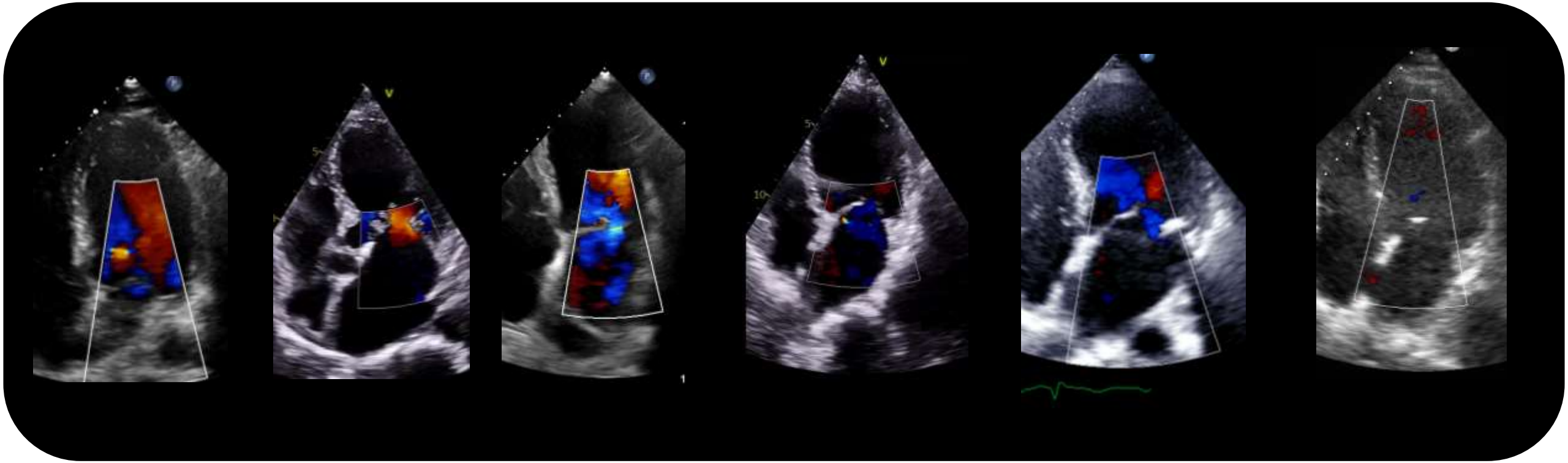
Conditions de charge

- Post charge
- Diuretiques
- effort

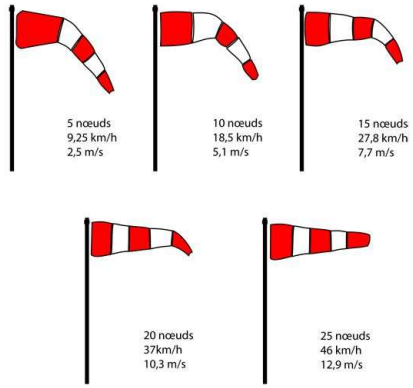
Pas d’estimation visuelle !

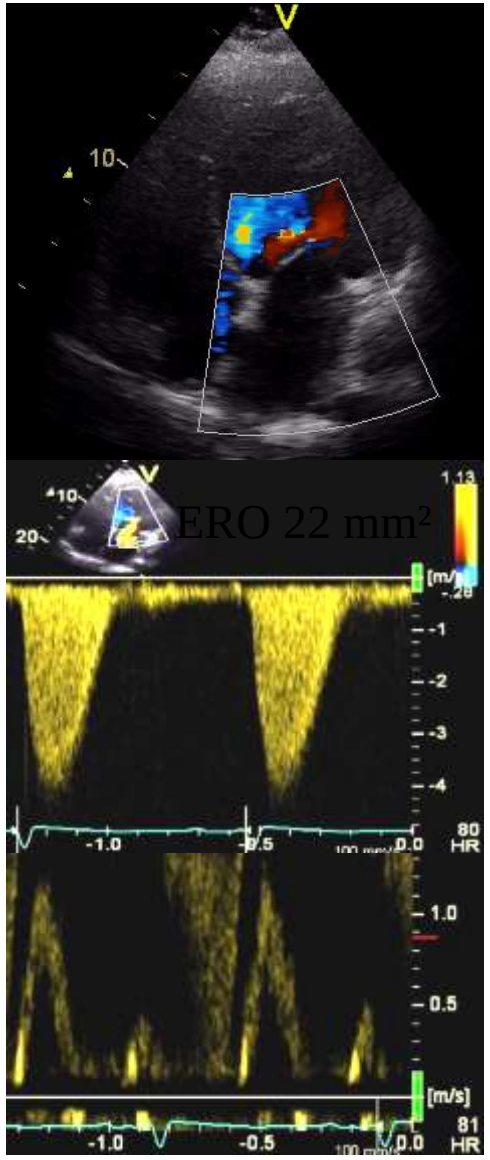
Quantifiez !!!!

Eyeball Grading of Color Jet Profiles in Mitral Regurgitaion	
Mild	1+
Moderate	2+
Moderate-to-Severe	3+
Severe	4+

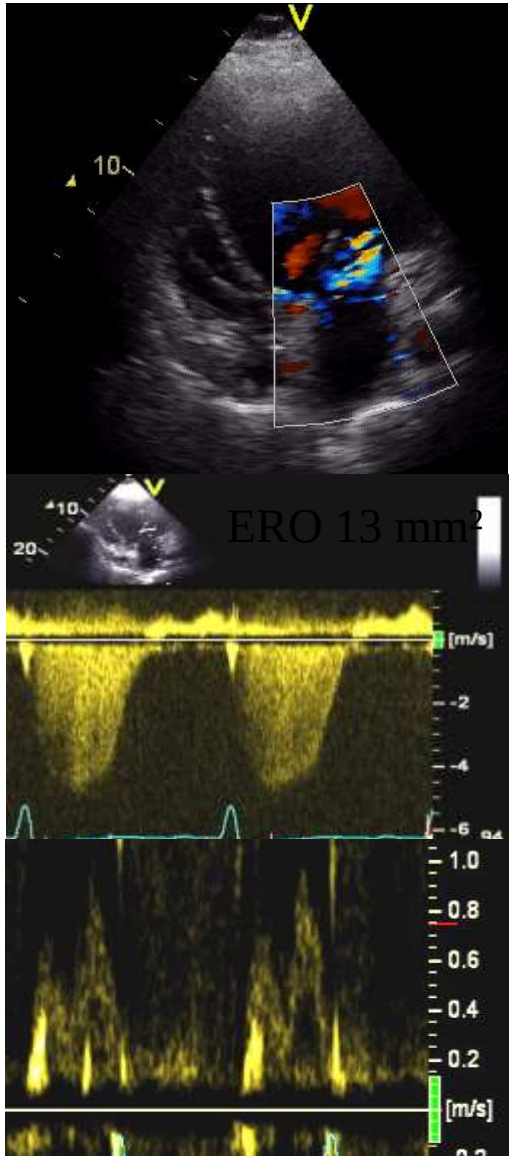


Mechanisms: Importance of cardiac load conditions

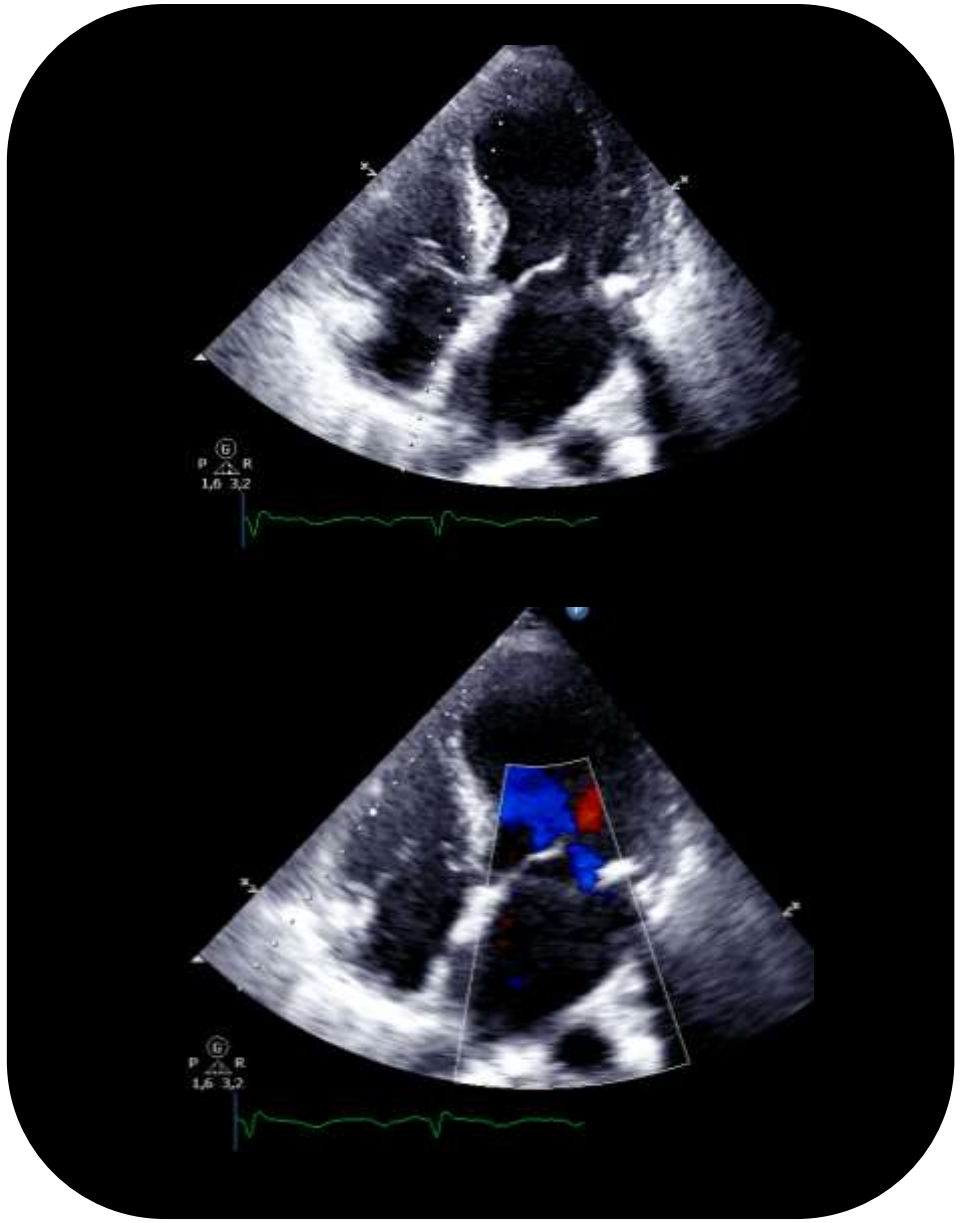




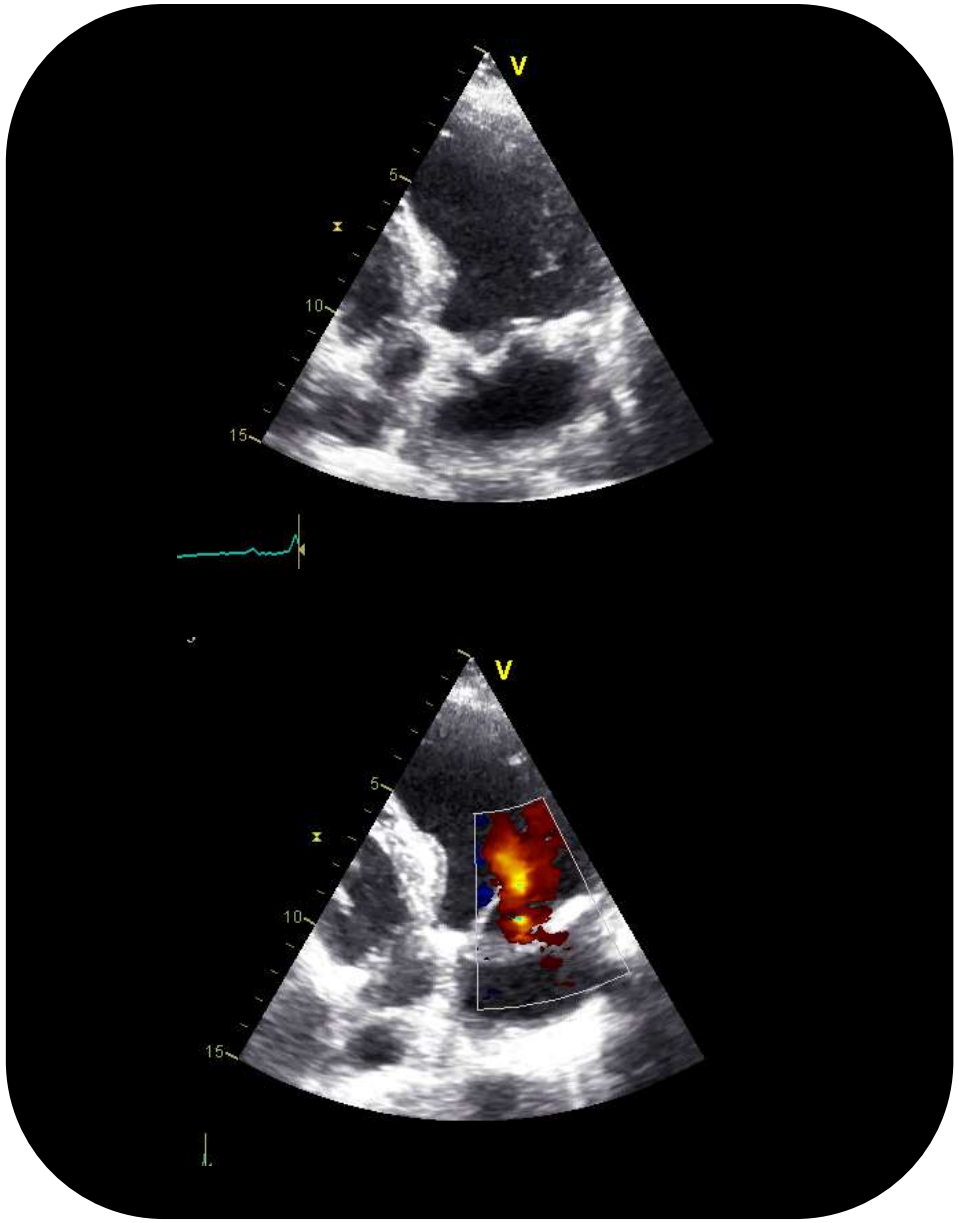
Before unloading therapy



After unloading therapy

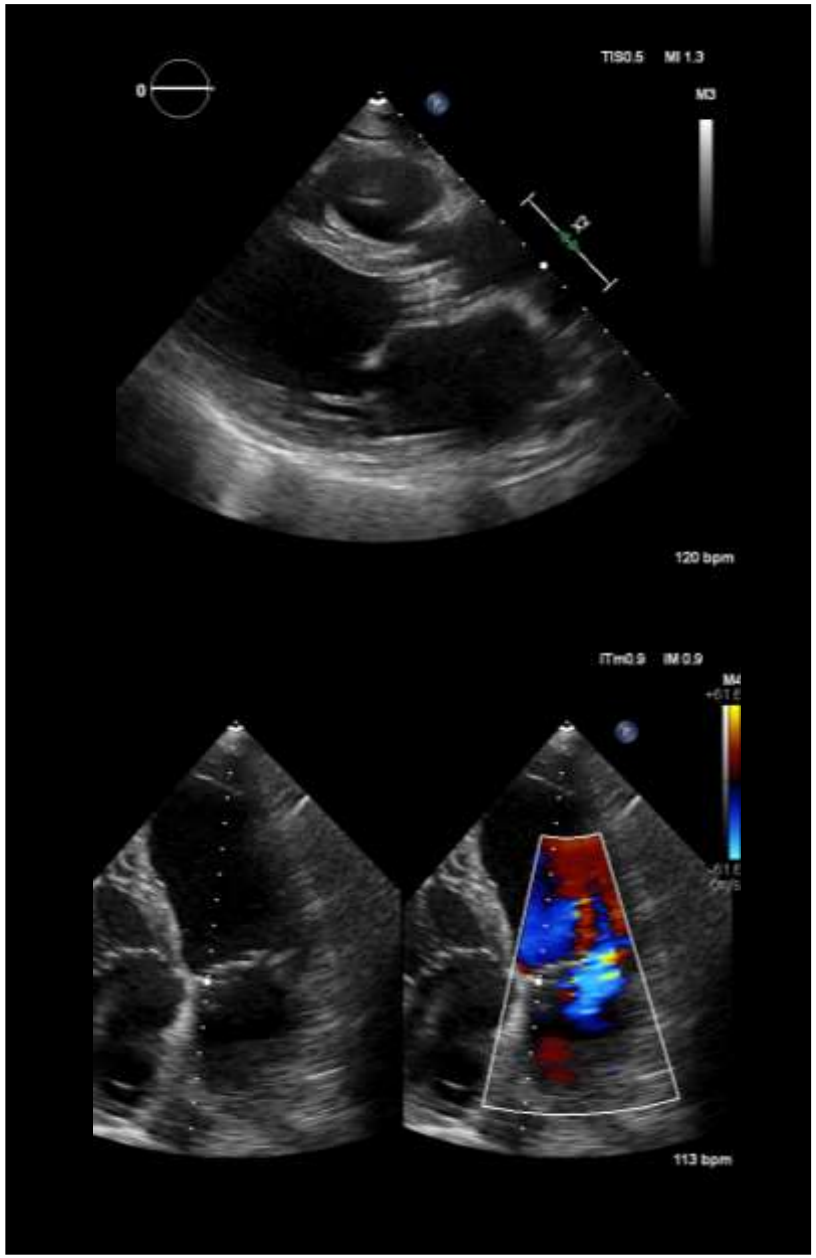


230/100



140/80

1



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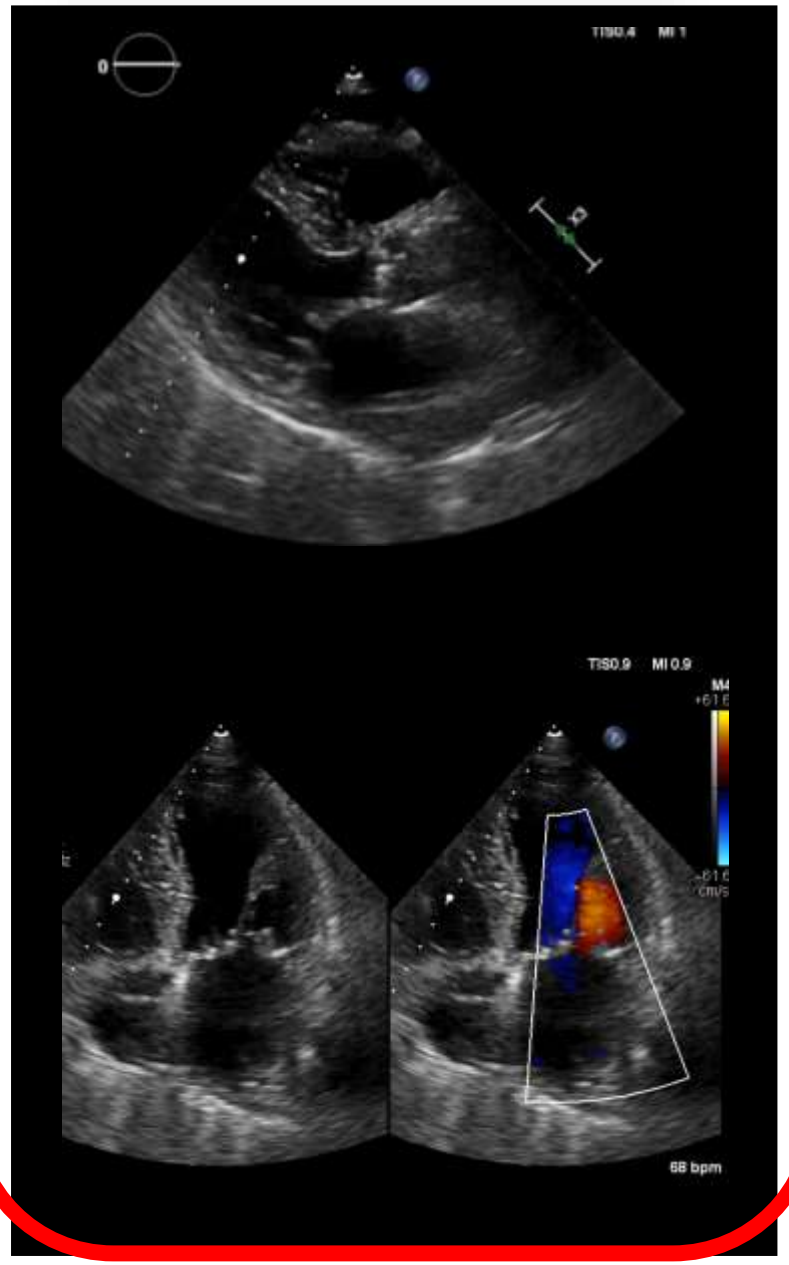

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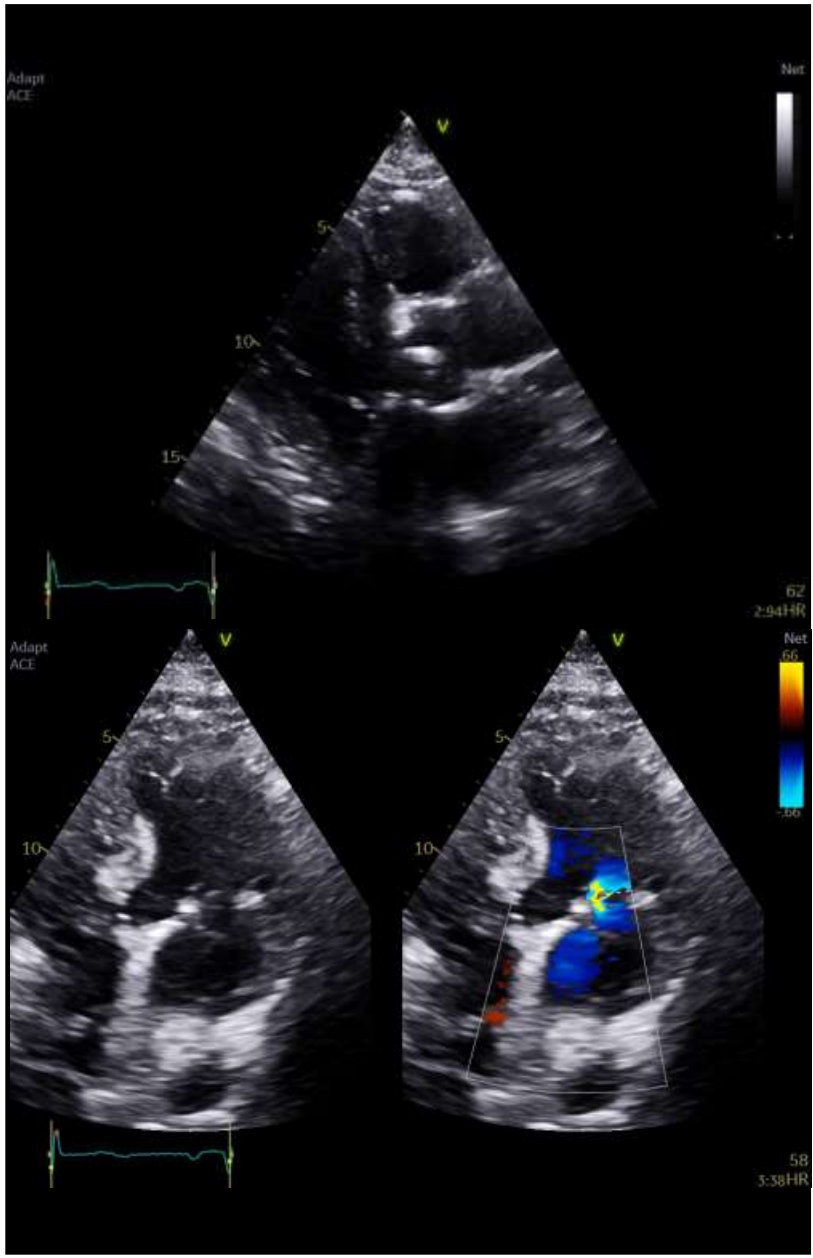
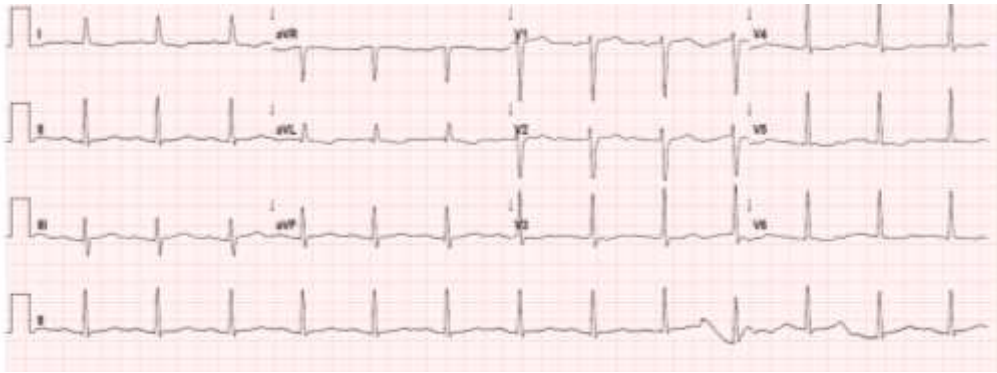


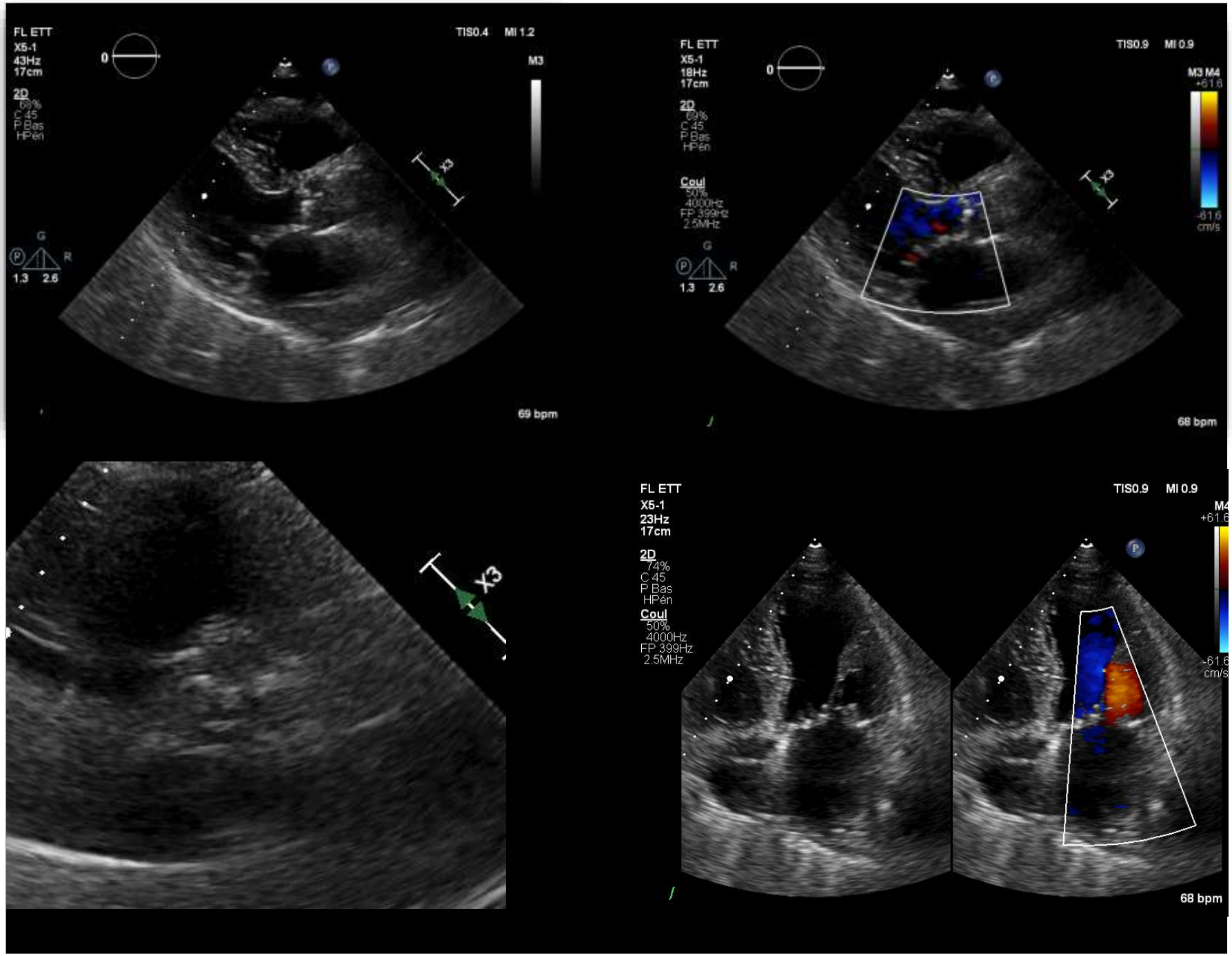
Cas clinique N°2

- Patiente de 68ans , 158cm x64 kg
- OAP récent
- BPCO post tabagique, emphysème
- AVC ischémique, EP, HTA

- Souffle systolique 3/6 b2 diminué

- Coronaropathie: thrombose droite ancienne et sténose intermédiaire IVA




FL ETT
X5-1
43Hz
17cm
2D
69%
C 45
P Bas
HPén
TIS0.4 MI 1.2
M3
69 bpm
FL ETT
X5-1
18Hz
17cm
2D
69%
C 45
P Bas
HPén
Coul
50%
4000Hz
FP 399Hz
2.5MHz
TIS0.9 MI 0.9
M3 M4
+61.6
-61.6
cm/s
68 bpm
FL ETT
X5-1
23Hz
17cm
2D
74%
C 45
P Bas
HPén
Coul
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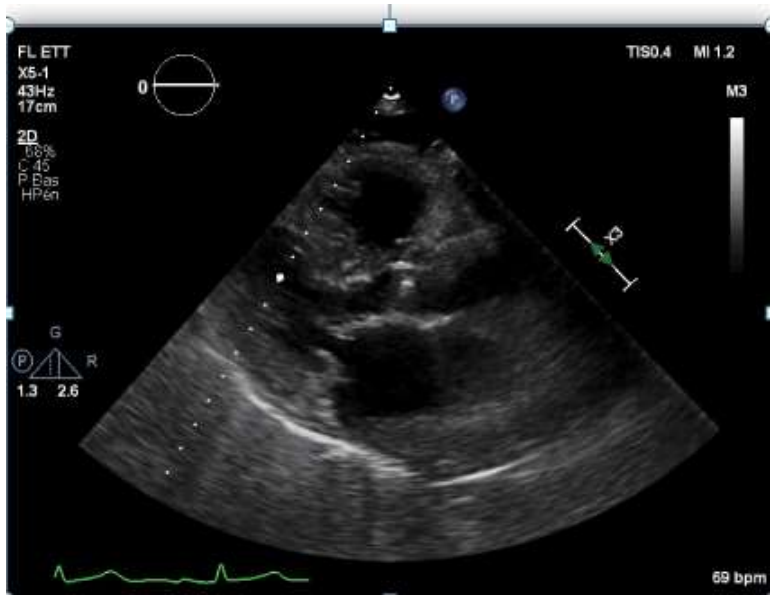
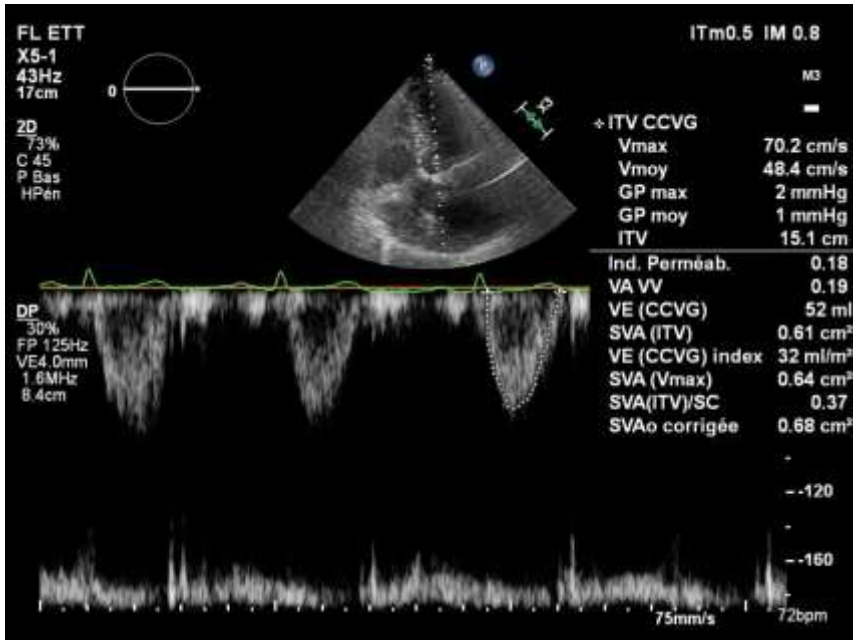




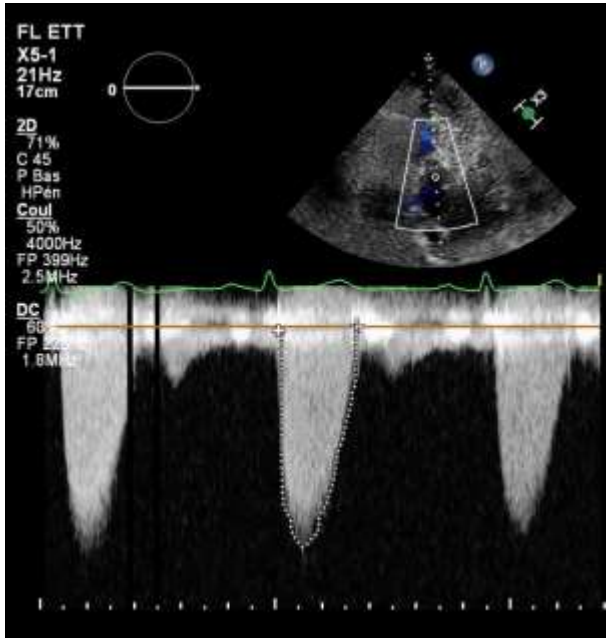
Ccvg 21mm

VESi 32ml/m²

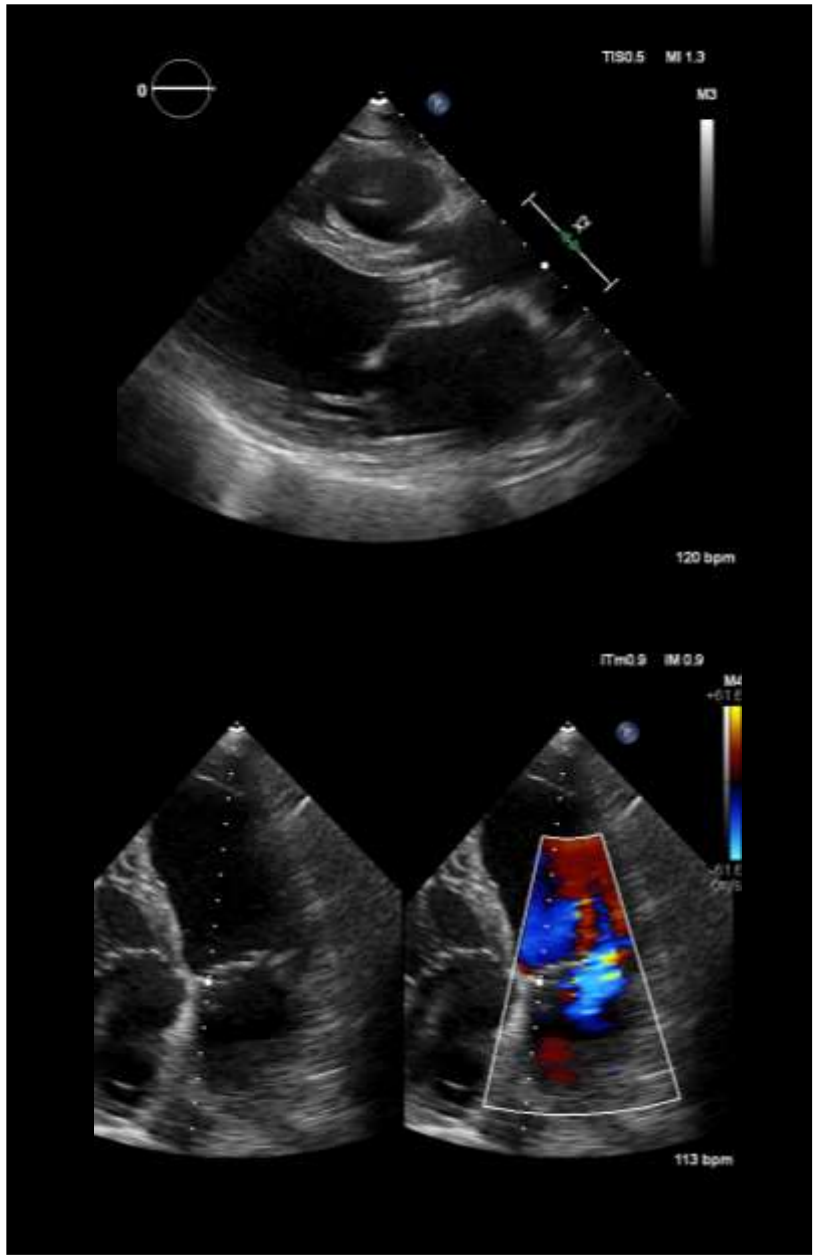
Gdt moyen 34mmhg

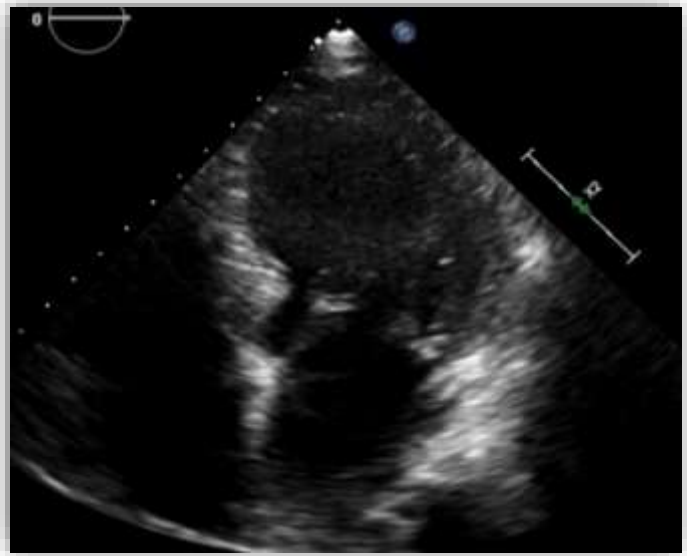
Sao 0.8cm2

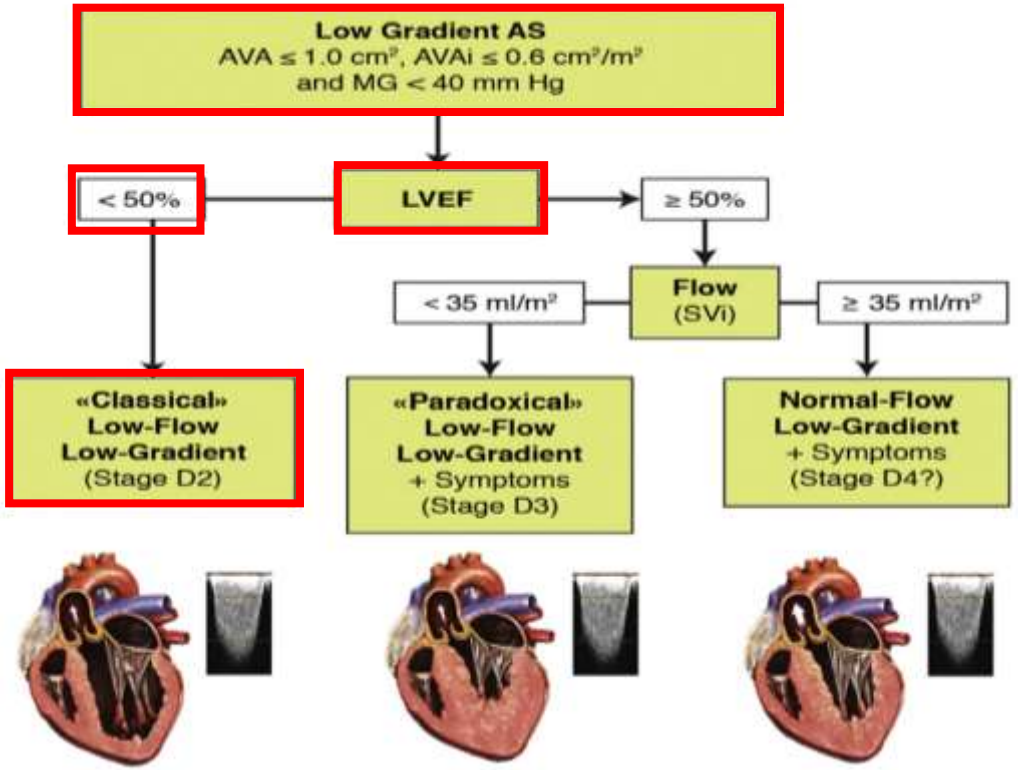
V max 3.7m/s



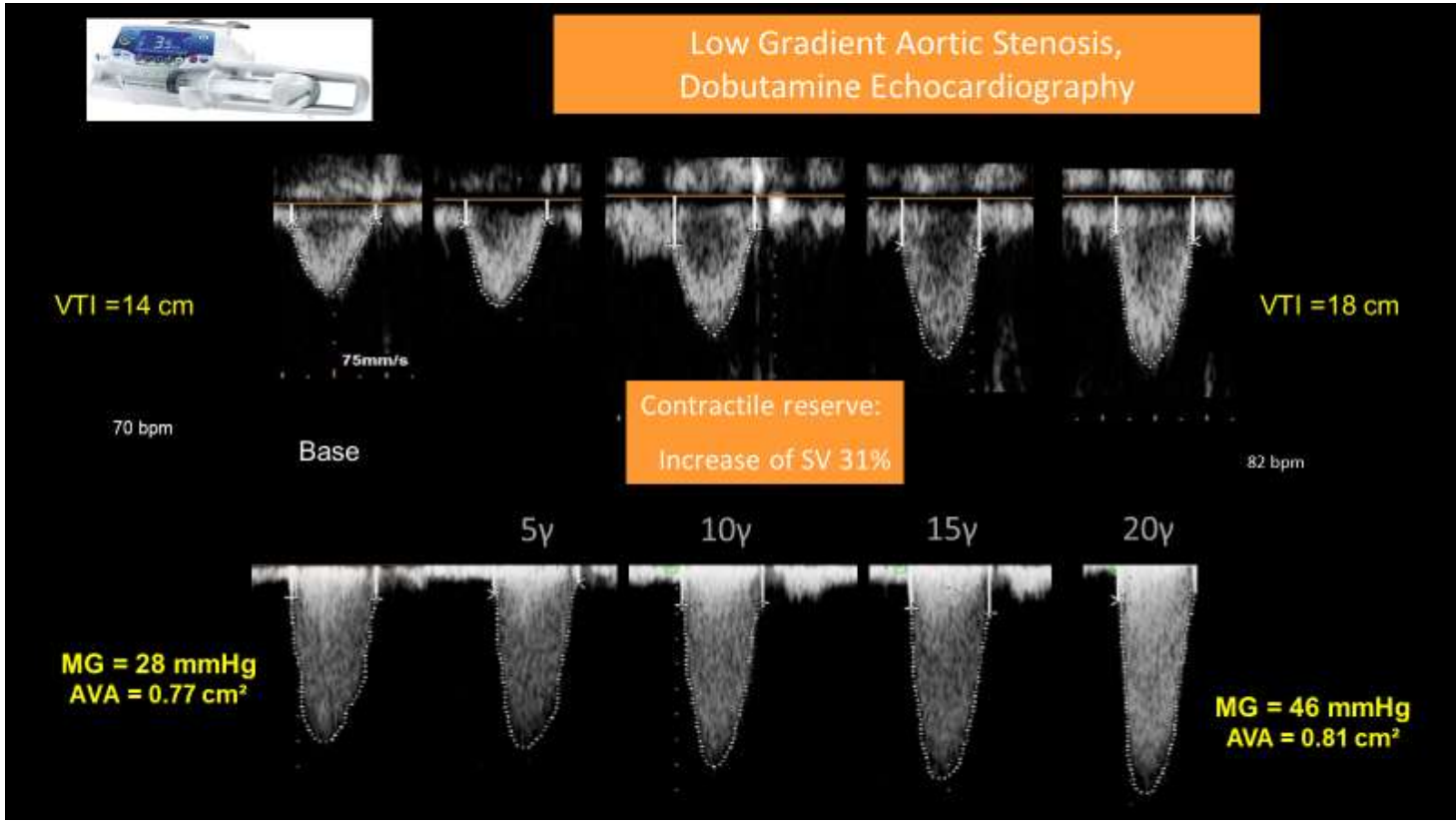
Decreased cardiac output







J Am Coll Cardiol Img 2017;10:185–202



Flow dependency

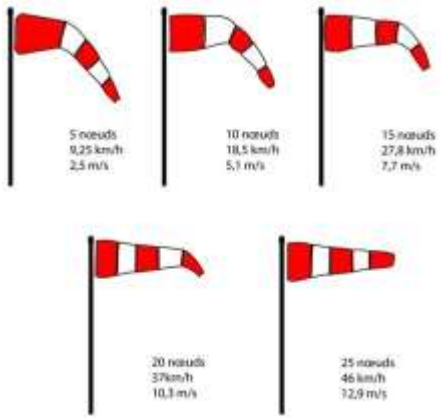
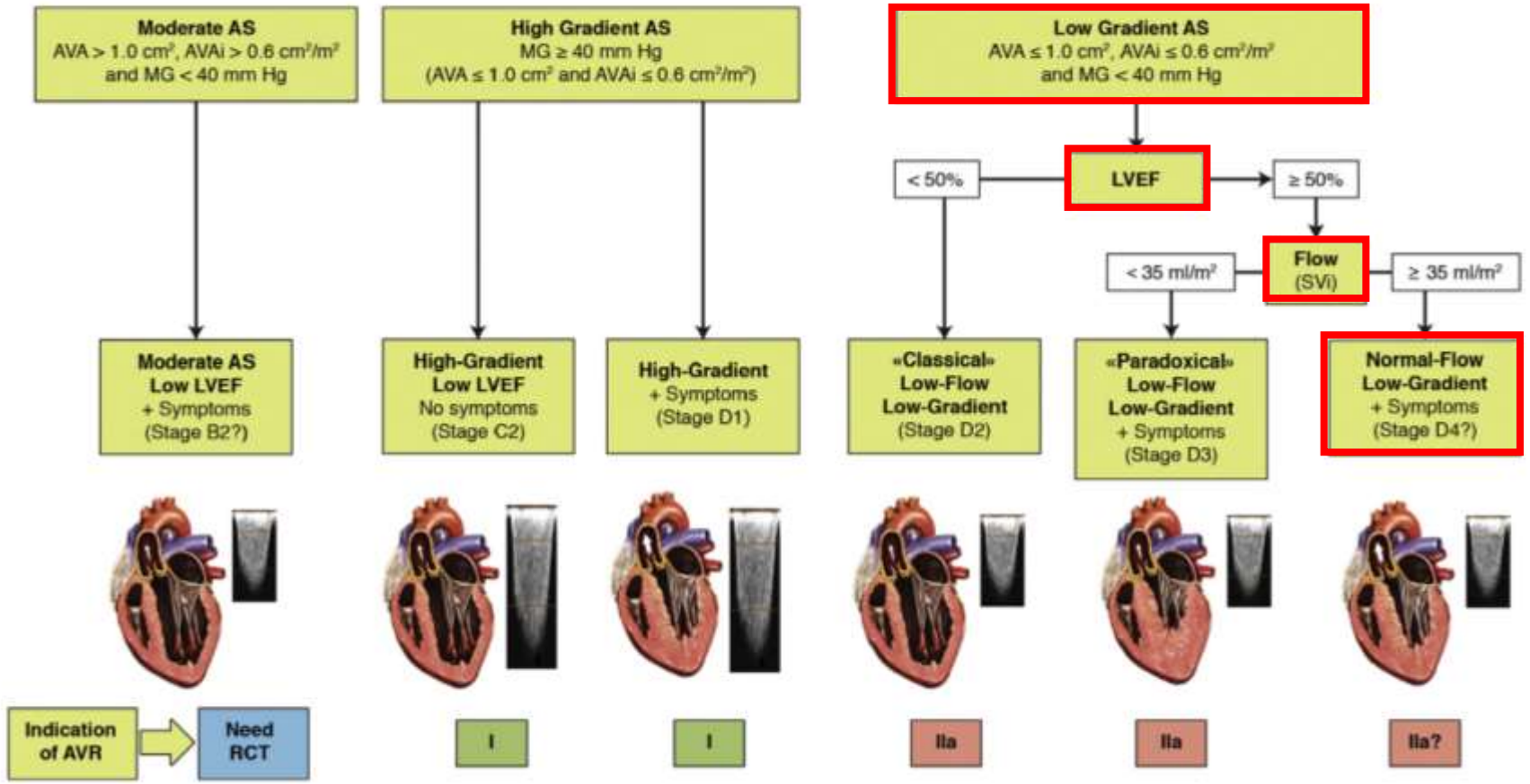
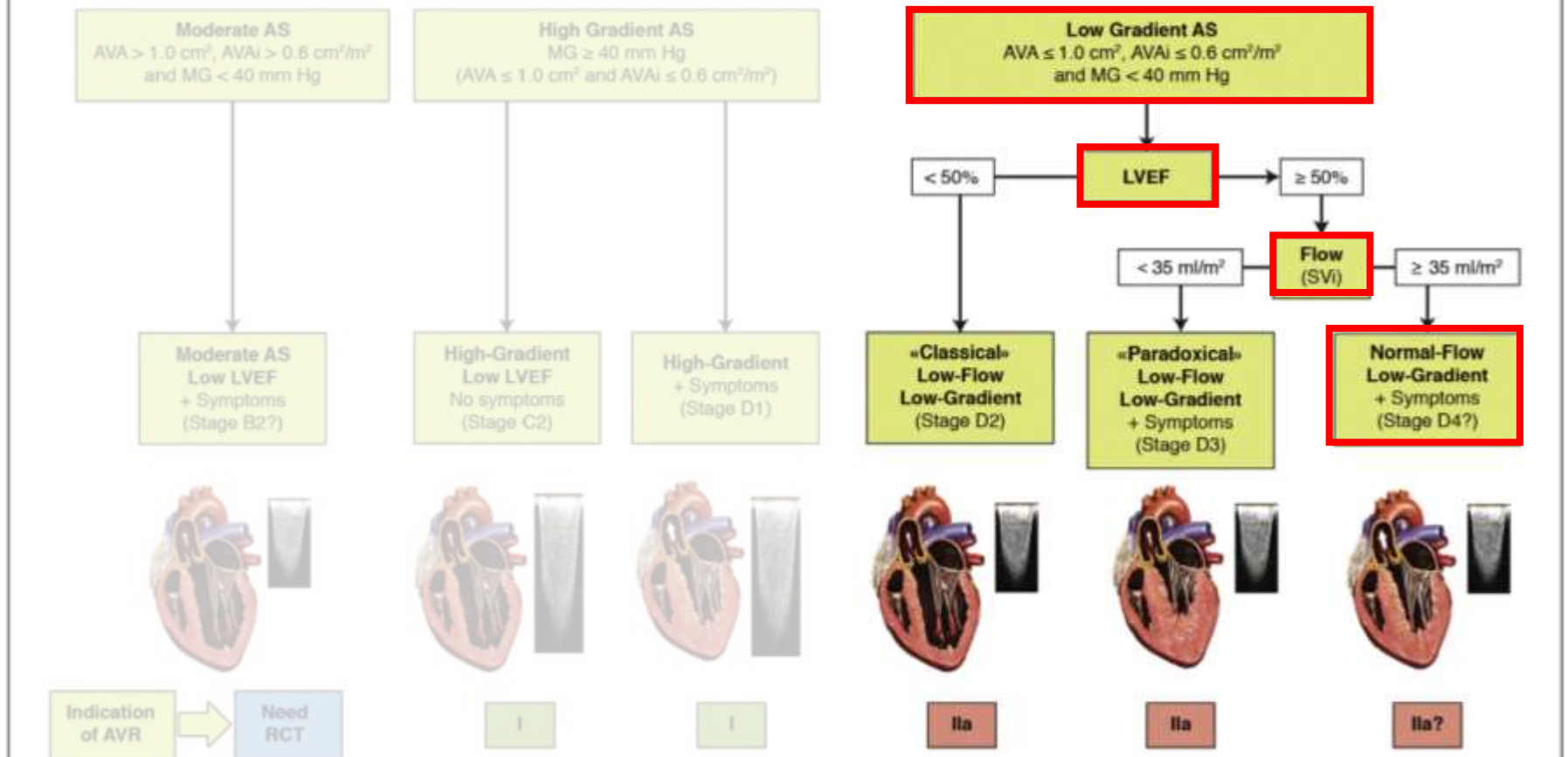


FIGURE 1 Classification and Characterization of the Different Types of AS According to AVA, Gradient, LVEF, and Flow



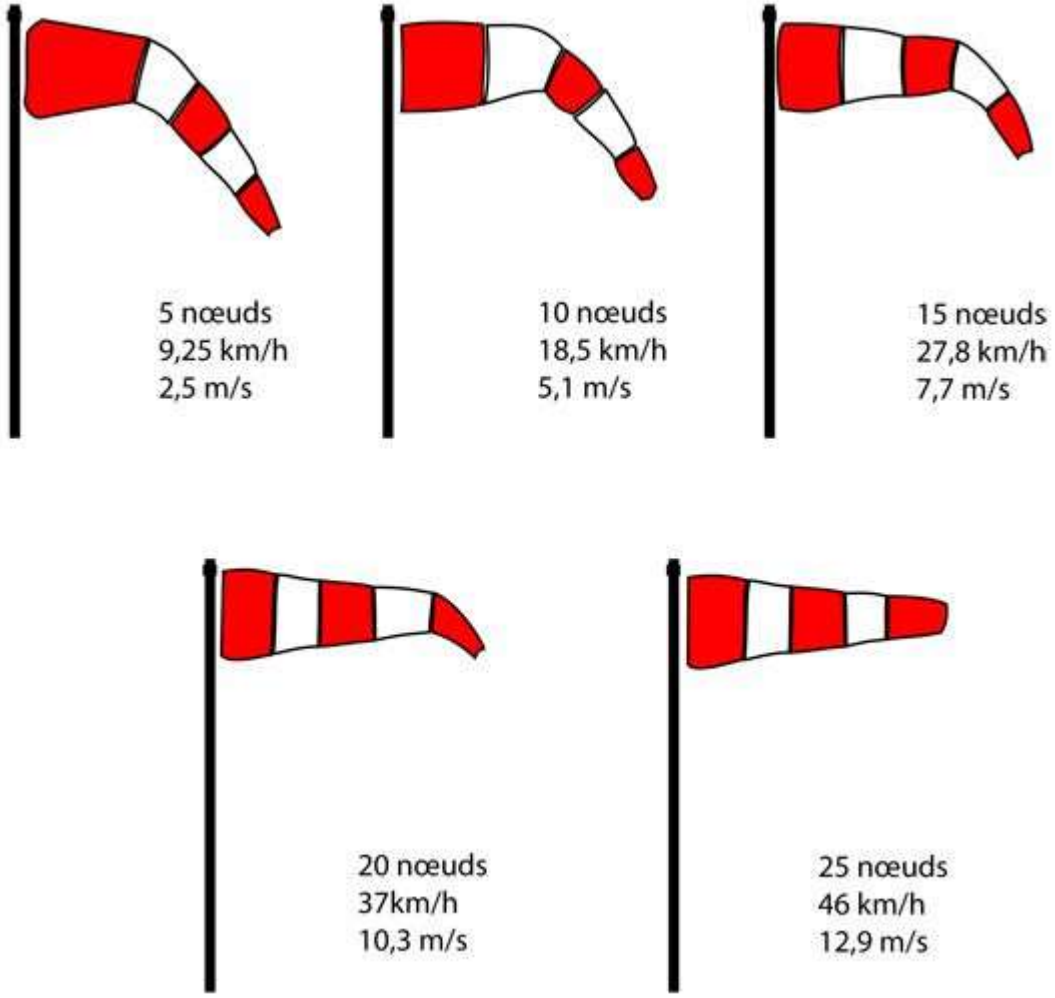
J Am Coll Cardiol Img 2017;10:185–202

FIGURE 1 Classification and Characterization of the Different Types of AS According to AVA, Gradient, LVEF, and Flow



J Am Coll Cardiol Img 2017;10:185–202

Flow dependency



1998

2006

2007

2012

AVA 0.75 cm2
MG 50mmHg

AVA 1 cm2
MG 40mmHg

AVA 1 cm2
MG 50mmHg

AVA 1 cm2
MG 40mmHg
Possible PLFLG

ACC/AHA Practice Guidelines

Guidelines for the Management of Patients With Valvular Heart Disease

Executive Summary

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Patients With Valvular Heart Disease)

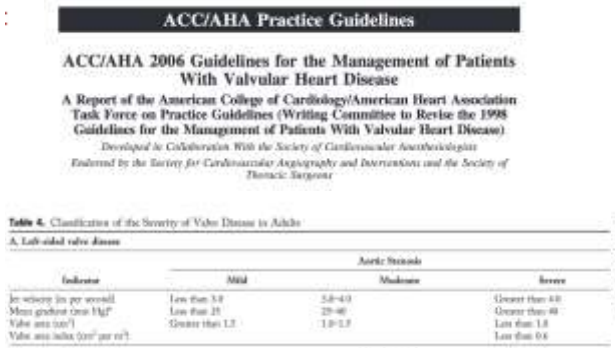
A. Aortic Stenosis

Grading the Degree of Stenosis

The aortic valve area must be reduced to one fourth its normal size before significant changes in the circulation occur. Because the normal adult valve orifice is ≈3.0 to 4.0 cm², an area ≥0.75 to 1.0 cm² is usually not considered severe AS. In large patients, a valve area of 1.0 cm² may be severely stenotic, whereas a valve area of 0.7 cm² may be adequate for a smaller patient.

The committee used a variety of hemodynamic and natural history data to grade the degree of AS as mild (area >1.5 cm²), moderate (area >1.0 to 1.5 cm²), or severe (area ≈1.0 cm²). When stenosis is severe and cardiac output is normal, the mean transvalvular pressure gradient is generally >50 mm Hg. Some patients with severe AS remain asymptomatic, whereas others with only moderate stenosis develop symptoms. Therapeutic decisions, particularly those related to corrective surgery, are based largely on the presence or absence of symptoms. Thus, the absolute valve area (or transvalvular pressure gradient) is not usually the primary determinant of the need for aortic valve replacement (AVR).

An ejection systolic murmur may be heard in the presence of a normal valve, one that is thickened and minimally calcified, and one that is stenotic. The 3 conditions must be distinguished.



ACC/AHA Practice Guidelines

ACC/AHA 2006 Guidelines for the Management of Patients With Valvular Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1998 Guidelines for the Management of Patients With Valvular Heart Disease)

Developed in Collaboration With the Society of Cardiovascular Anesthesiologists

Endorsed by the Society for Cardiovascular Angiography and Interventions and the Society of Thoracic Surgeons

Table 4. Classification of the Severity of Valve Disease in Adults

A. Left-sided valve disease

	Aortic Stenosis		
Indicator	Mild	Moderate	Severe
Jet velocity (m per second)	Less than 3.0	3.0–4.0	Greater than 4.0
Mean gradient (mm Hg)*	Less than 25	25–40	Greater than 40
Valve area (cm²)	Greater than 1.5	1.0–1.5	Less than 1.0
Valve area index (cm² per m²)			Less than 0.6

ESC Guidelines

Guidelines on the management of valvular heart disease

The Task Force on the Management of Valvular Heart Disease of the European Society of Cardiology

Nevertheless, it has to be emphasized that valve area measurements also have their potential inaccuracies and are less robust than gradient estimates in clinical practice. Thus, valve area alone with absolute cut-off points cannot be relied upon for clinical decision-making and it should be considered in combination with flow rate, pressure gradient and ventricular function, as well as functional status. AS with a valve area <1.0 cm² is considered severe; however, indexing to BSA, with a cut-off value of 0.6 cm²/m² BSA is helpful, in particular in patients with either unusually small or large BSA.

Severe AS is unlikely if cardiac output is normal, and there is a mean pressure gradient <50 mmHg. In the presence of low flow, usually due to depressed LV function, low pressure gradients may be encountered in patients with severe AS. As soon as mean gradient is <40 mmHg, even a small valve area does not definitely confirm severe AS since mild-to-moderately diseased valves may not open fully, resulting in a 'functionally small valve area' (pseudosevere AS).[57]

ESC/EACTS GUIDELINES

Guidelines on the management of valvular heart disease (version 2012)

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

Severe AS is unlikely if cardiac output (more precisely, transvalvular flow) is normal and there is a mean pressure gradient <40 mmHg. In the presence of low flow, however, lower pressure gradients may be encountered in patients with severe AS (low flow–low gradient AS), although the majority will still present with high gradients. So far, this has mainly been recognized in patients with poor systolic LV function. However, when the

More recently, the possible presence of severe AS in patients with valve area <1.0 cm² and mean gradient <40 mmHg, despite preserved LVEF, has been suggested, introducing the new entity of 'paradoxical low flow (stroke volume index <35 ml/m²), low gradient (mean gradient <40 mmHg) AS with preserved LVEF'.[74] This appears to be typically encountered in the elderly and is associated with small ventricular size, marked LV hypertrophy, and a history of hypertension. This subset of AS patients

Discrepancy gradient/area

Moderate AS

Severe AS

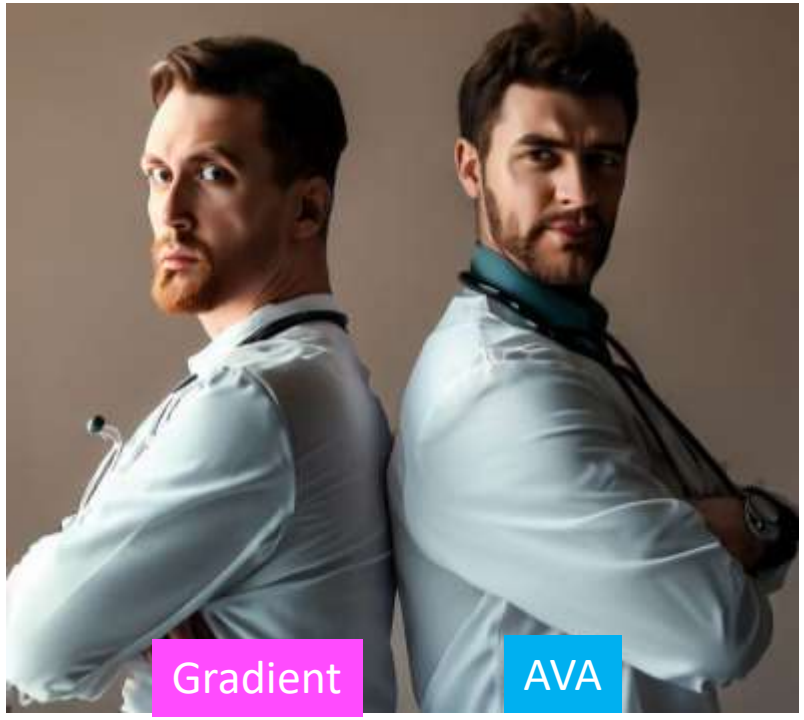


Table I Categories of aortic stenosis severity

	Aortic sclerosis	Mild AS	Moderate AS	Severe AS
Aortic jet velocity (m/s)	<2.6	2.6–3.0	3–4	>4
Mean gradient (mmHg)	—	<30 (25)	30–50 (25–40)	>50 (40)
AVA (cm^2)	—	>1.5	1.0–1.5	<1.0
Indexed AVA (cm^2/m^2)		>0.9	0.6–0.9	<0.6
Velocity ratio		>0.50	0.25–0.50	<0.25

Based on the ASE/EAE Recommendations for Quantitation of Stenosis Severity,[2] ESC Valve Guidelines,[3] and American College of Cardiology/American Heart Association (ACC/AHA) Valve Guidelines.[4] ACC/AHA guidelines use lower mean gradient cutoffs as indicated in parentheses. The ESC definitions apply only in the presence of normal flow conditions. The velocity ratio is included in the ASE/EAE guidelines only.

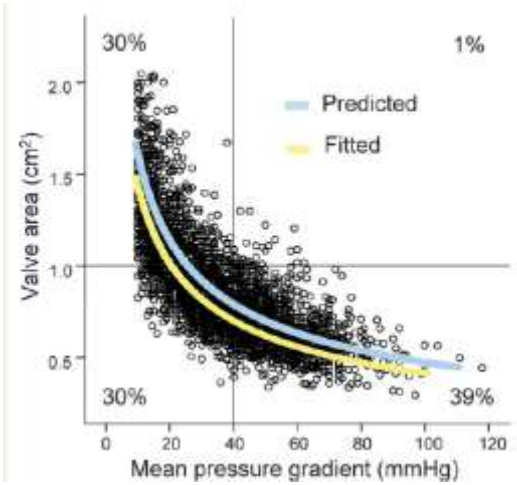


Table I Relation of the aortic valve area to the gradient

Aortic valve area (cm^2)	Mean gradient (mmHg)
4	1.7
3	2.9
2	6.6
1	26
0.9	32
0.8	41
0.7	53
0.6	73
0.5	105

Reproduced with permission from Carabello[4]. Data were derived with the Gorlin formula:

$$\text{Aortic valve area} = \frac{\text{cardiac output} \div (\text{systolic ejection period} \times \text{heart rate})}{44.3\sqrt{\text{mean gradient}}}$$

Dumesnil JG et al. European Heart Journal (2010) 31, 281–289

A definition based on gradient / flow

ESC European Society of Cardiology
European Heart Journal (2022) 43, S61–632
https://doi.org/10.1093/eurheartj/ehab395

ESC/EACTS GUIDELINES

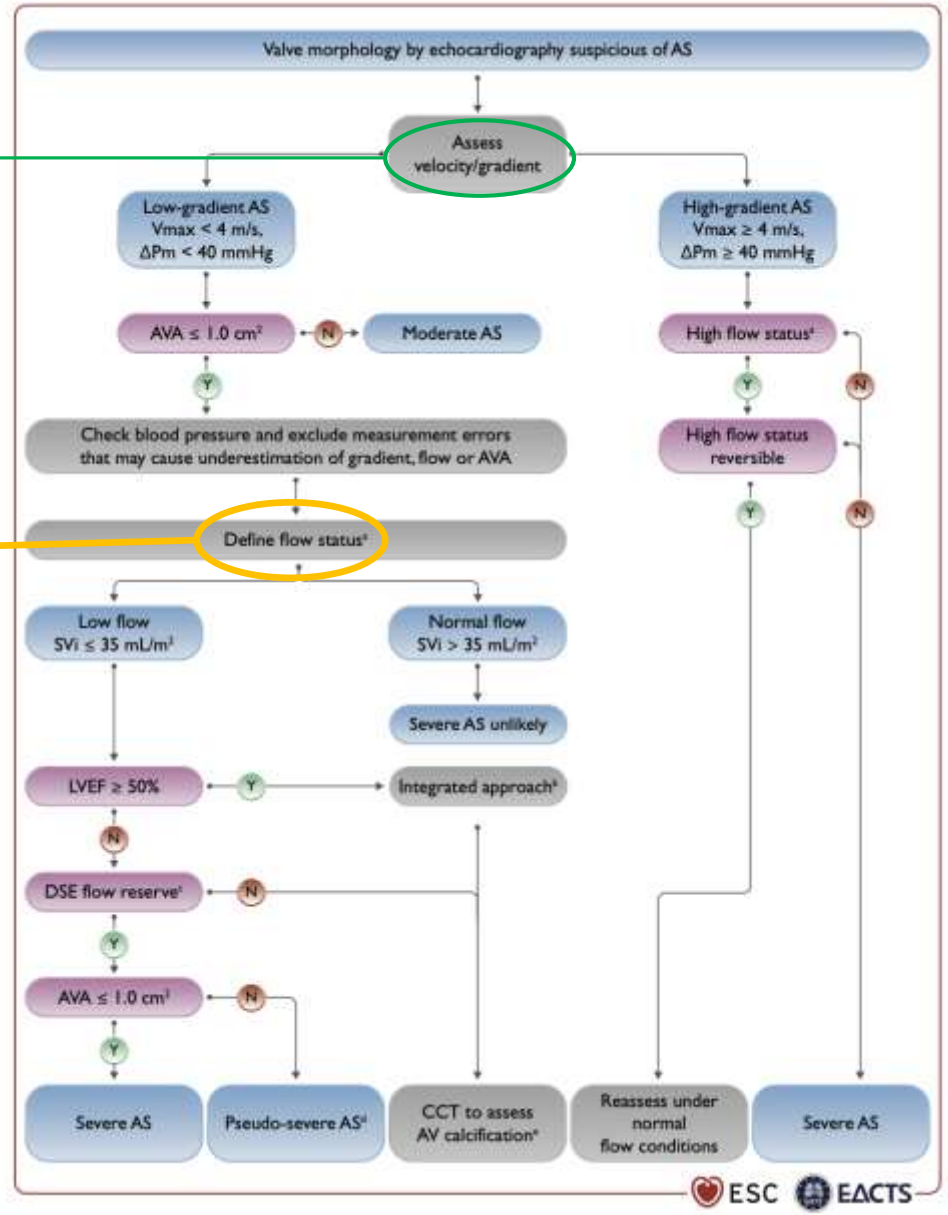
2021 ESC/EACTS Guidelines for the management of valvular heart disease

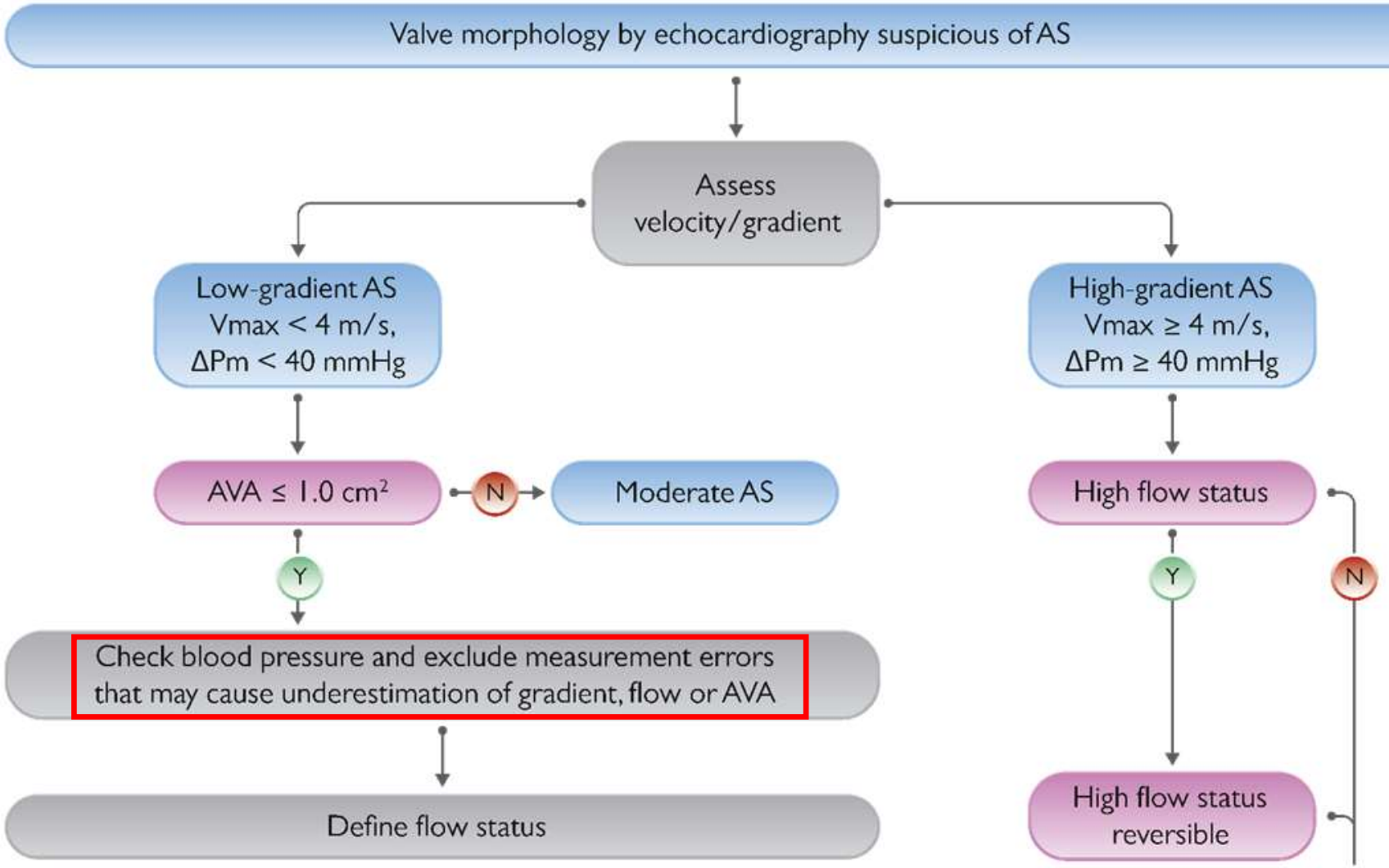
Developed by the Task Force for the management of valvular heart disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

High gradient AS		
Low gradient AS (MG < 40 mmHg, AVA < 1.0 cm2)	**LF/LG AS with reduced LVEF** LVEF < 50%, SVI < 35 ml/m²	Low flow
	LF/LG AS with preserved LVEF LVEF ≥ 50%, SVI < 35 ml/m²	Low flow
	NF/LG AS LVEF ≥ 50%, SVI ≥ 35 ml/m²	→ *Usually moderate*

Gradient

Flow





2021 ESC/EACTS Guidelines for the management of valvular heart disease
(European Heart Journal; 2021 – doi: 10.1093/eurheartj/ehab395; European Journal of Cardio-Thoracic Surgery; 2021 – doi: 10.1093/ejcts/ezab389)

Uncontrolled hypertension

↓

Decreased cardiac output and gradient

Paradoxical LFLG AS

1. Eliminer une **erreur de mesure** ou de recueil
   - (Anneau aortique, VTI)
2. Confirmer le **bas débit et le contexte**
   - (IRM, Simpson, Amylose, strain, acfa, RM IM IT femme…)
3. Confirmer le **bas gradient**
   - (parasternale droite….)
4. Score calcique

Paradoxical LFLG AS

1

- Eliminer une **erreur de mesure** ou de recueil
- (Anneau aortique, VTI)

2

3

4

Listen to the heart

« it's time to turn to more effective technology—ultrasound, not acoustic sound »

Catherine Otto. Edito *Heart* 2018;104:1810–1.

« In many countries the GP is the 'gatekeeper' and the door-opener for further examinations »

10 seconds
0 euro

Table 4 Diagnostic accuracy of auscultation in aortic stenosis

Aortic stenosis		
Etchells 1998[22]	114 pt., 15 moderate/severe (and 1 mild) AS, 45 with systolic murmur.	Sens 0.93, spec 0.69 LR 2.98 (2.1–4.3)
Attenhofer 2000[48]	100 pt., 29 with mild/moderate/severe AS,	Sens 0.72, spec 0.83 LR 4.28 (2.44–7.52)
Iversen 2008[21]	2077 pt., 85 with mod/severe AS,	Sens 0.87, spec 0.79 LR 4.24 (3.75–4.80)
McGee 2010[28]	376 pt., 73 mild/moderate/severe AS, 221 with systolic murmur.	Sens 0.97, Spec 0.51 LR 1.96 (1.74–2.22)
Mehta 2014[50]	2[illegible] with suspected AS after auscultation.	Sens 0.88, spec 0.97 LR 26 (13-52)
Parras 2015[29]	100 pt., 49 moderate/severe AS, 85 with grade 3/6 systolic murmur.	Sens 0.98, spec 0.28 LR 1.35 (1.14–1.61)
Chorba 2021[52]	122 pt., 40 moderate/severe AS. Number of participants with murmur not specified	Sens 0.90, spec 0.71 LR 3.10 (2.18–4.42)
Steeds 2021[24]	167 pt., 16 with 'abnormal V-scan' (8 with echo-confirmed AS; 5 mild, 3 moderate). 30 with murmur.	Sens 0.88, spec 0.86 LR 6.05 (3.82–9.58)

Sensitivity ranged from 72% to 97%.
Specificity ranged from 28% to 97%.

Likelyhood Ratio ranged from 1.35 to 26,
mean LR was 6.2.

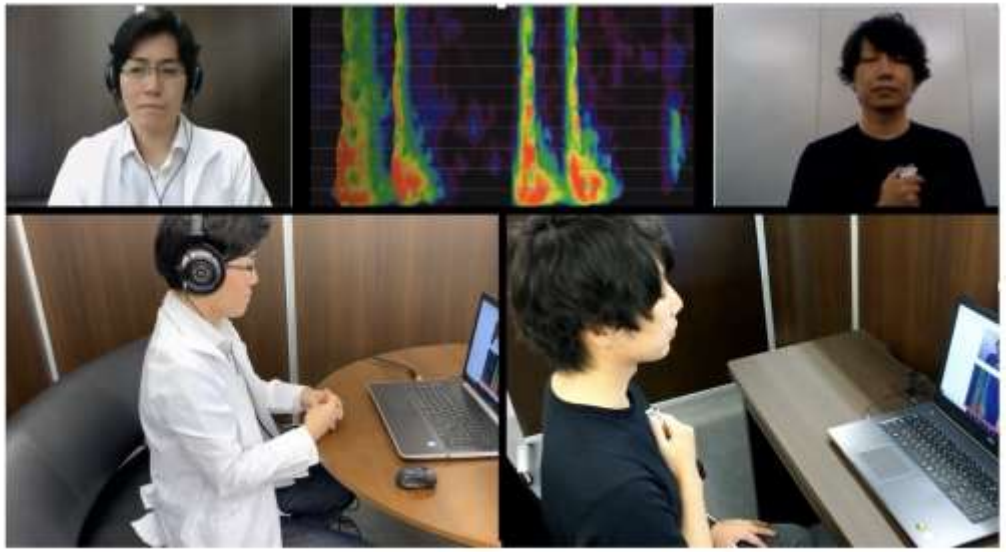
Davidsen AH, et al. BMJ Open 2023;**13**:e068121

Listen to the heart 2.0

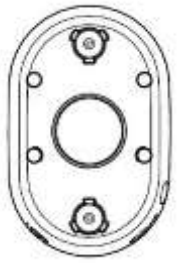
AI diagnosis of heart sounds differentiated with super StethoScope

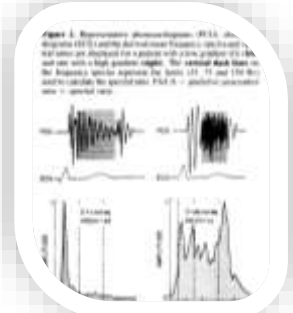
Shimpei Ogawa (MD), Fuminori Namino (PhD, MT), Tomoyo Mori (MD), Ginga Sato (BS), Toshitaka Yamakawa (PhD), Shumpei Saito (MS, RN) *

AMI Inc., Kagoshima, Japan



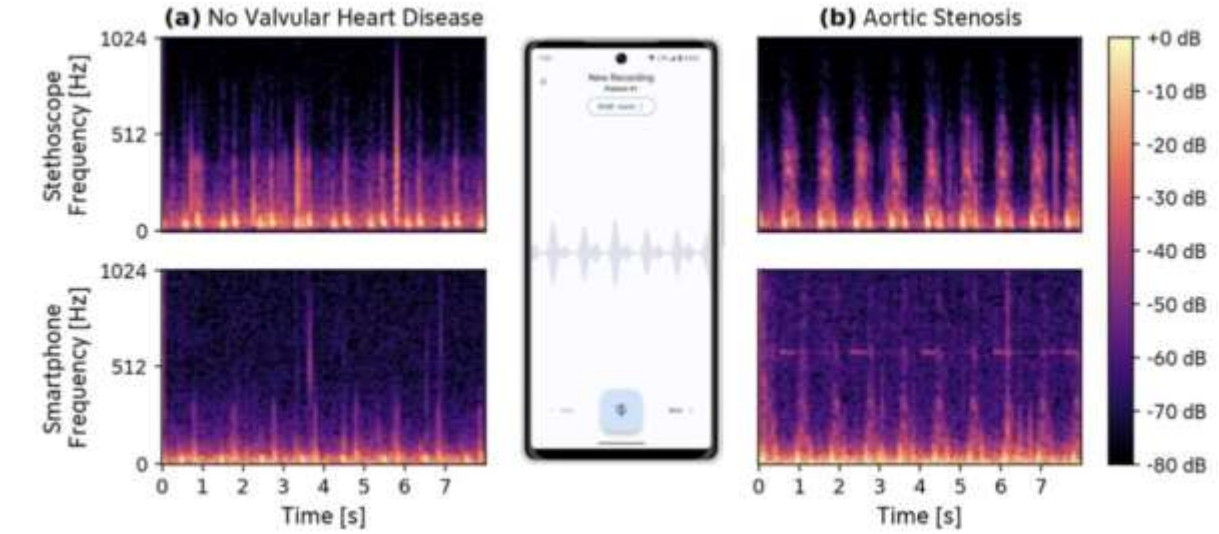
Journal of Cardiology, https://doi.org/10.1016/j.jjcc.2023.09.007





Detection of aortic stenosis using built-in microphones of commercially available smartphones

J.M. Altstidl[1], T.R. Altstidl[2], L. Anneken[1], L. Gaede[1], B.M. Eskofier[2], S. Achenbach[1]

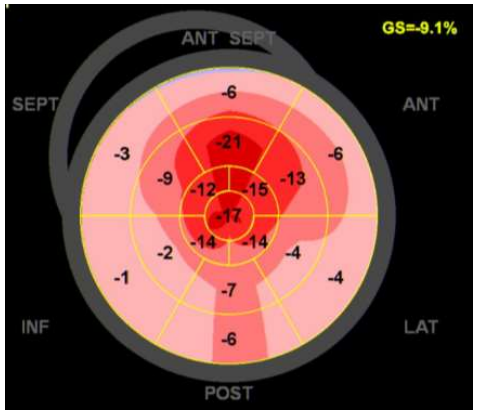


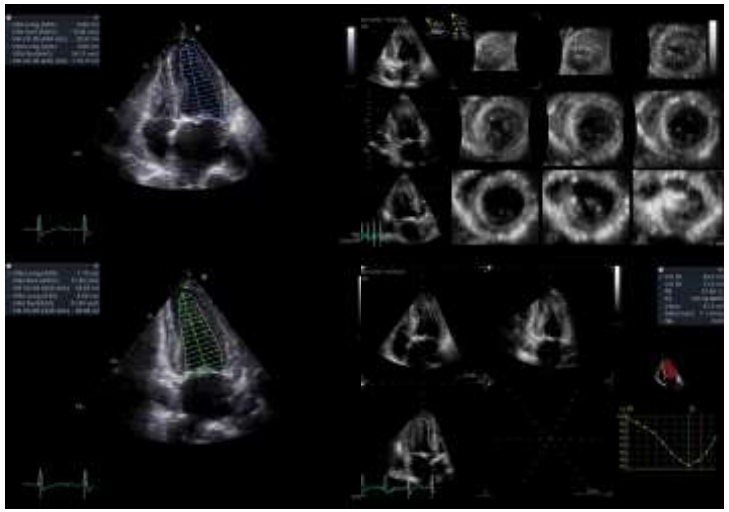
Abstract ESC European Heart Journal (2023) 44 (Suppl 2)

First step

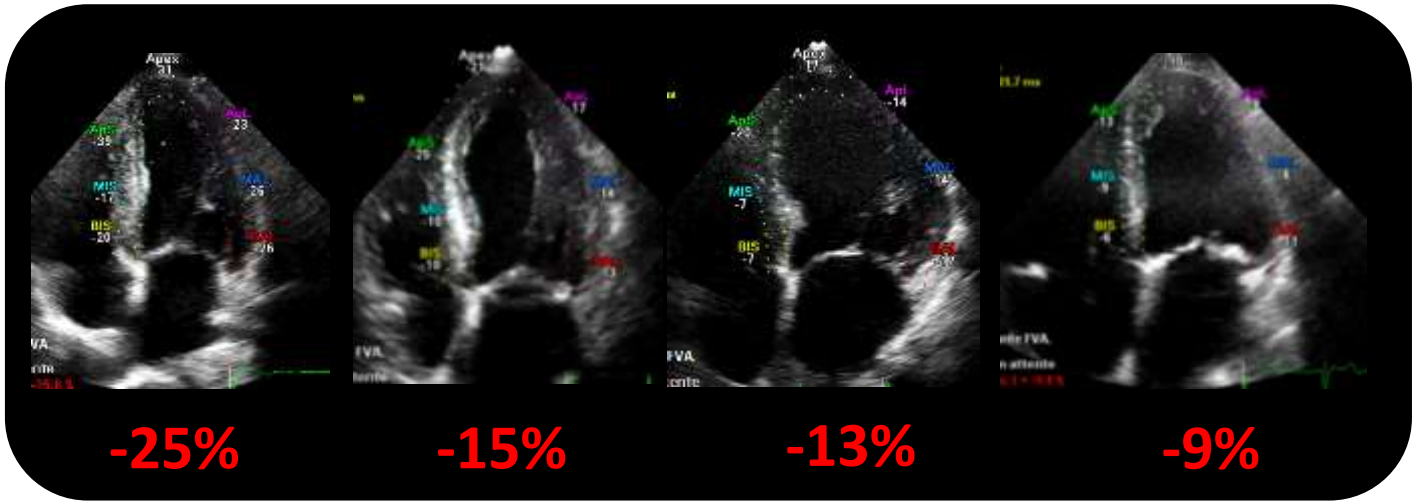
Assess the consequences of AS

- Assess LV geometry
- Assess LV systolic function





EF cut off 50%



Staging Cardiac Damage in Patients With Asymptomatic Aortic Valve Stenosis

Lionel Tastet, MS,[a] Christophe Tribouilloy, MD,[b] Sylvestre Maréchaux, MD,[c] E. Mara Vollema, MD,[d] Victoria Delgado, MD,[d] Erwan Salaun, MD,[a] Mylène Shen, MS,[a] Romain Capoulade, PhD,[e] Marie-Annick Clavel, DVM, PhD,[a] Marie Arsenault, MD,[a] Élisabeth Bédard, MD,[a] Mathieu Bernier, MD,[a] Jonathan Beaudoin, MD,[a] Jagat Narula, MD,[f] Patrizio Lancellotti, MD,[g] Jeroen J. Bax, MD,[d] Philippe Généreux, MD,[h,i,j] Philippe Pibarot, DVM, PhD[a]

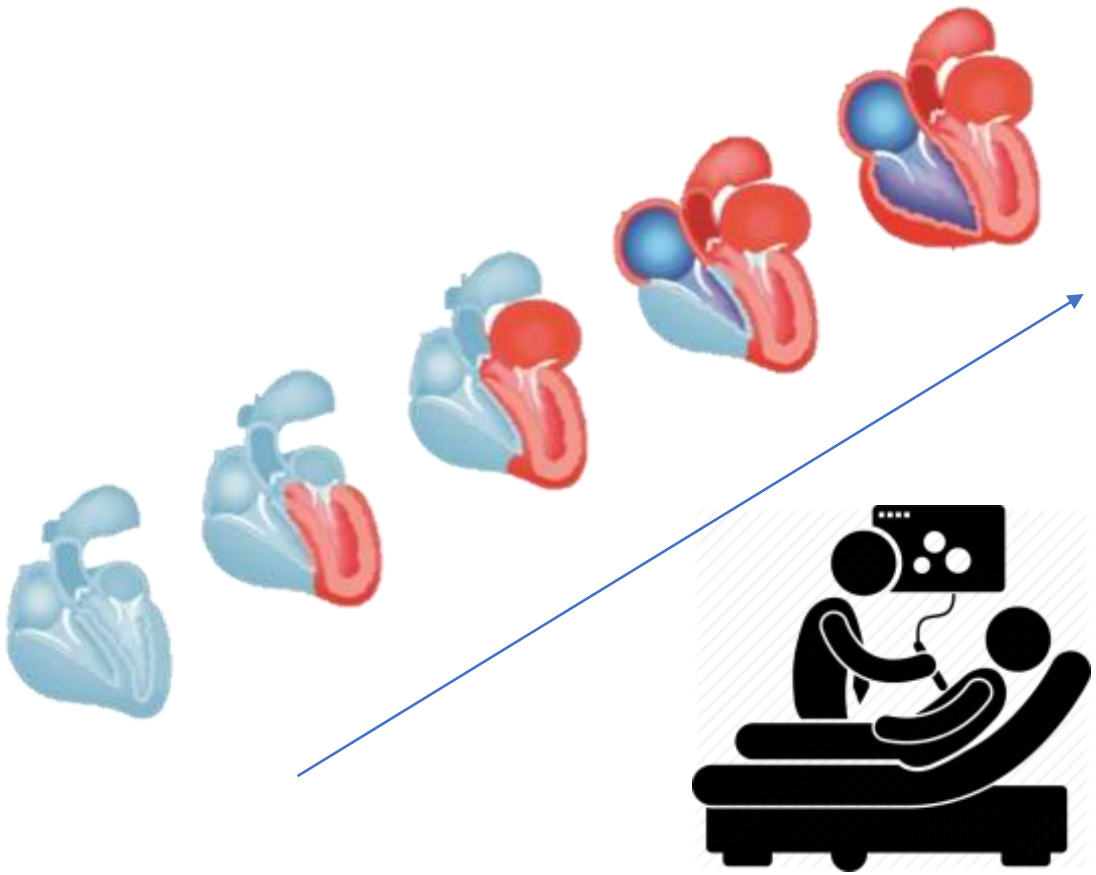
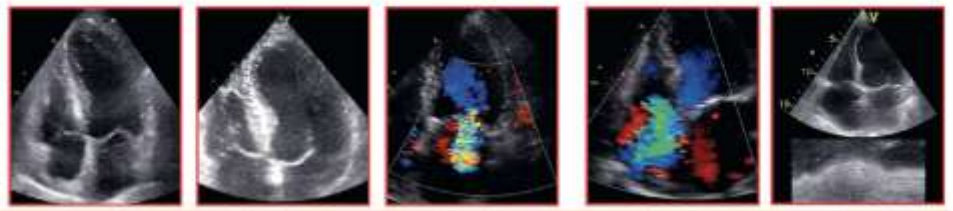
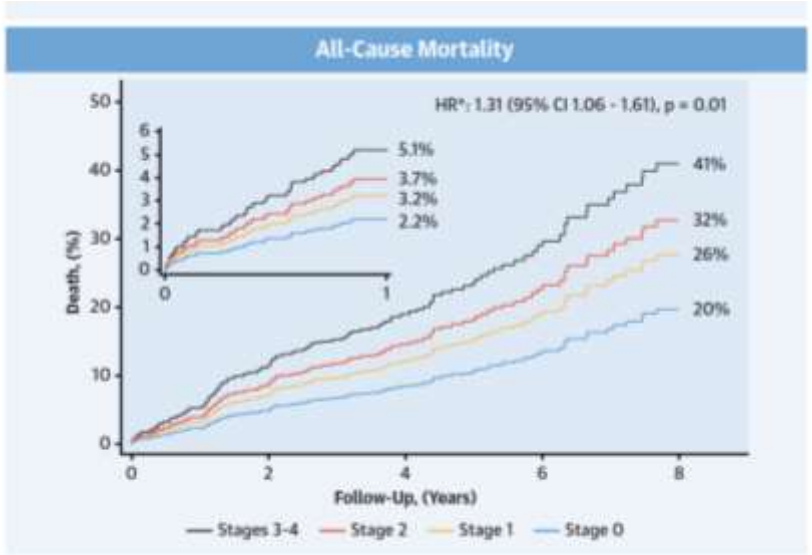


FIGURE 1 Stages of Cardiac Damage in Severe AS



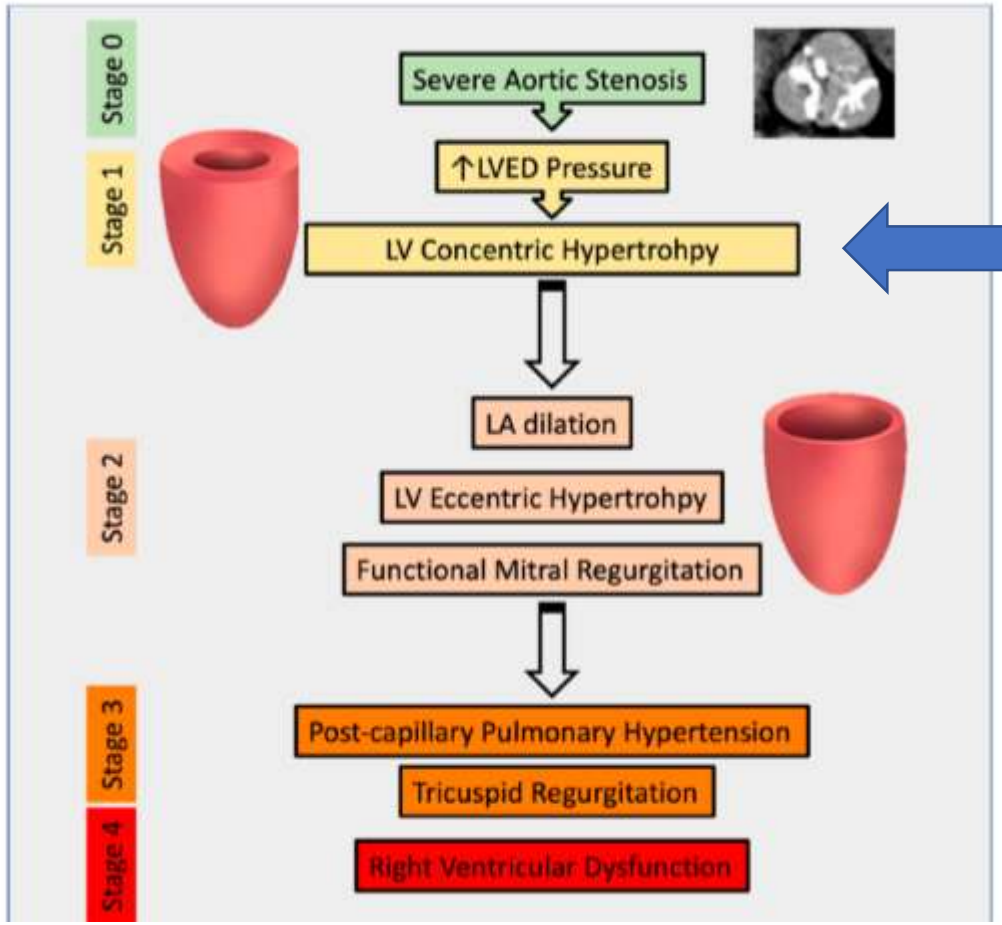
	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4
	No cardiac damage	Left ventricular damage	Left atrial or mitral damage	Pulmonary vasculature or tricuspid damage	Right ventricular damage
Echocardiographic criteria		LV mass index ♂ >115 g/m² ♀ >95 g/m² LV ejection fraction <50% E/e' ratio >14	Left atrial volume index >34 ml/m² Presence of atrial fibrillation Moderate/severe mitral regurgitation	Systolic pulmonary arterial pressure ≥60 mm Hg Moderate/severe tricuspid regurgitation	TAPSE <16 mm

Proposed staging classification based on the extent of echocardiographic signs of extra-aortic valvular cardiac damage. AS = aortic stenosis; LA = left atrial; LV = left ventricular; TAPSE = tricuspid annular plane systolic excursion.



et al. J Am Coll Cardiol. 2019;74(4):550-63.

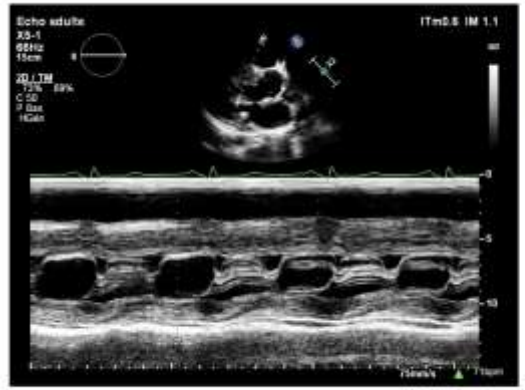
J Am Coll Cardiol 2019;74:550–63


Stage 0
Stage 1
Stage 2
Stage 3
Stage 4
Severe Aortic Stenosis
↑LVED Pressure
LV Concentric Hypertrohpy
LA dilation
LV Eccentric Hypertrohpy
Functional Mitral Regurgitation
Post-capillary Pulmonary Hypertension
Tricuspid Regurgitation
Right Ventricular Dysfunction

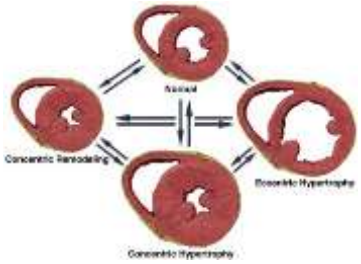
First step

Assess the consequences of AS

- Assess LV geometry



Left ventricular remodeling and hypertrophy in patients with aortic stenosis: insights from cardiovascular magnetic resonance



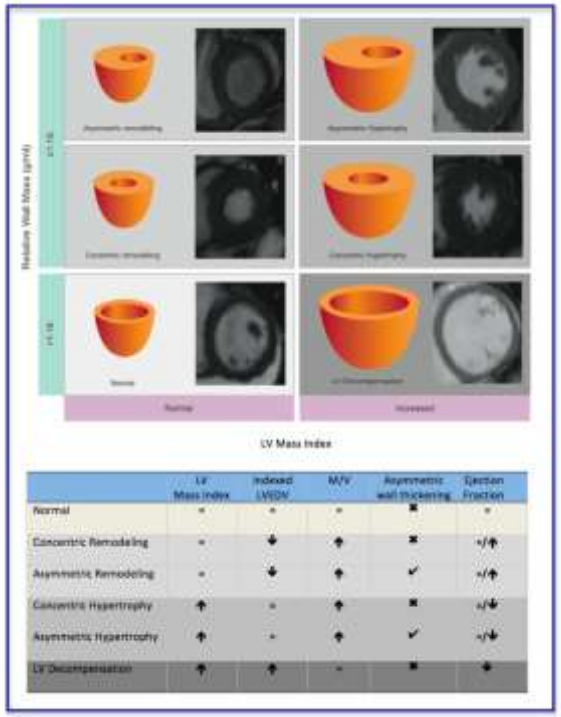
6 patterns :

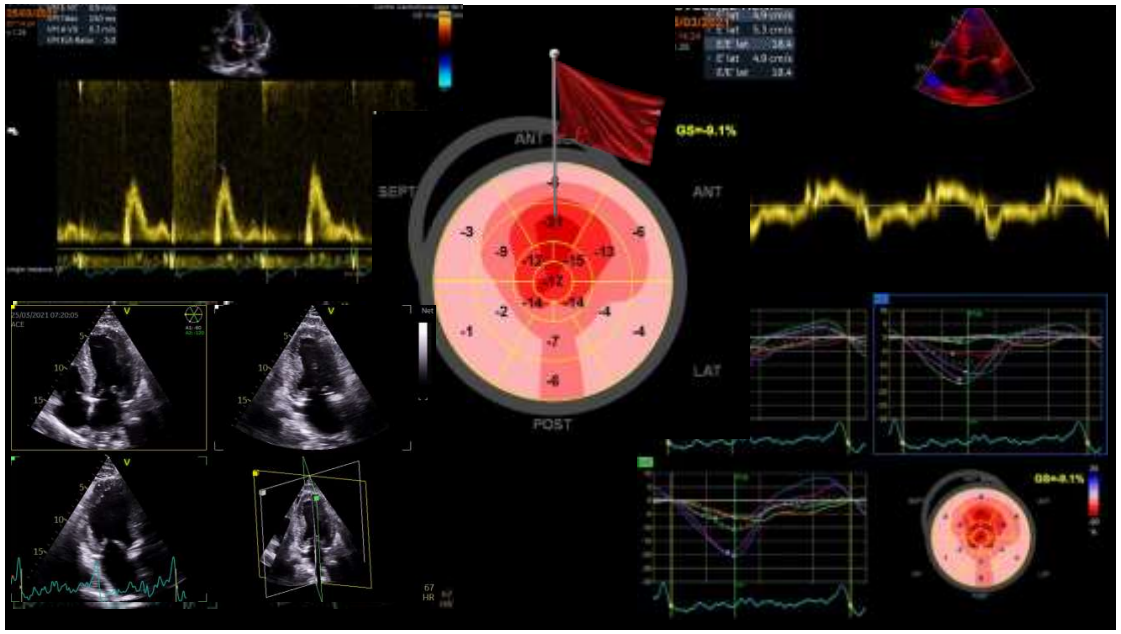
Normal

Remodeling (normal LV mass)
asymmetric
concentric

Hypertrophy (increased LV mass)
asymmetric
concentric
LV decompensation

remodeling hypertrophy





Dweck et al. Journal of Cardiovascular Magnetic Resonance 2012, 14:50


25/03/2021
07:14:24
x 1.25
VM E Vit 0.9 m/s
VM Tdéc 150 ms
VM A Vit 0.3 m/s
VM E/A Ratio 3.0
E' lat 4.9 cm/s
E' lat 5.3 cm/s
E/E' lat 18.4
E' lat 4.9 cm/s
E/E' lat 18.4
GS=-9.1%
ANT SEPT
SEPT
ANT
INF
LAT
POST
-6
-21
-3
-6
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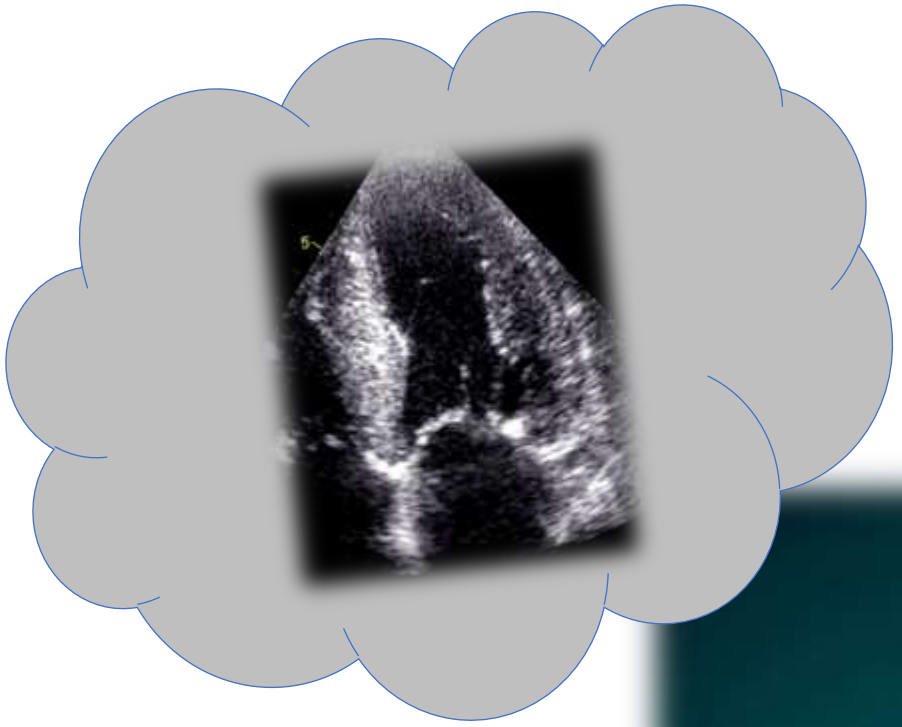
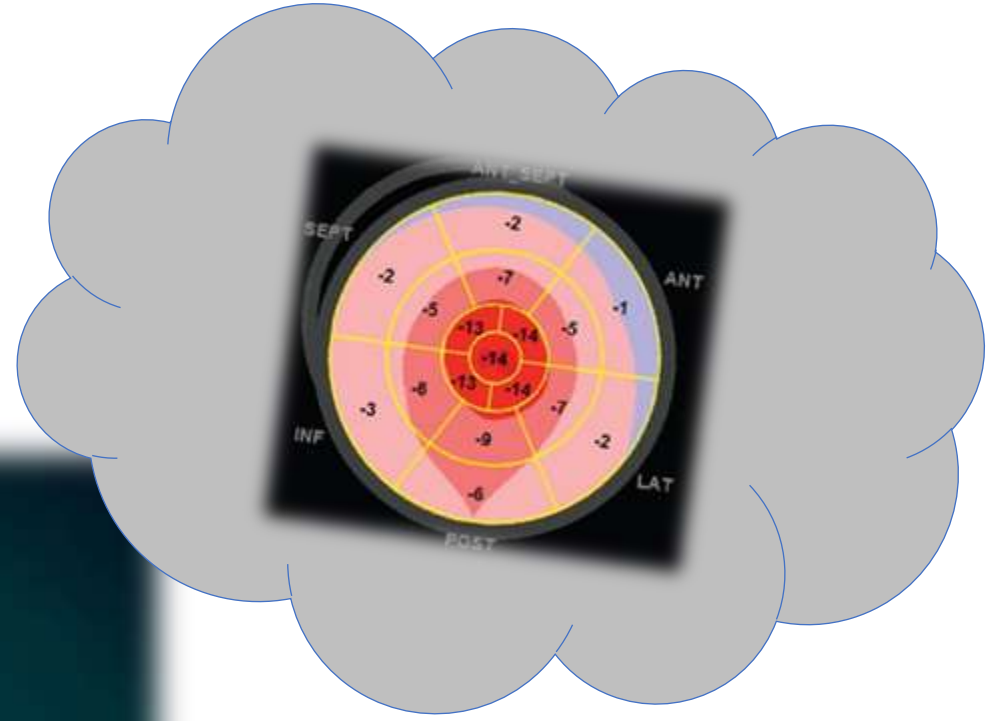
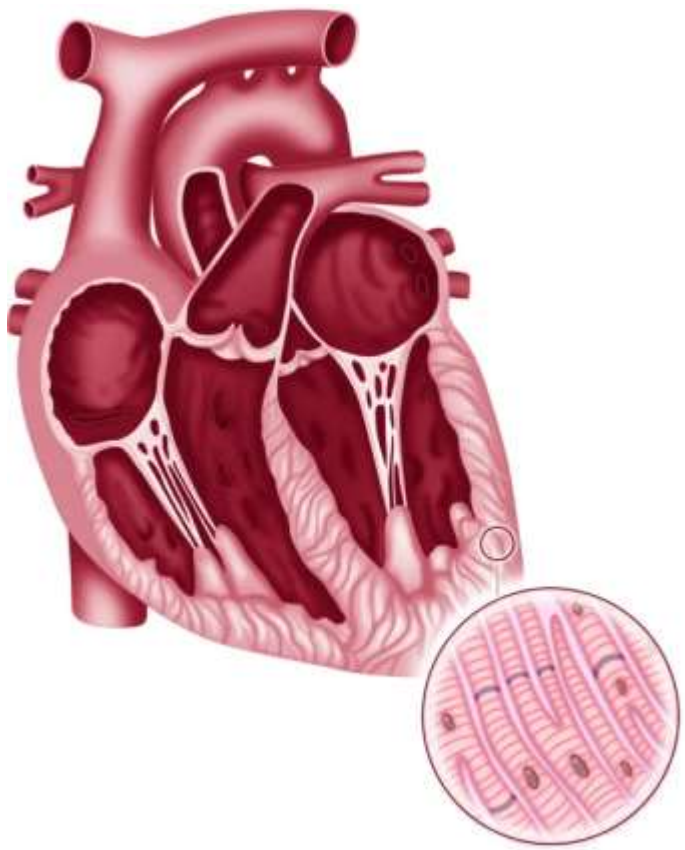
ACE
ASC
FVA
67
HR

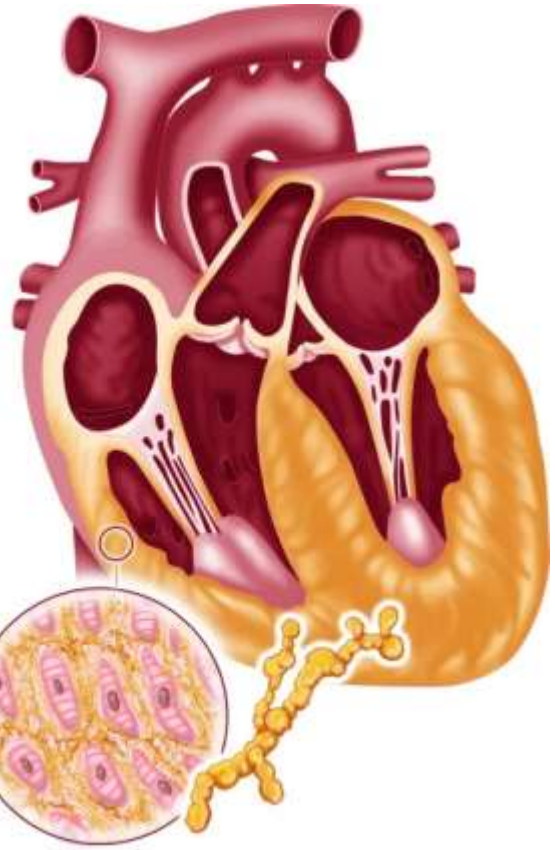


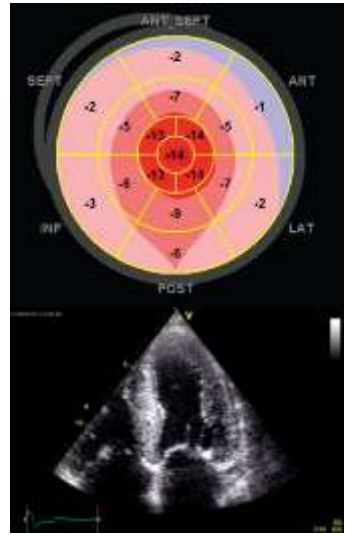
LF LG AS



Amylose cardiaque







European Heart Journal (2016) **37**, 3525–3531
doi:10.1093/eurheartj/ehw033

EHJ BRIEF COMMUNICATION
Valvular heart disease

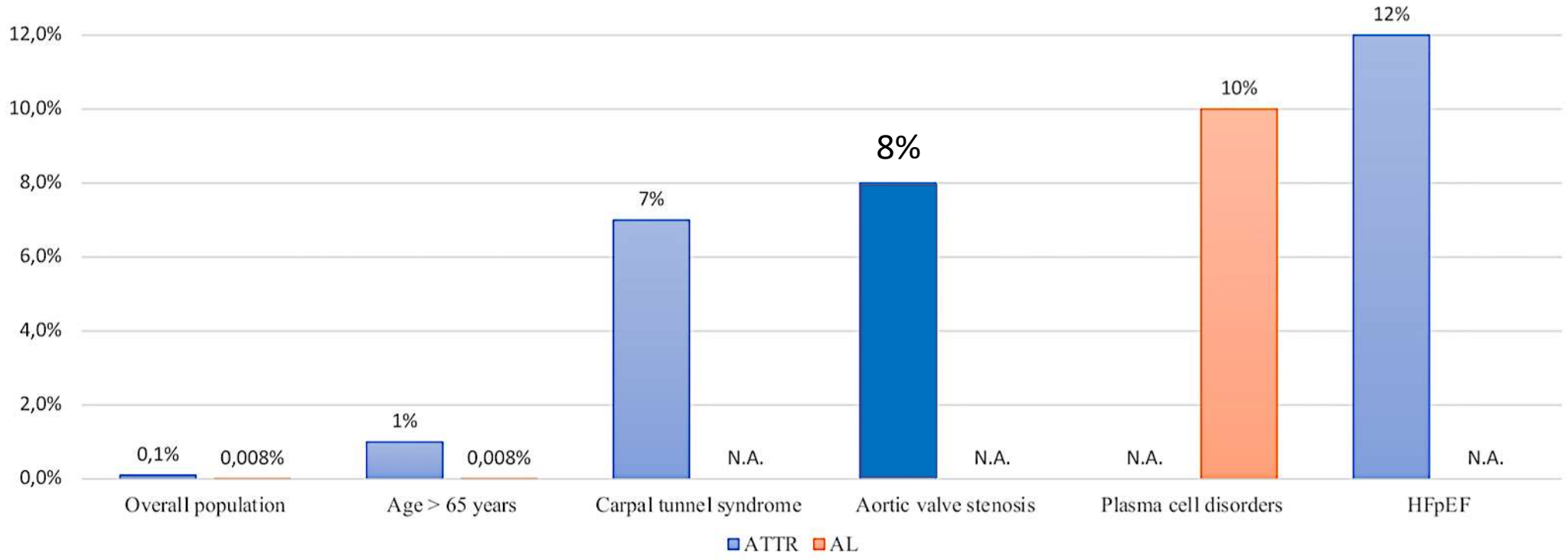
Aortic stenosis and transthyretin cardiac amyloidosis: the chicken or the egg?

Arnault Galat[1,2,3,4,5], Aziz Guellich[1,2,3,4,5], Diane Bodez[1,2,3,4,5], Michel Slama[6], Marina Dijos[7], David Messika Zeitoun[8], Olivier Milleron[8], David Attias[9], Jean-Luc Dubois-Randé[1,2,3,4,5], Dania Mohty[10], Etienne Audureau[1,2,4,5,11,12], Emmanuel Teiger[1,2,3,4,5], Jean Rosso[1,2,13], Jean-Luc Monin[1,2,3,4,5], and Thibaud Damy[1,2,3,4,5]*

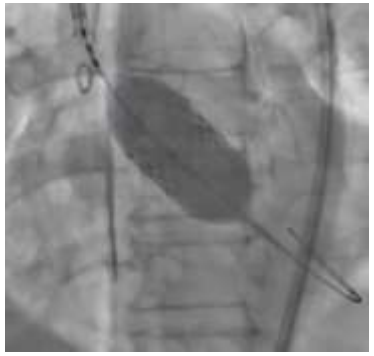
- Combination of AS and TTR-CA may occur in elderly patients particularly those with a low-flow low-gradient AS pattern & carries bad prognosis
- Diagnosis of TTR-CA in AS is relevant to discuss specific treatment and management

Prevalence of cardiac amyloidosis in different clinical settings.

La prévalence varie selon le contexte clinique et la population étudiée…

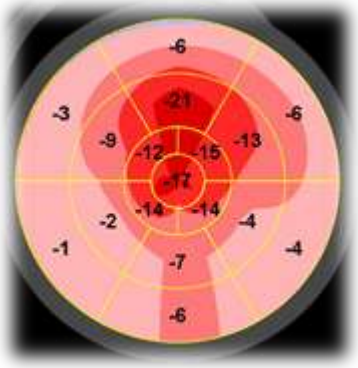


prévalence



Dans les études, la prévalence rapportée de l'amylose parmi les patients porteurs de RAC, varie entre 4 à 29%.

Parmi les patients adressés pour TAVI, elle est d'environ un patient sur huit.



1/8

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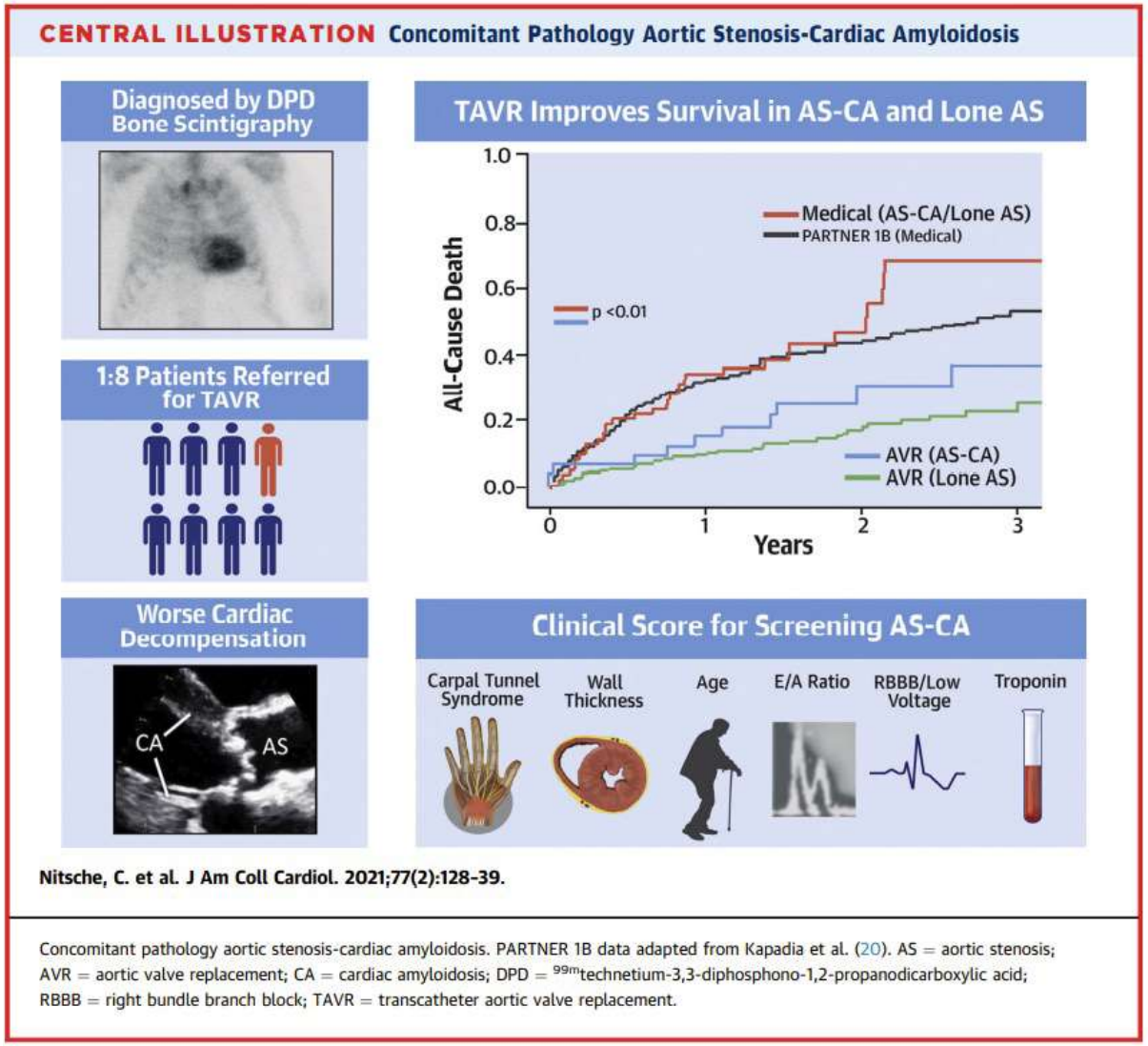
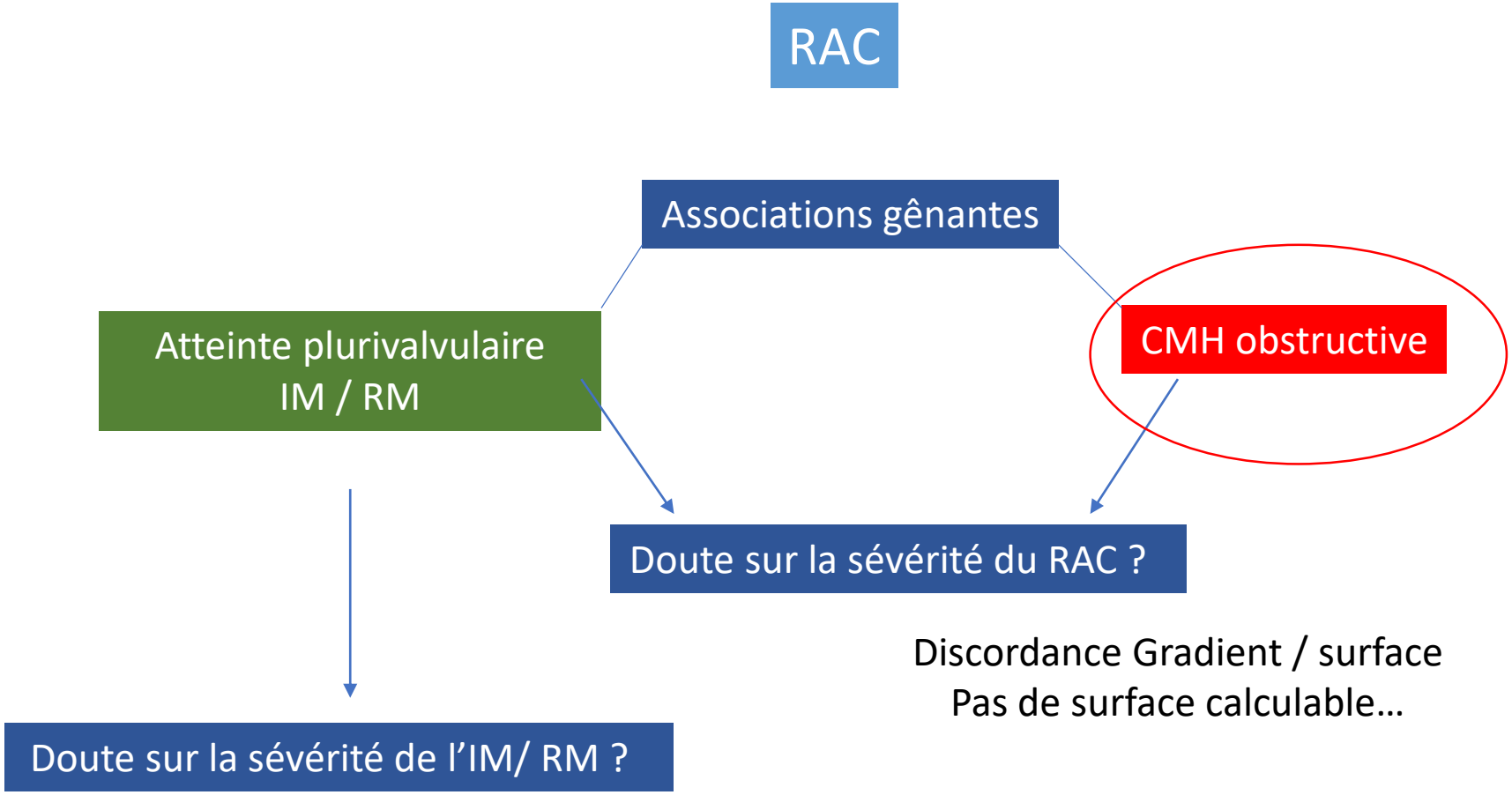
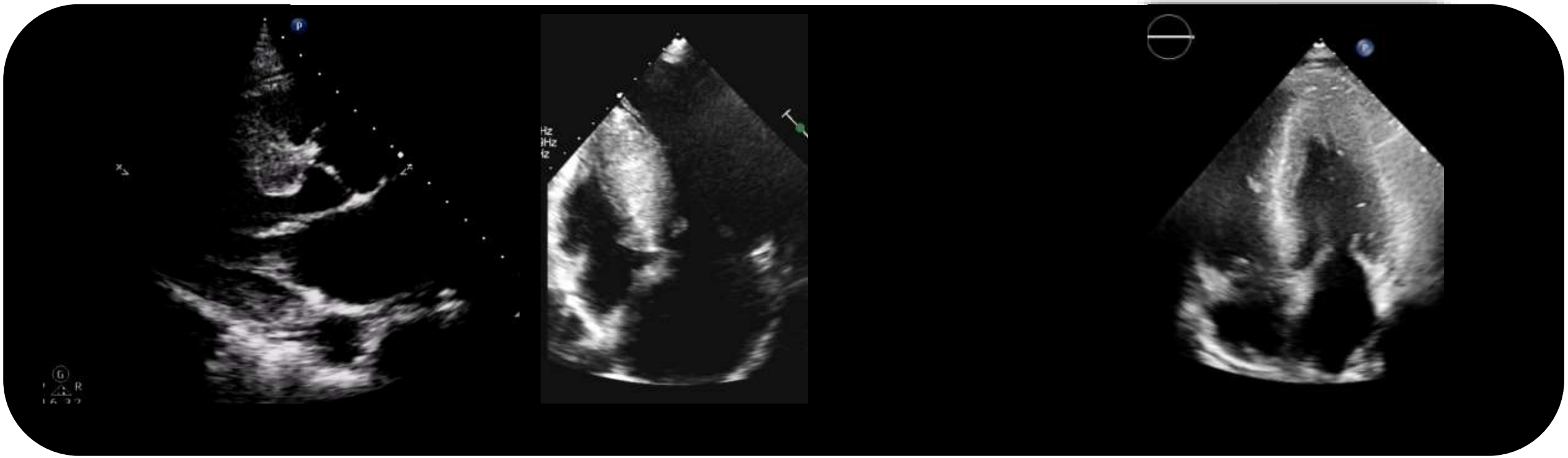


Situations complexes?

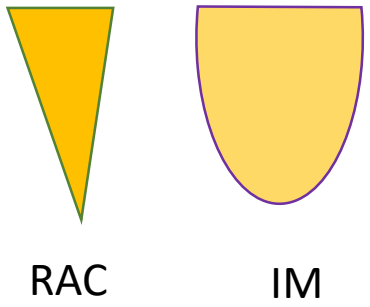


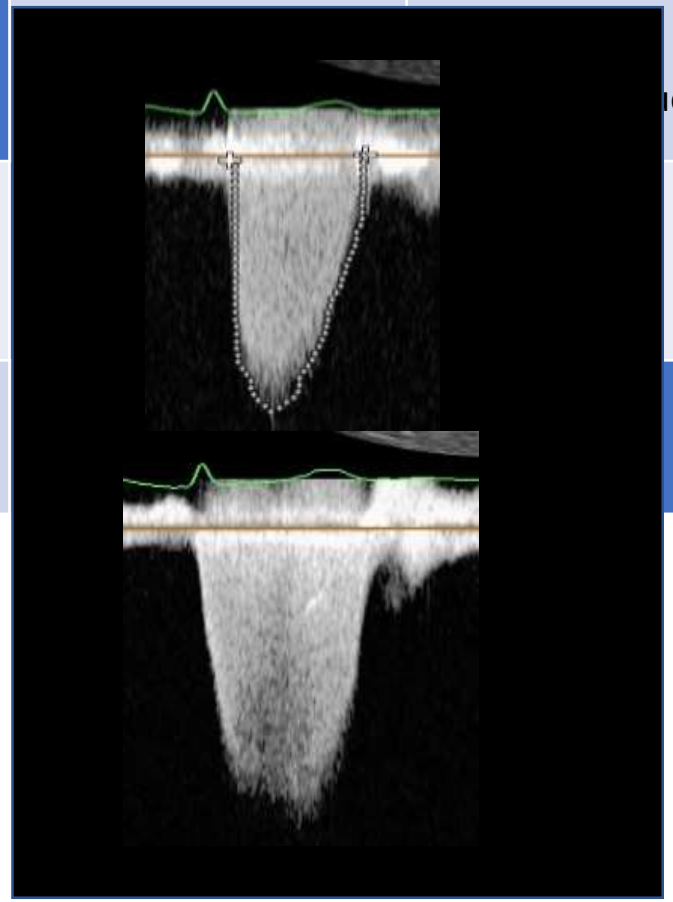
Sigmoid Reverse curve Neutral Apical

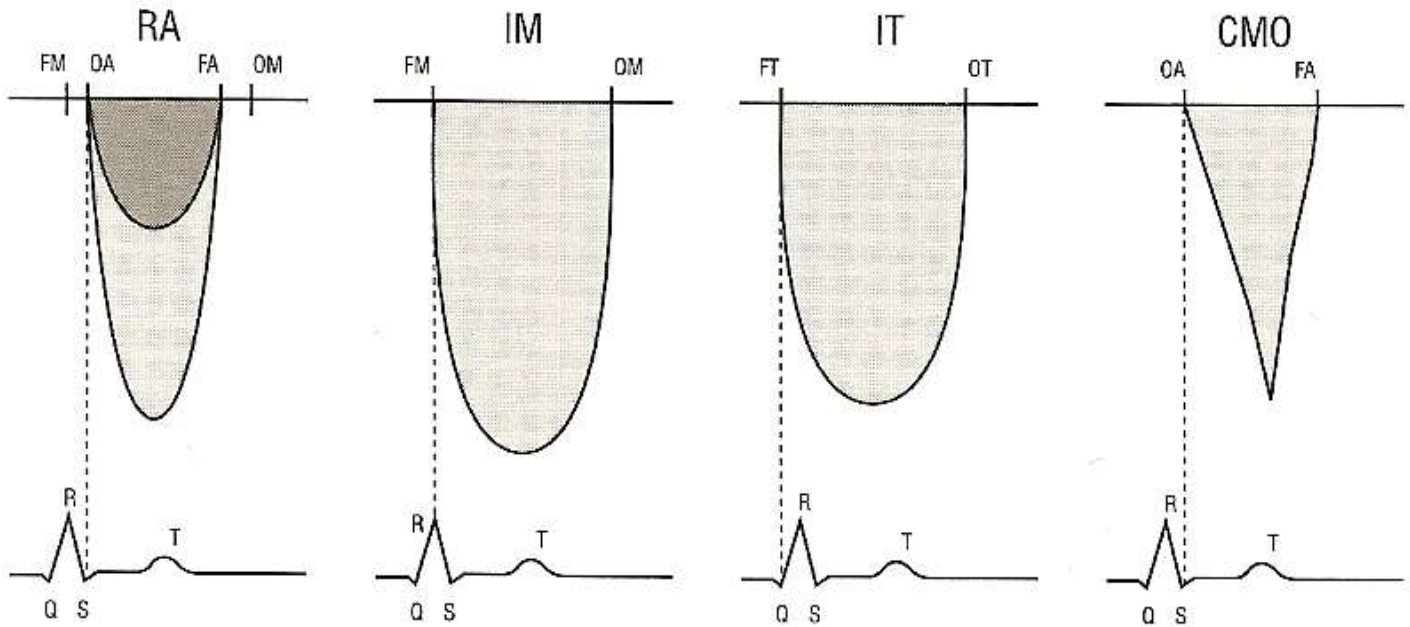


L'évaluation de….peut être modifiée

En présence de ….		RAC	Iao	RM	IM
	RAC		PHT ●	PHT ● Sous estimation de la sévérité du RM par le pht Planimétrie ●	Majoration du jet couleur PISA ++ ●
	Iao	Bernoulli ● (gradient) AVA ● V max +++ ●			●
	RM	RAC Bas débit bas gradient+++ (attention avec valvuloplastie au ballon de ne pas sous estimer le RAC+++)	Le RM masque l'hyperdebit de l'IAO		
	IM	RAC Bas débit bas gradient Ne pas confondre flux RAC / IM	PHT ●		



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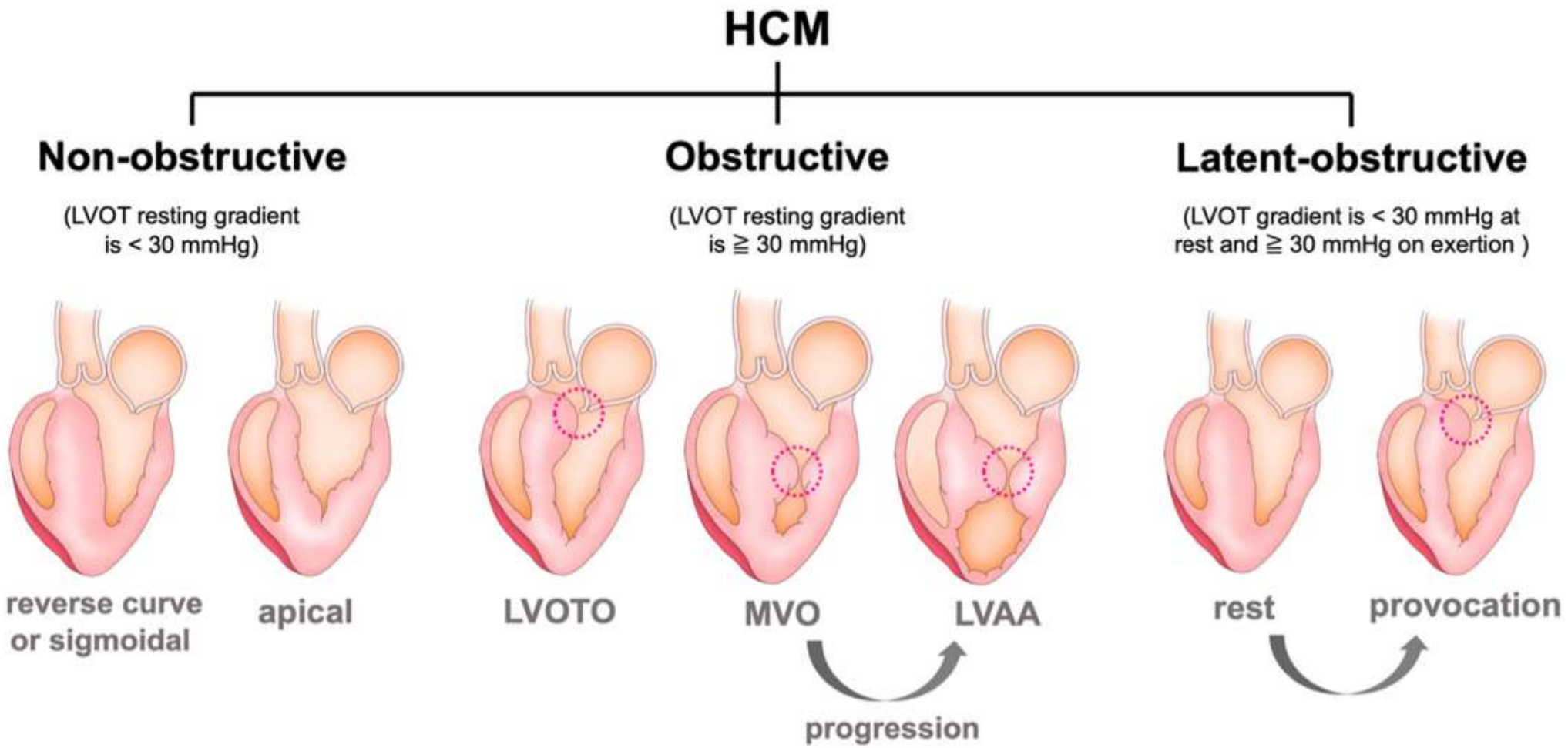
CMH et obstruction

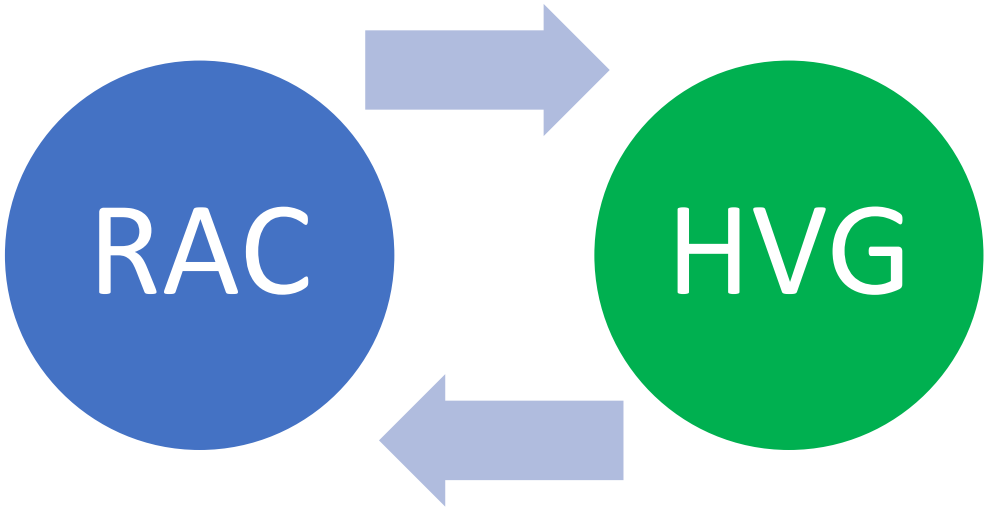


La cardiomyopathie hypertrophique

Definition

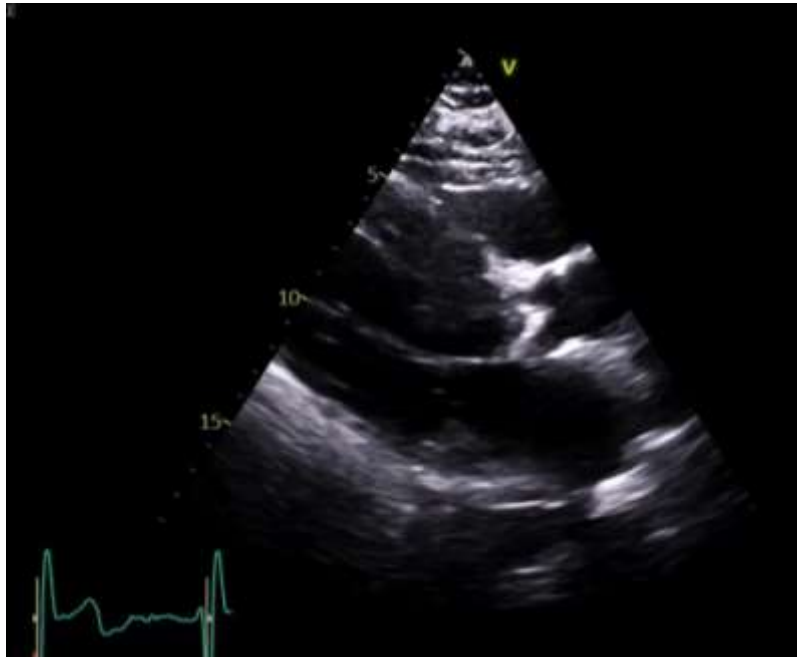
- Unexplained left ventricular hypertrophy
  - Diagnosis of exclusion – rule out HTN AS or infiltrative disorders
- Typically wall thickness ≥15 mm
  - Lesser degrees of hypertrophy might be present
  - Thickened walls are not always due to hypertrophy

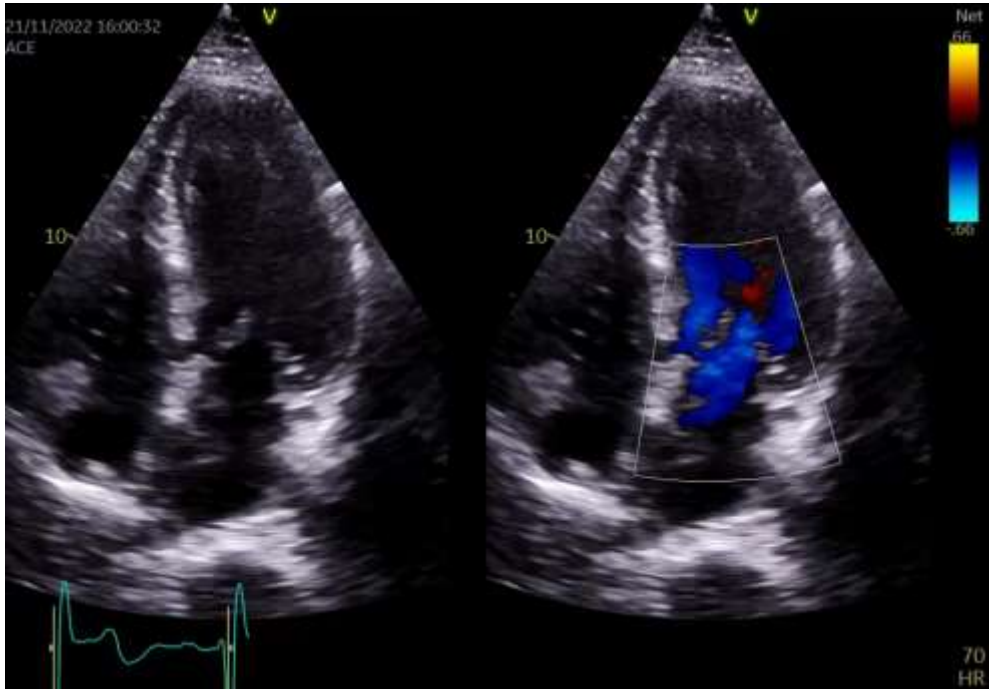
MAYO CLINIC

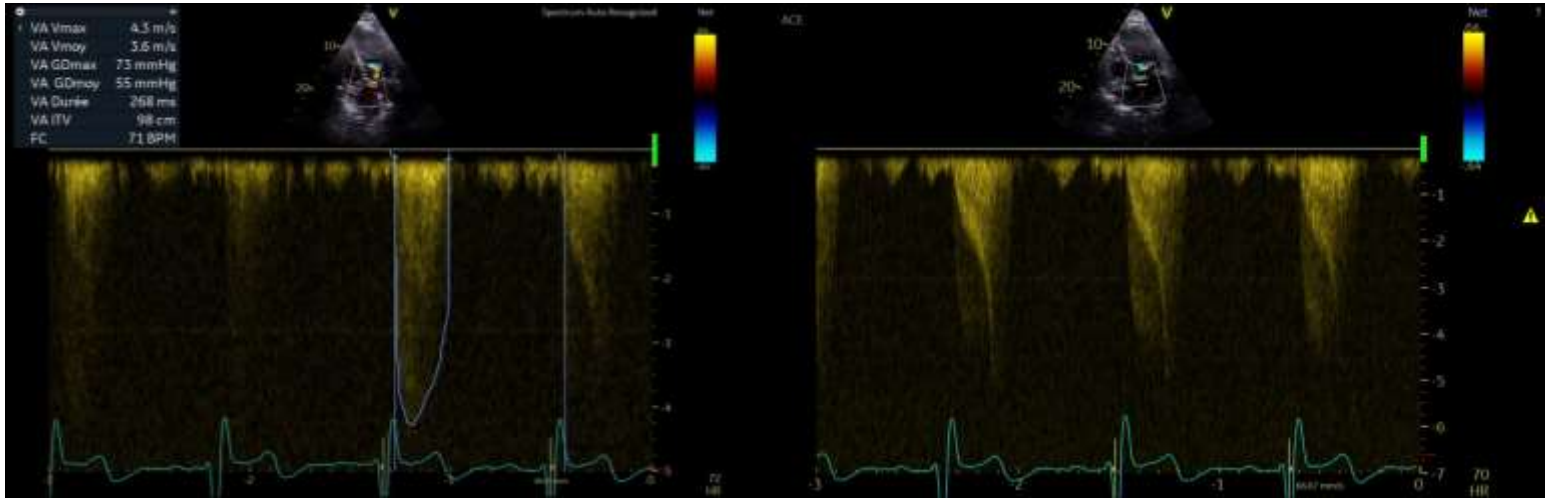


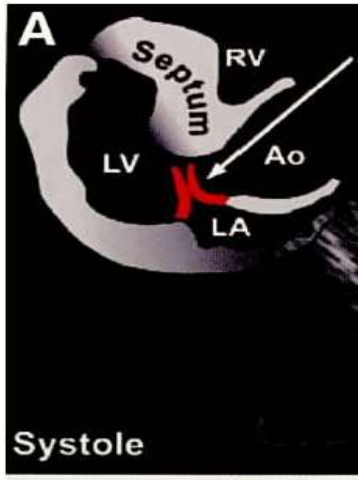
Association RAC + CMH

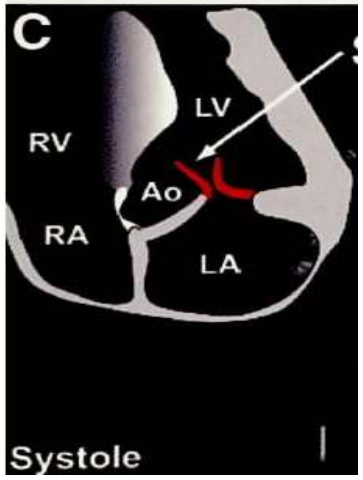
+

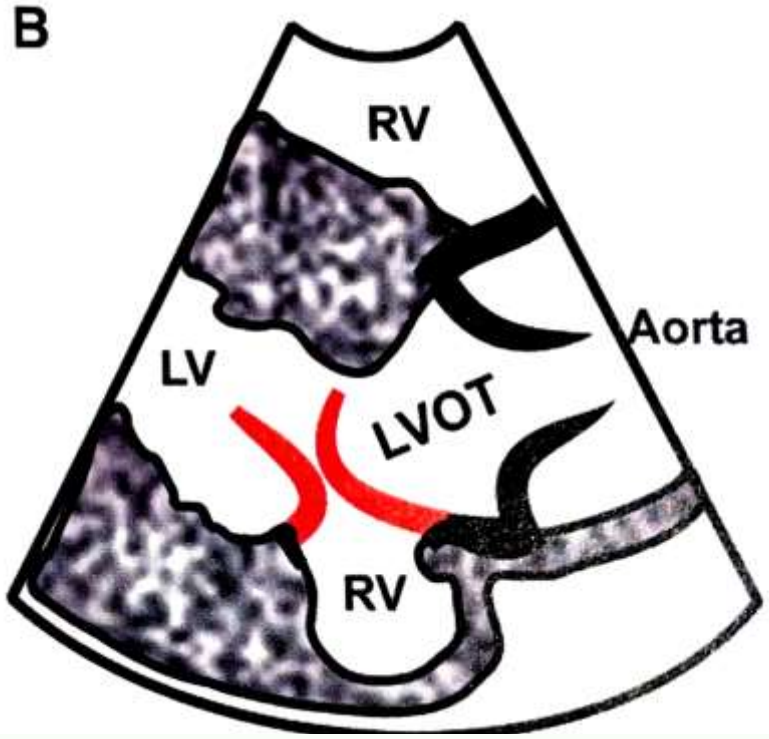


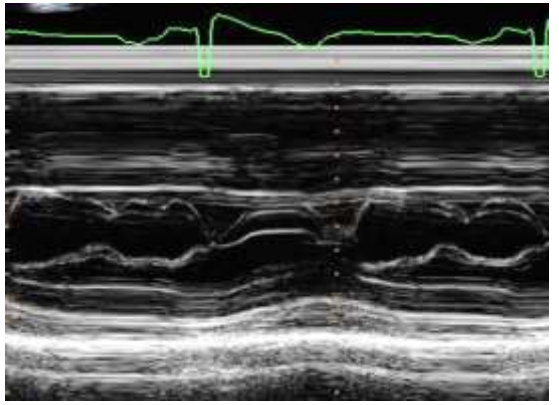




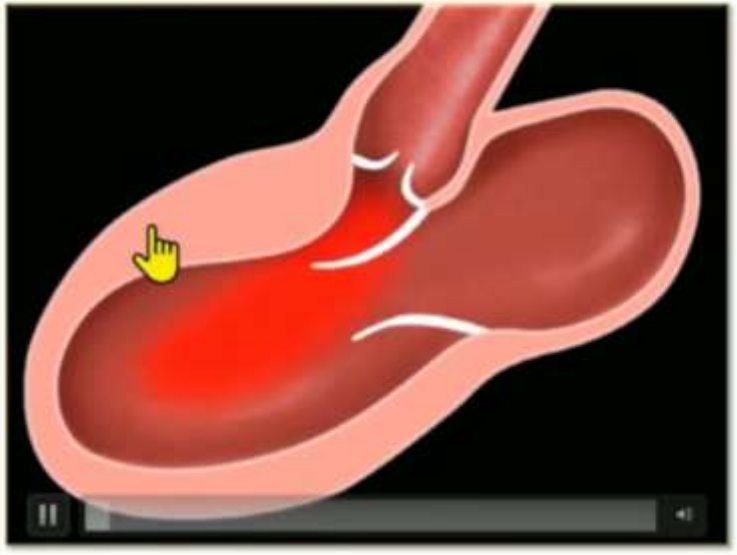


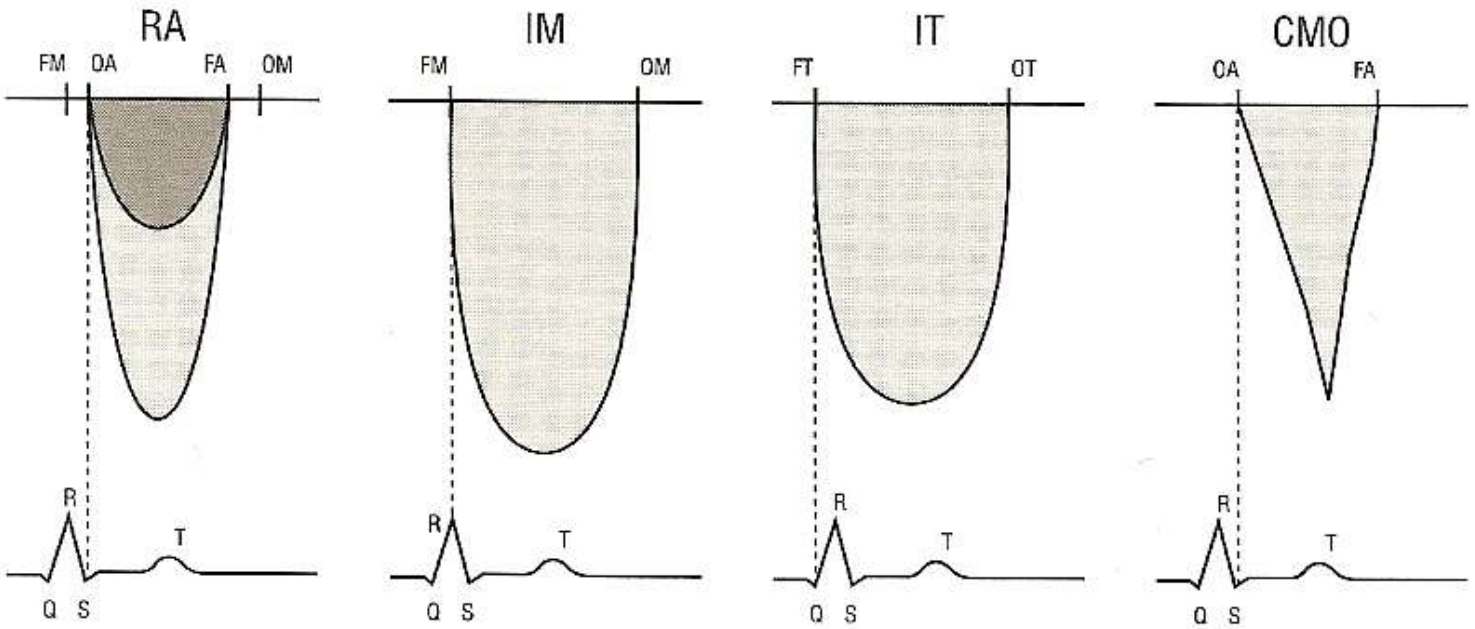






Obstruction

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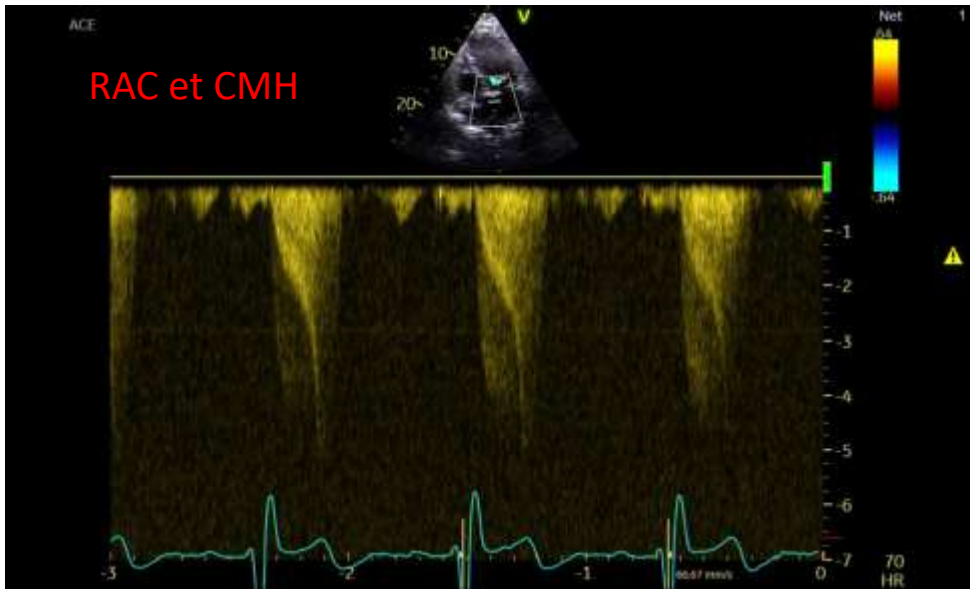
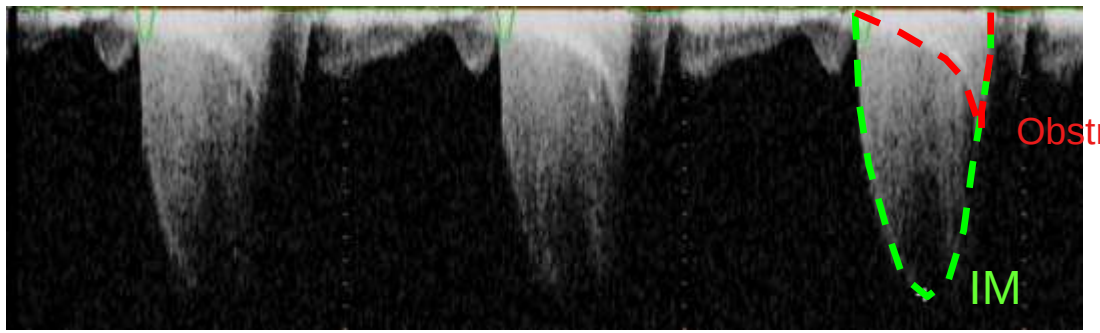
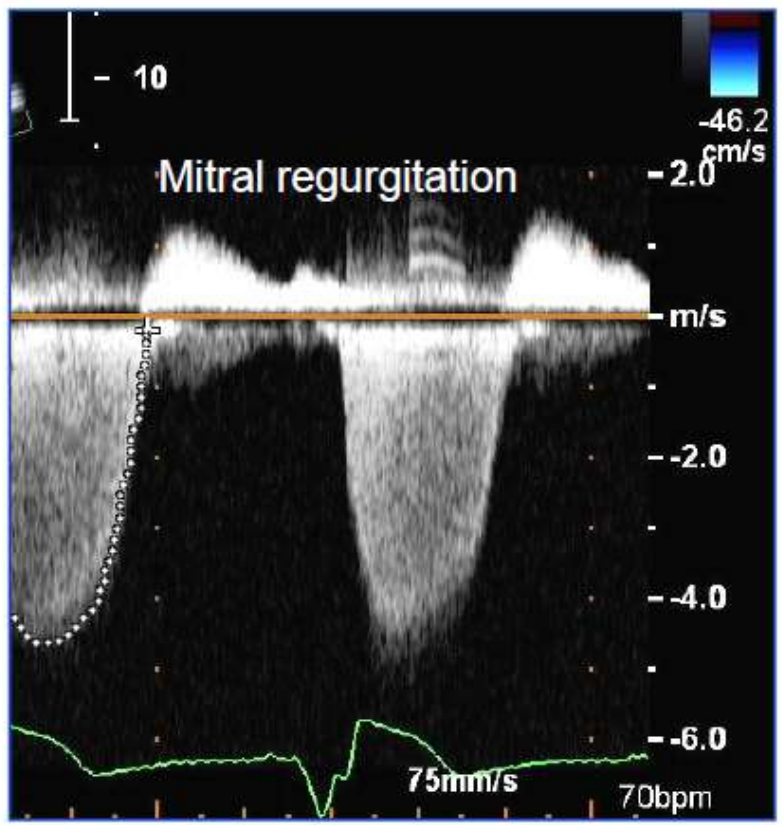
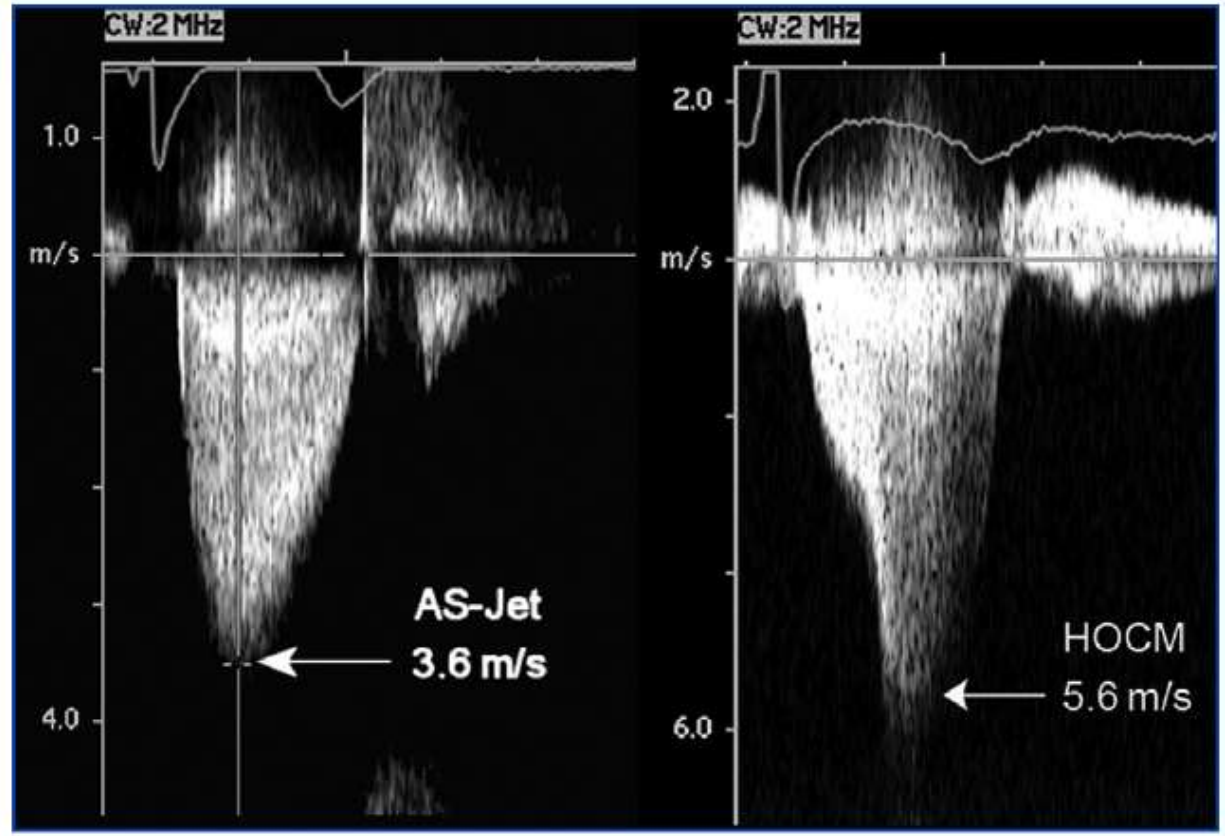
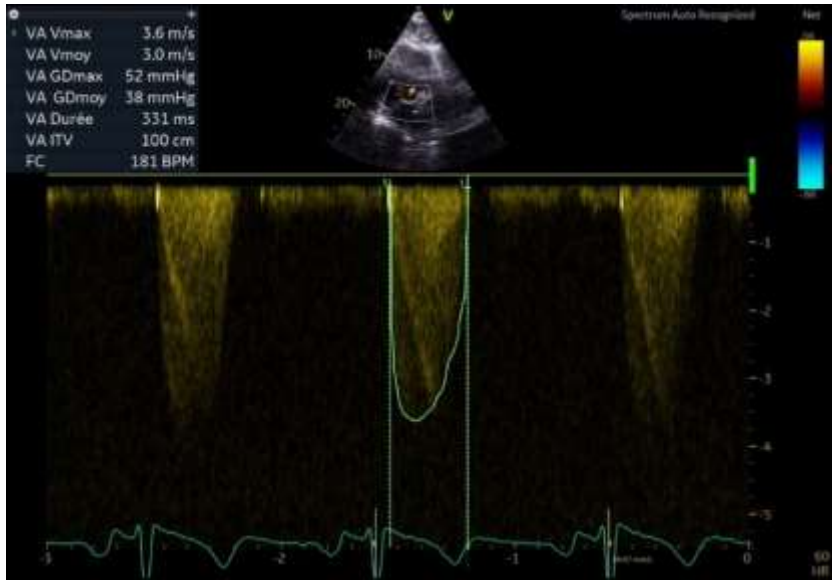

ACE
V
Net
RAC et CMH
70
HR


Obstruction
IM

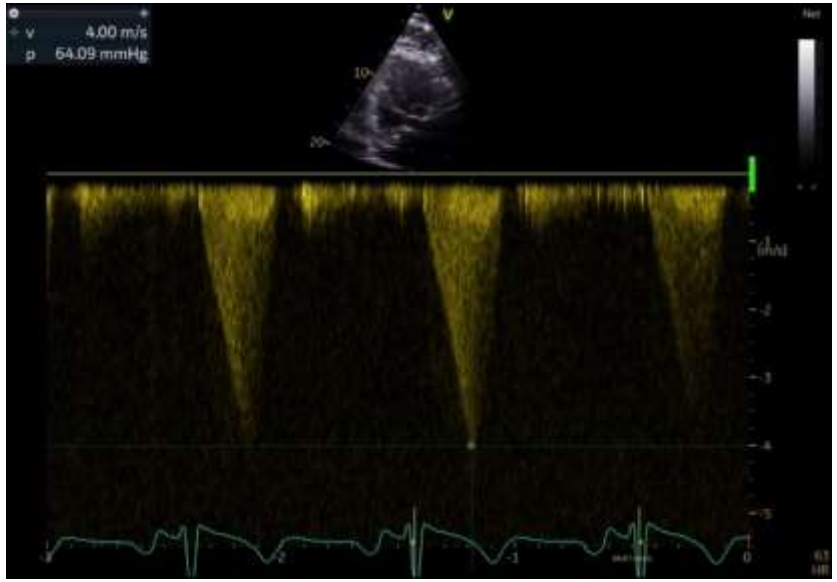

10
-46.2
cm/s
Mitral regurgitation
2.0
m/s
-2.0
-4.0
-6.0
75mm/s
70bpm


CW:2 MHz
1.0
m/s
4.0
AS-Jet
3.6 m/s
CW:2 MHz
2.0
m/s
6.0
HOCM
5.6 m/s

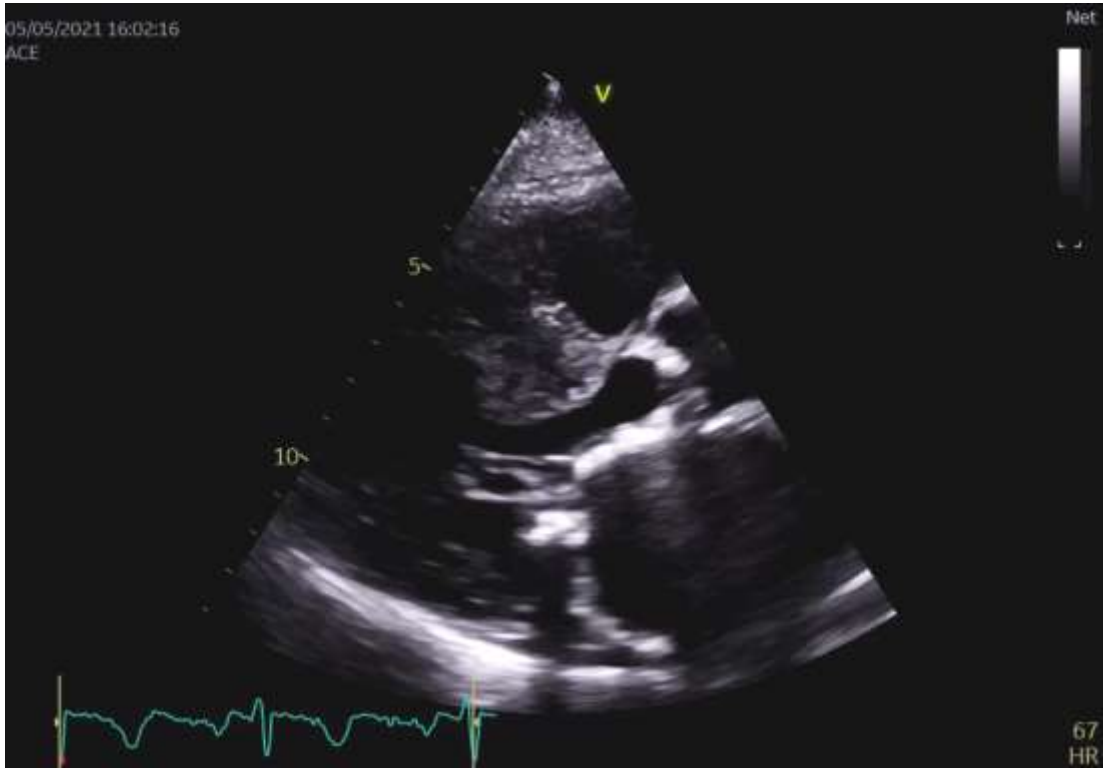
RAC + CMH sarcomérique obstructive



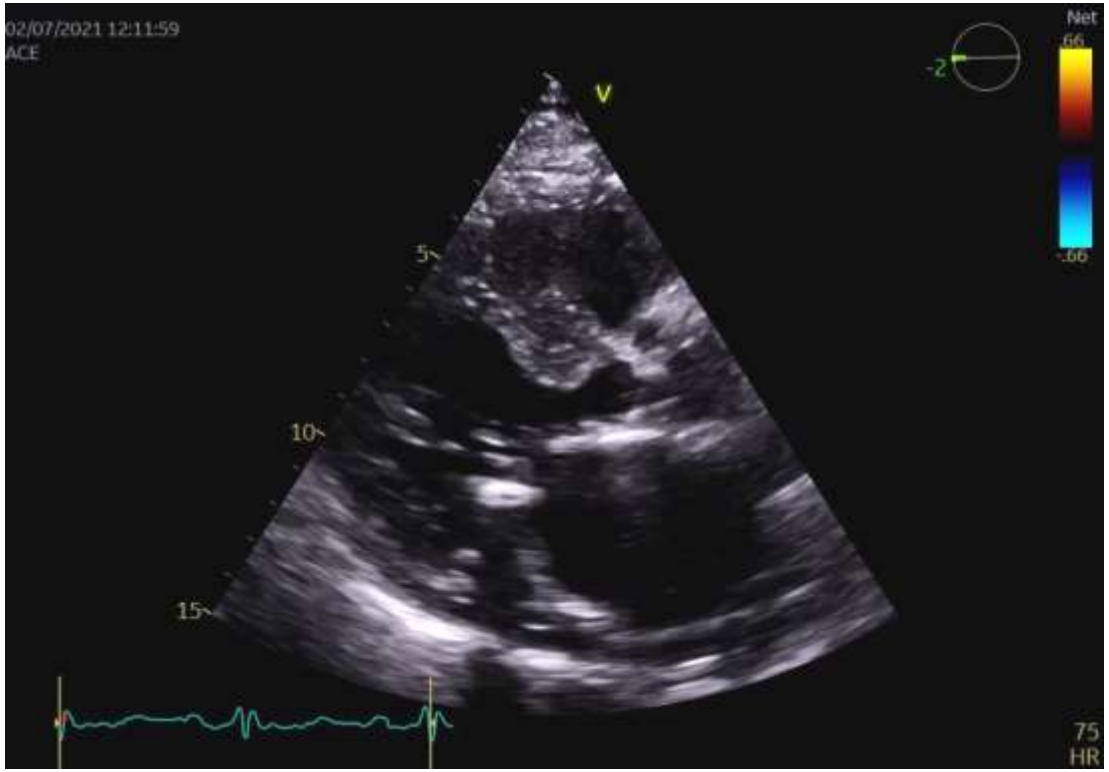
Sao non calculable

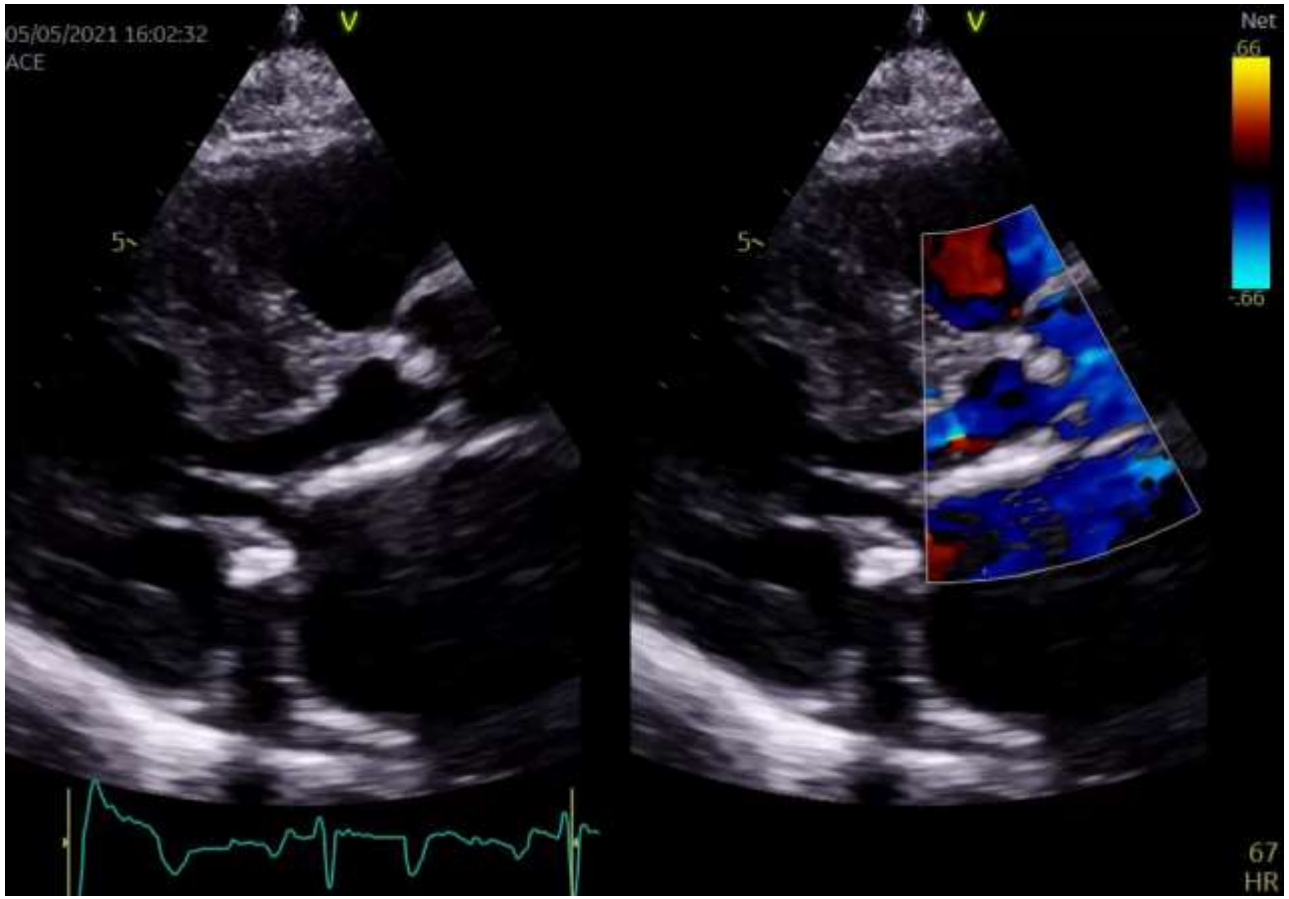


Avant alcoolisation



Après alcoolisation




05/05/2021 16:02:32
ACE
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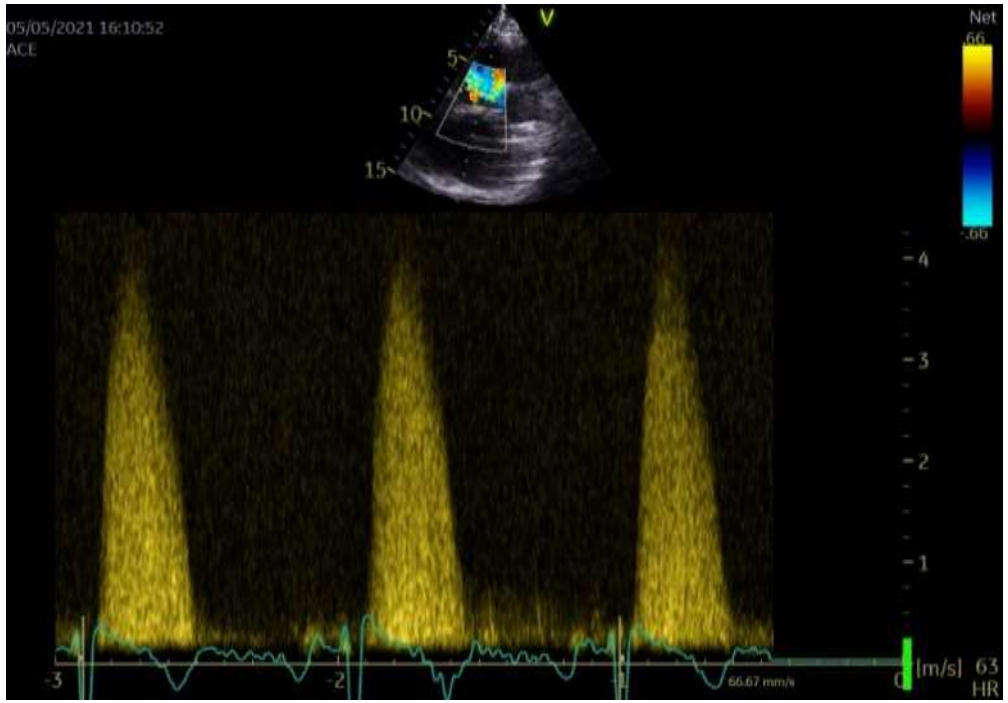
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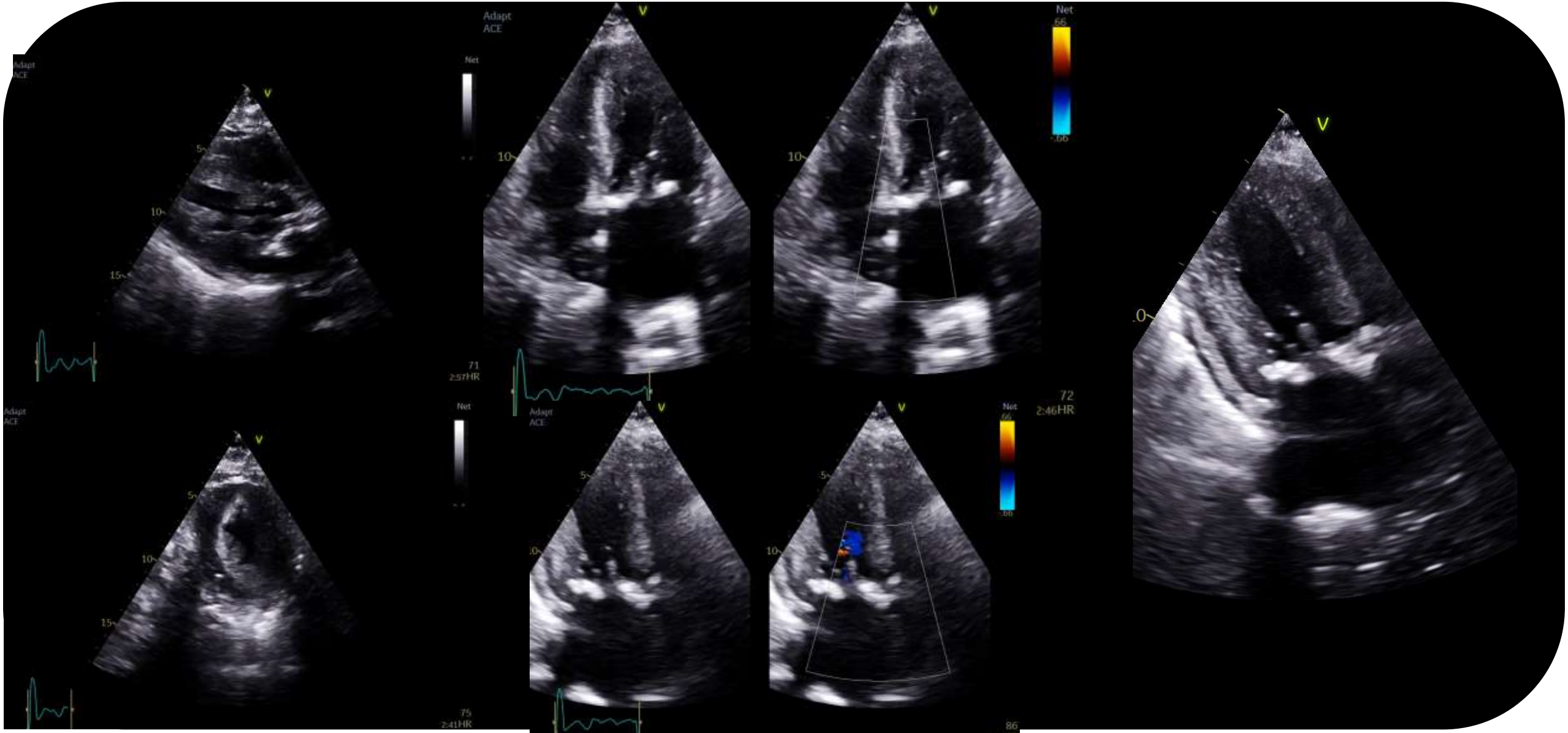
HR

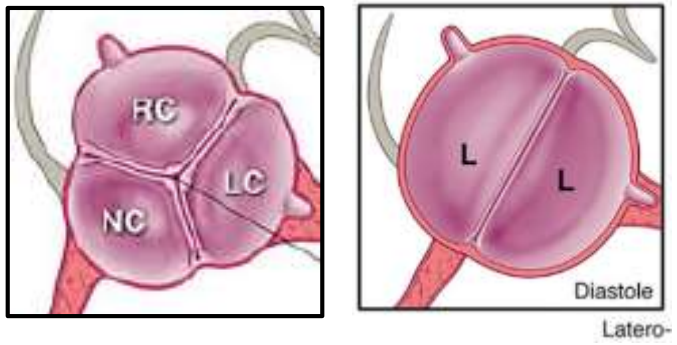
RAC + CMH + RM/MAC = OMG



2nd step

Look at the valve: Bi or Tricuspide?

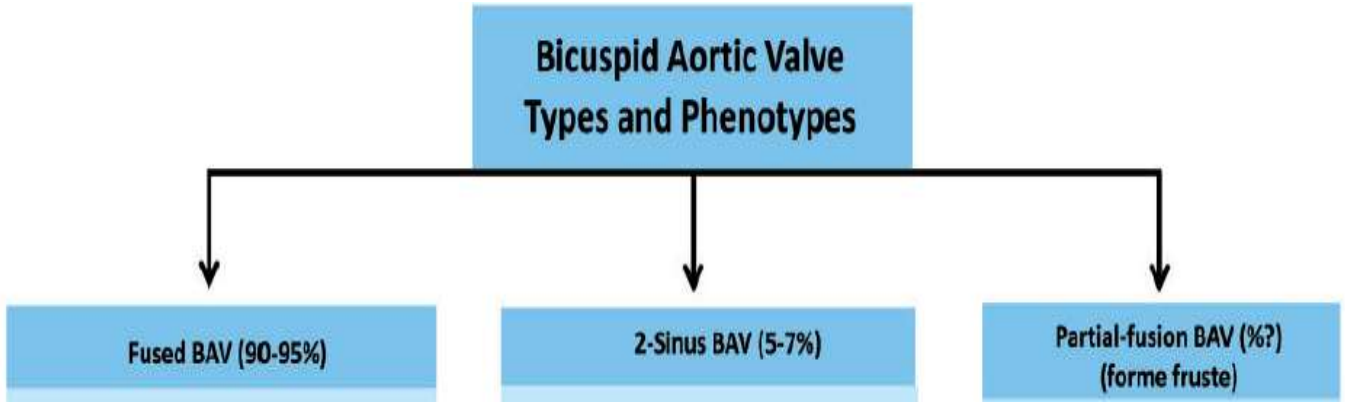
- Not easy when heavily calcified (CT scan?)
- Systolic Dooming
- Large annulus
- Family screening



Filamin A heart valve disease as a genetic cause of inherited bicuspid and tricuspid aortic valve disease

Constance Delwarde [1], Claire Toquet [1], Anne Sophie Boureau [1], Robin Le Ruz [1], Solena Le Scouarnec [1], Jean Mérot [1], Florence Kyndt [1], Daniel Bernstein [2], Jonathan A Bernstein [2], Jan J J Aalberts [3], Hervé Le Marec [1], Jean-Jacques Schott [1], Jean-Christian Roussel [1], Thierry Le Tourneau [1], Romain Capoulade [1]

Heart 2023 Dec 26:heartjnl-2023-323491



Unicuspidie

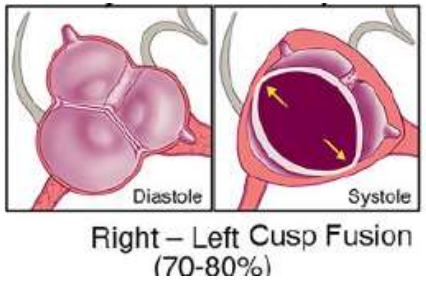
Quadricuspid

1 raphé

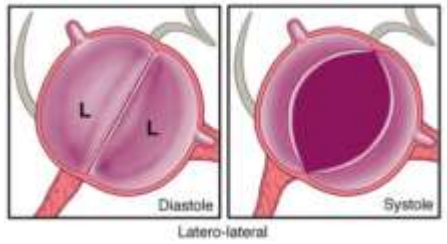
Pas de raphé

Petit raphé

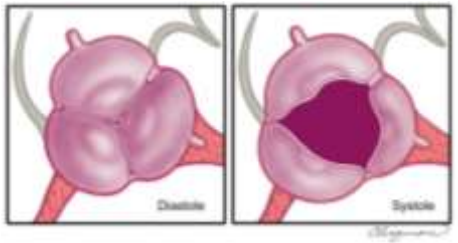
2 raphés

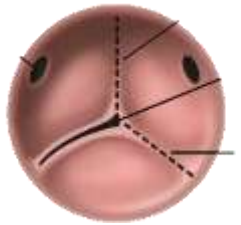


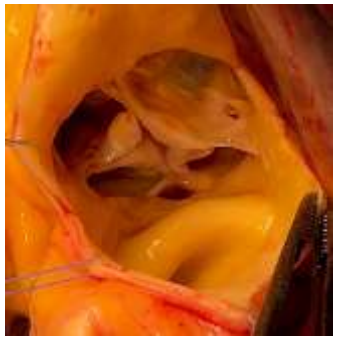
Right – Left Cusp Fusion
(70-80%)



Latero-lateral





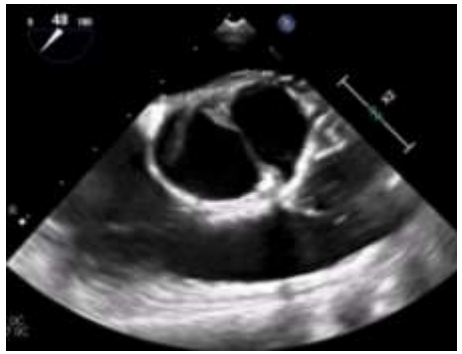


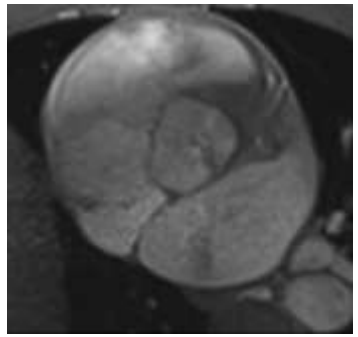
Type I

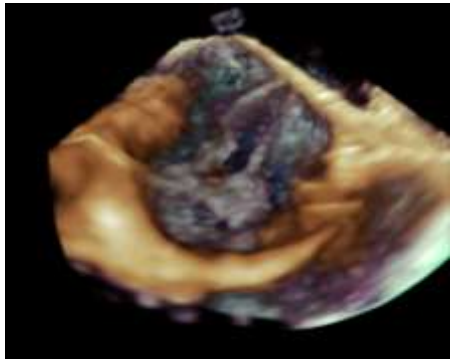
Type 0

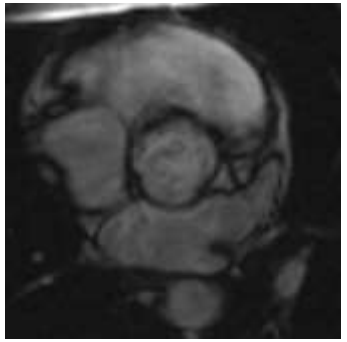
Forme fruste

Type II









2nd step

- Look at the valve: Bi or Tricuspide?

Age Related Etiology

Congenital (uni- or bicuspid): <30 yrs

Calcified bicuspid: 40 – 60 yrs

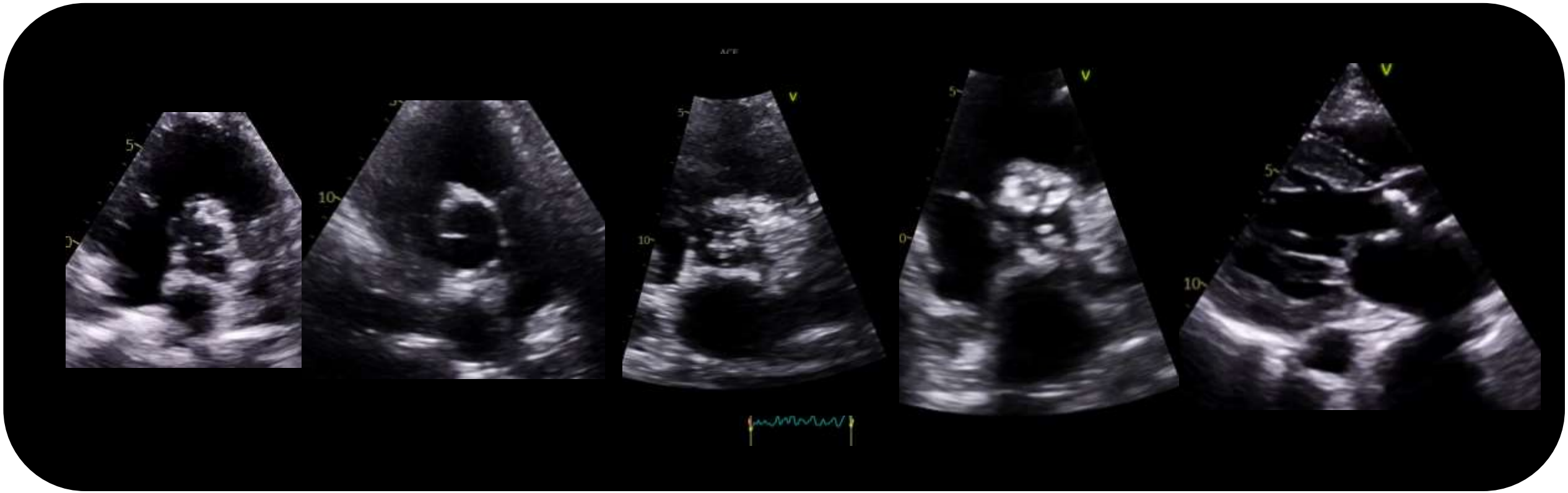
Rheumatic: <65 yrs

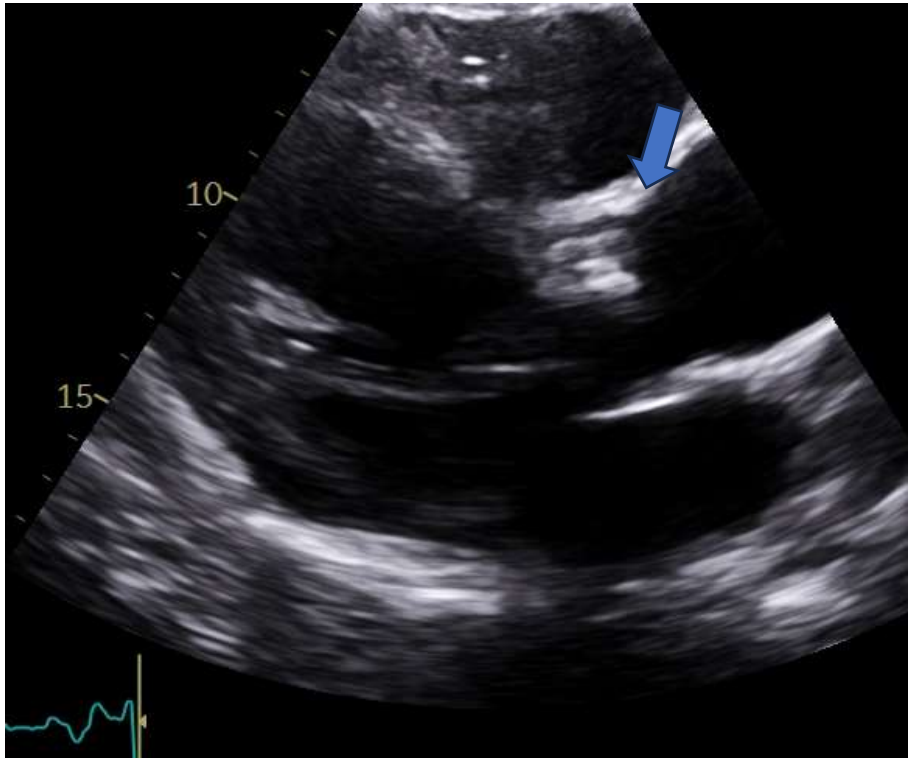
Senile degenerative: >75 yrs (most common cause of aortic stenosis)

2nd step

Look at the valve:

- Calcified ?

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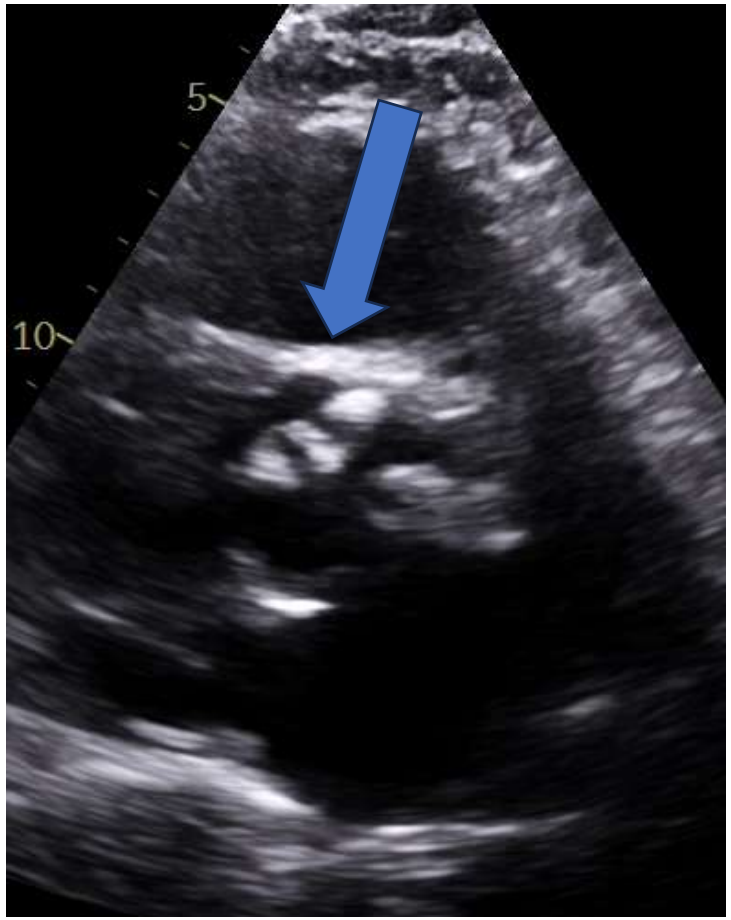
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Artificial intelligence

Screening?

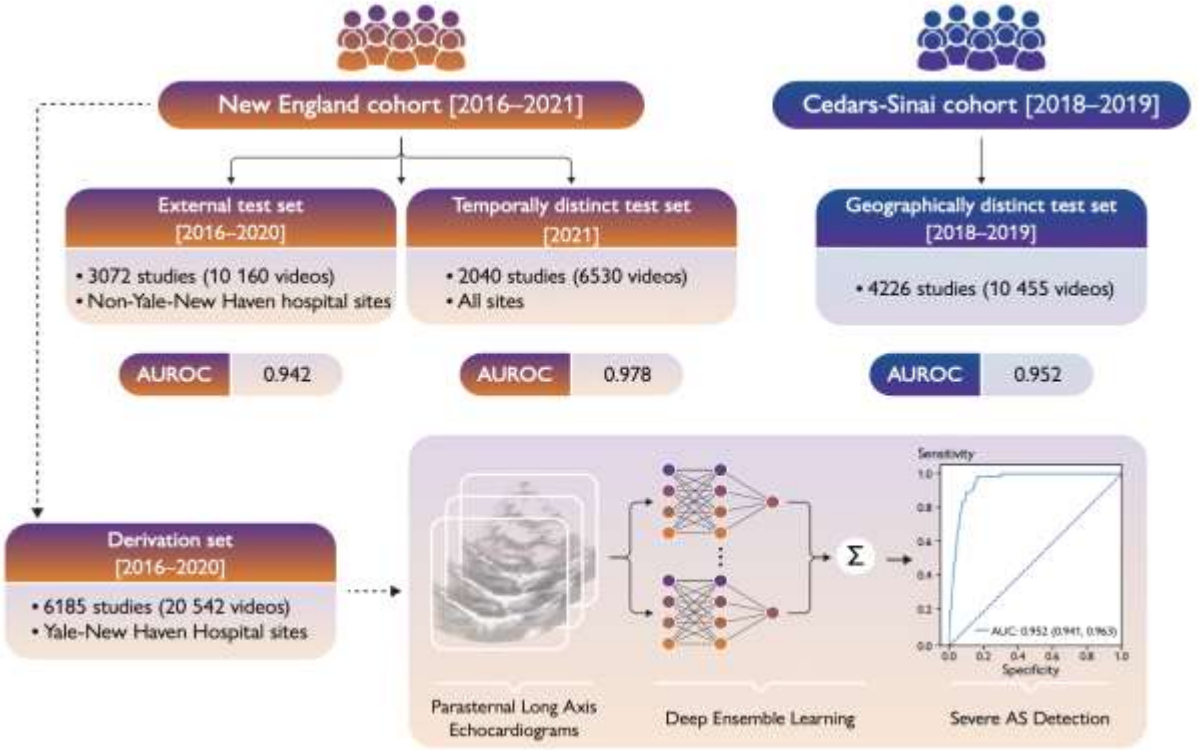
ESC European Society of Cardiology
European Heart Journal (2023) **44**, 4592–4604
https://doi.org/10.1093/eurheartj/ehad456

CLINICAL RESEARCH
Digital health and innovation

Severe aortic stenosis detection by deep learning applied to echocardiography

Gregory Holste [1,2†], Evangelos K. Oikonomou [2†], Bobak J. Mortazavi[3,4], Andreas Coppi[2,4], Kamil F. Faridi[2], Edward J. Miller [2], John K. Forrest[2], Robert L. McNamara[2], Lucila Ohno-Machado [5], Neal Yuan[6,7], Aakriti Gupta[8], David Ouyang[8,9], Harlan M. Krumholz[2,4,10], Zhangyang Wang[1], and Rohan Khera [2,4,5,11*]

Single view : parasternal long axis

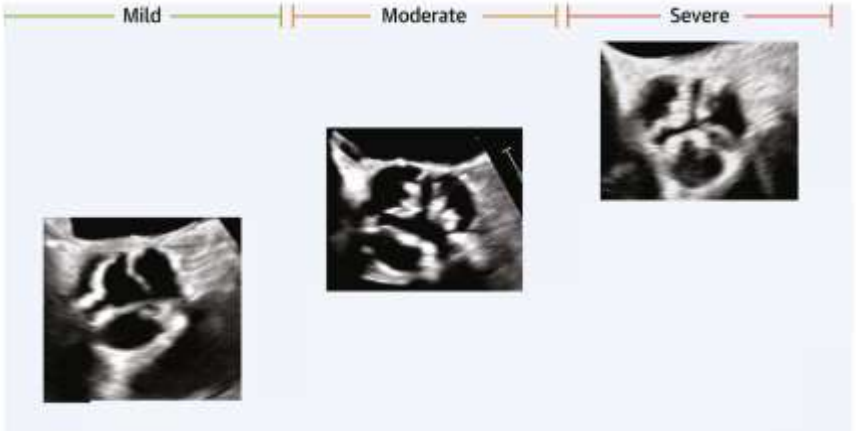


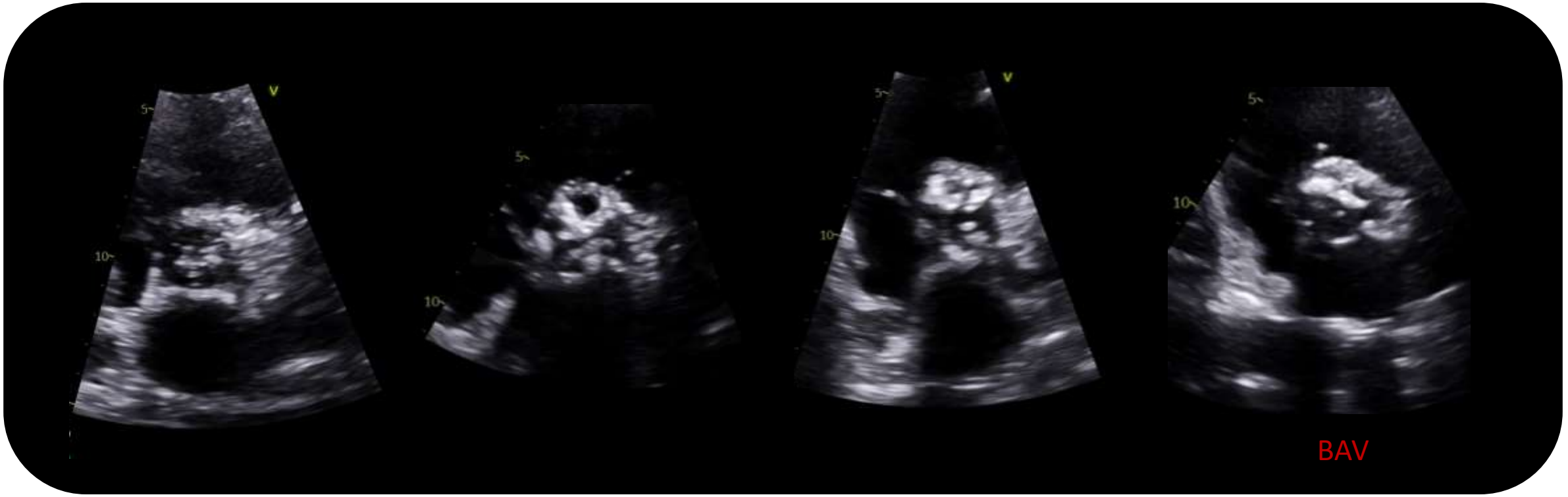
European Heart Journal (2023) **44**, 4592–4604

2nd step

Look at the valve:

- Calcified ? Ok but how much???

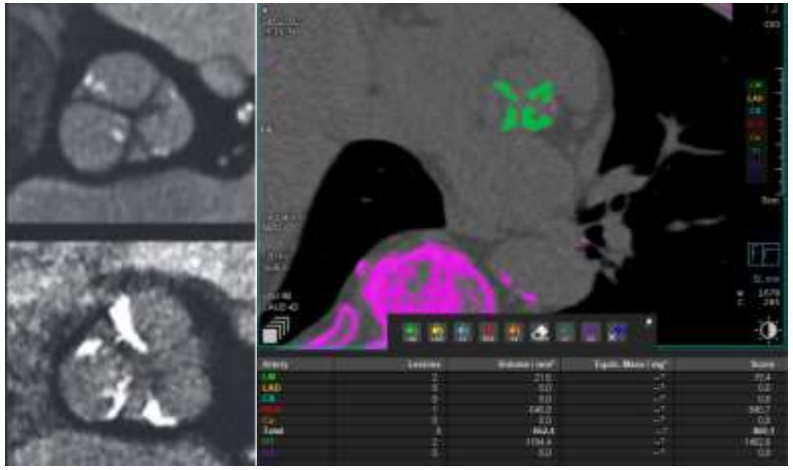


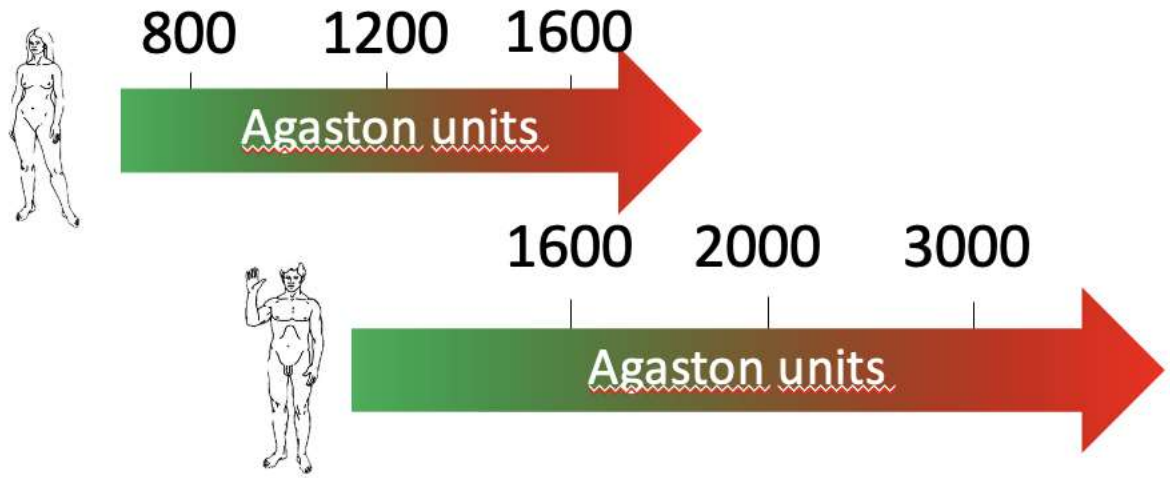


2nd step

Look at the valve:

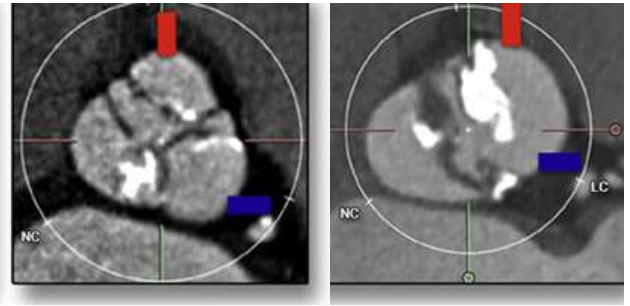
- Calcified ?





Calcium score in BAV vs TAV

Different cut-off between BAV / TAV and gender

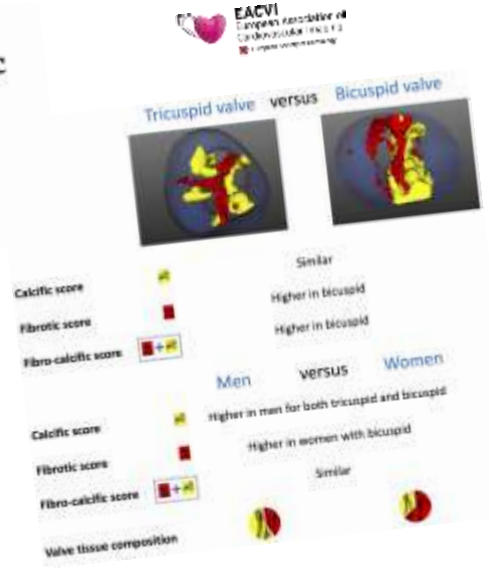


Influence of cusp morphology and sex on quantitative valve composition in severe aortic stenosis

Get access

Kush P Patel, Andrew Lin, Niraj Kumar, Giulia Esposito, Kajetan Grodecki, Guy Lloyd, Anthony Mathur, Andreas Baumbach, Michael J Mullen, Michelle C Williams, David E Newby, Thomas A Treibel, Marc R Dweck, Damini Dey

In severe aortic stenosis, bicuspid valves have proportionately more fibrosis than tricuspid valves, especially in women.

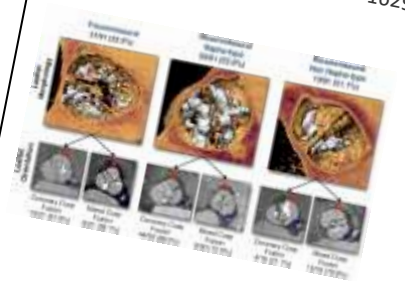


Eur Heart J Cardiovasc Imaging, jead142, https://doi.org/10.1093/ehjci/jead142

Computed tomography calcium scoring in aortic stenosis: bicuspid versus tricuspid morphology

Zi Ye, Marie-Annick Clavel, Thomas A Foley, Philippe Pibarot, Maurice Enriquez-Sarano, Hector I Michelena

1957 patients, 328 had BAV and 1629 had TAV



Best thresholds for severe AS diagnosis in BAV-men were 2916 AU by AVC_{scor}

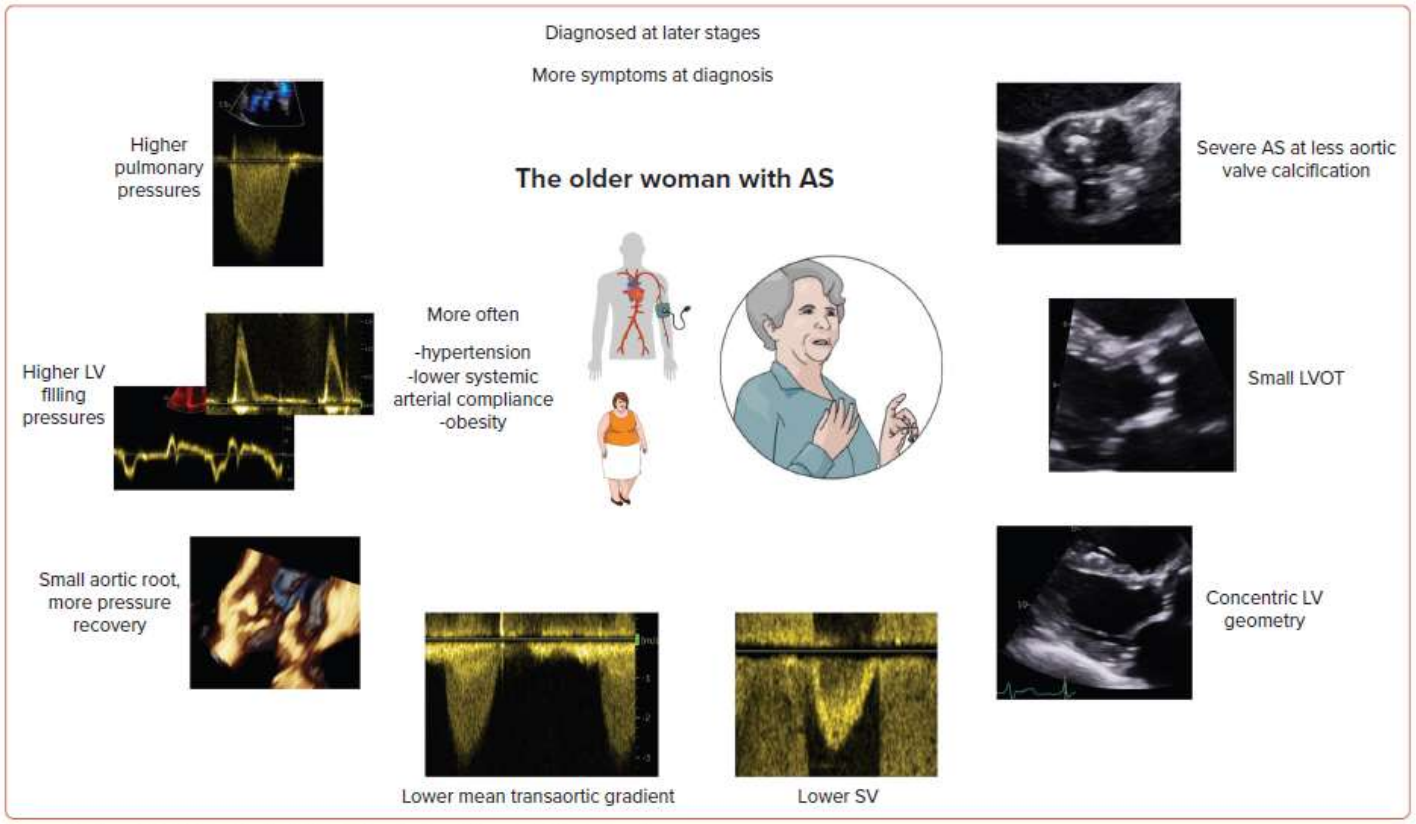
Valve calcification in AS differs according to valve morphology and sex.

BAV-men with severe AS exhibit greater AVC_{score} and $AVC_{density}$ than TAV-men.

Heart 2023 https://doi.org/10.1136/heartjnl-2023-323281

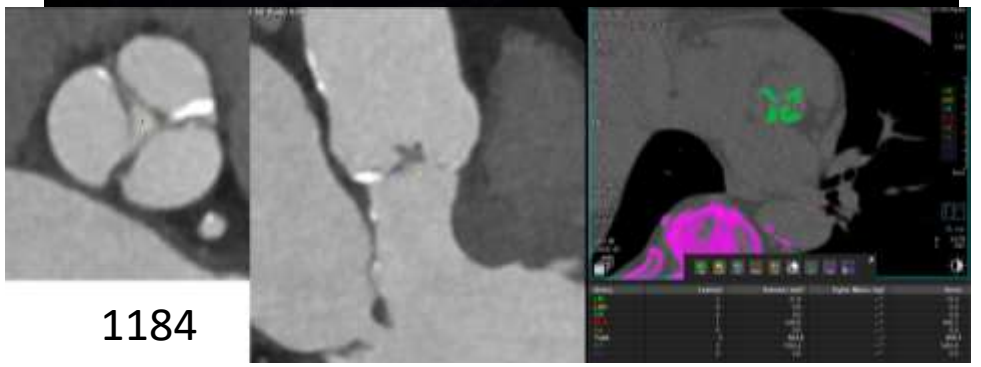
AS in women

Figure 1: Common Presentation of Aortic Stenosis in Older Women

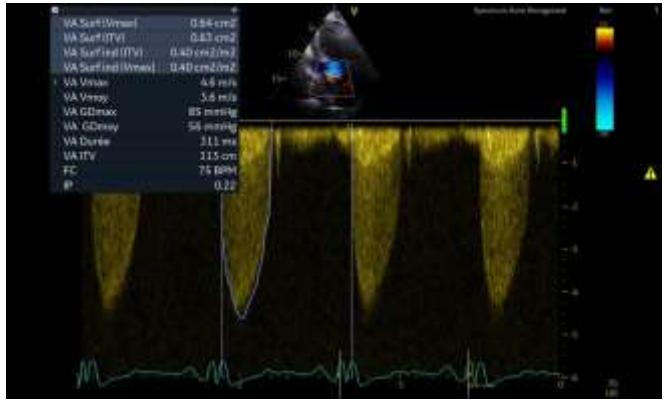


AS = aortic stenosis; LV = left ventricular; LVOT = left ventricular outflow tract; SV = stroke volume.

European Cardiology Review 2022;17:e21.



1184



men >3000, women>1600= highly likely

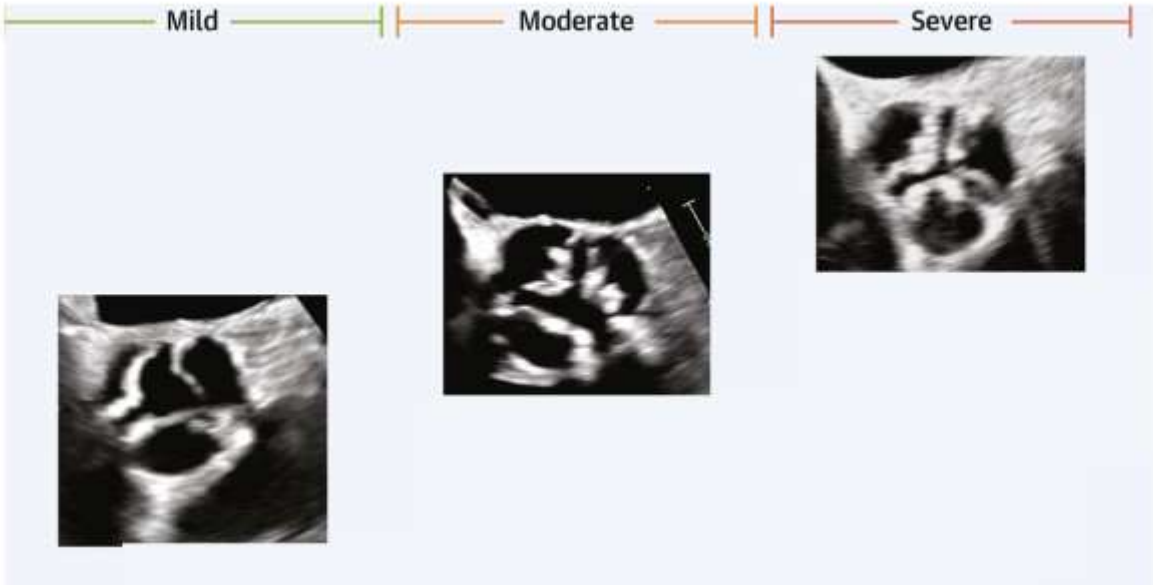
men >2000, women >1200= likely;

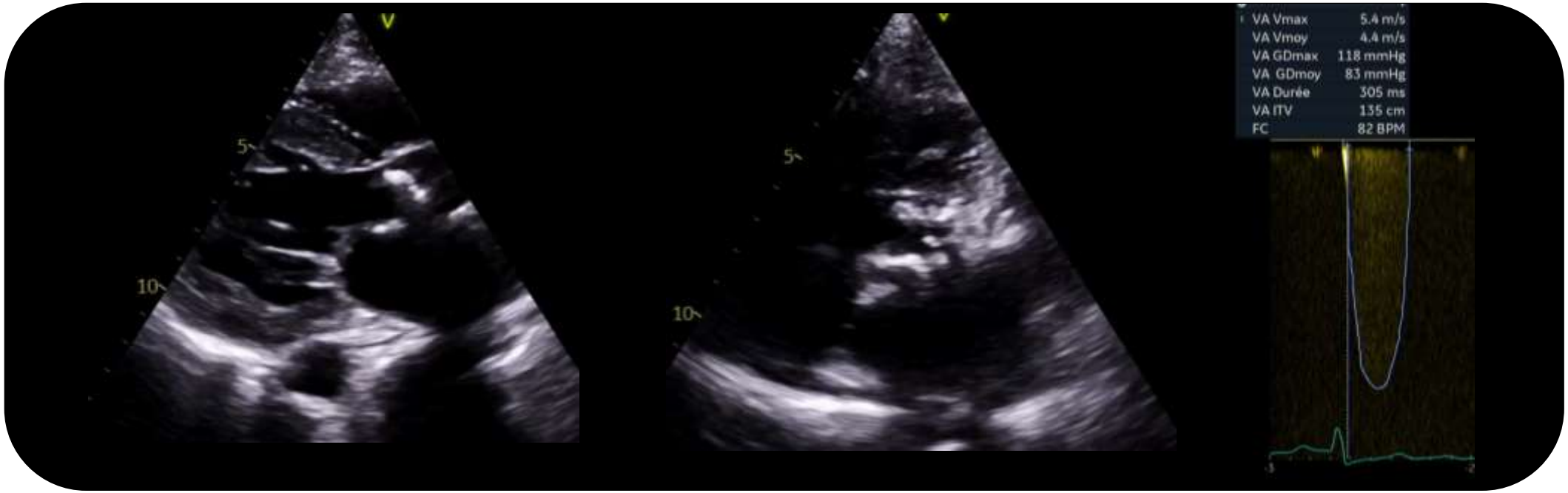
men <1600, women <800= unlikely

2nd step

Look at the valve:

- Calcified ?
- Reduced systolic opening ?

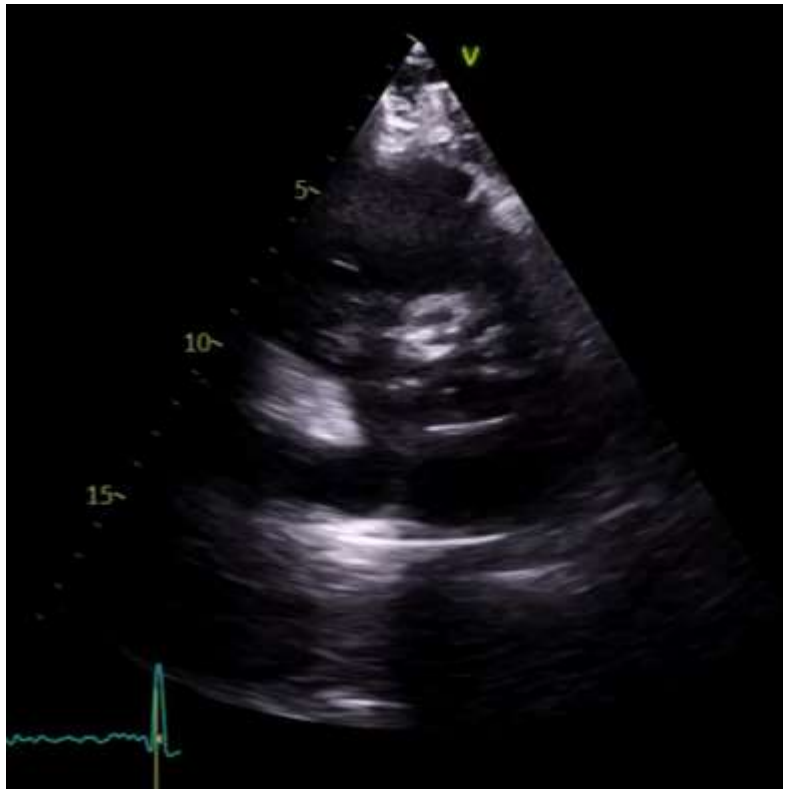


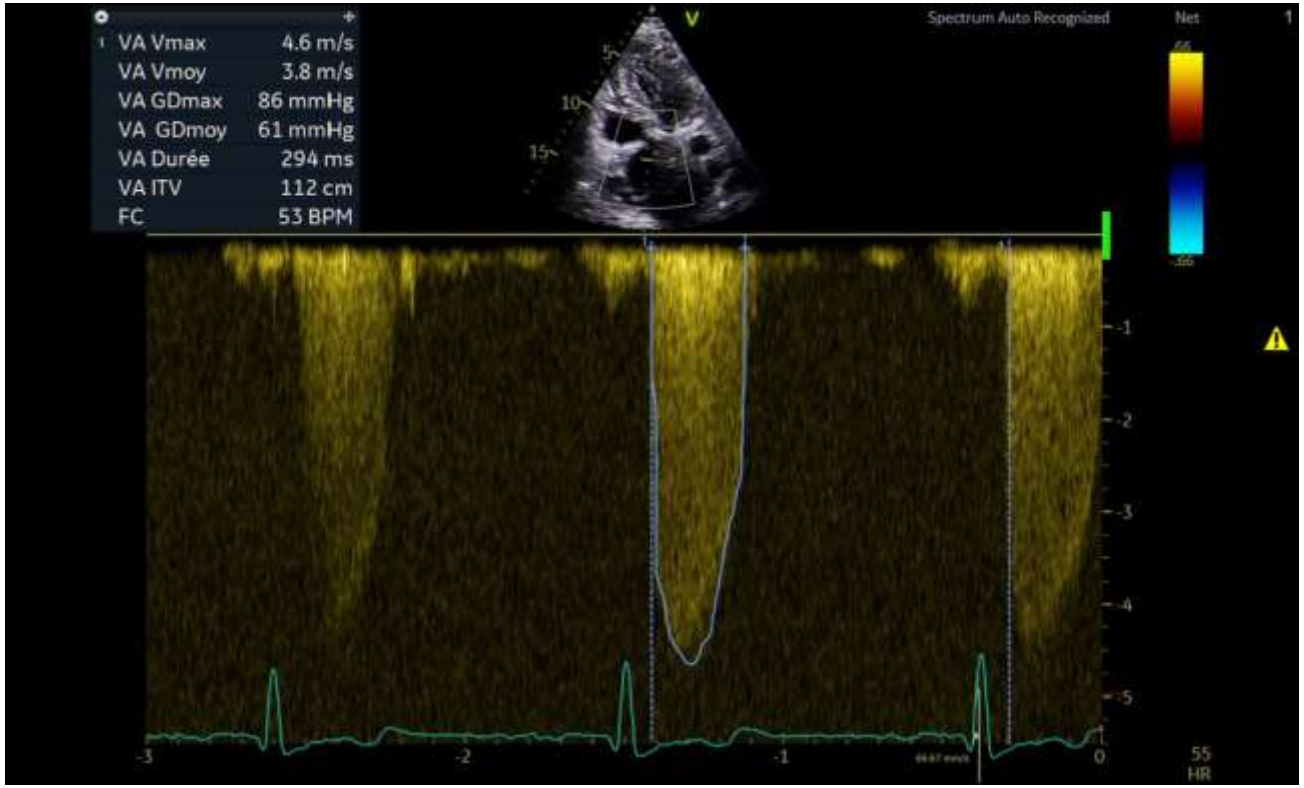


2nd step

Look at the valve:

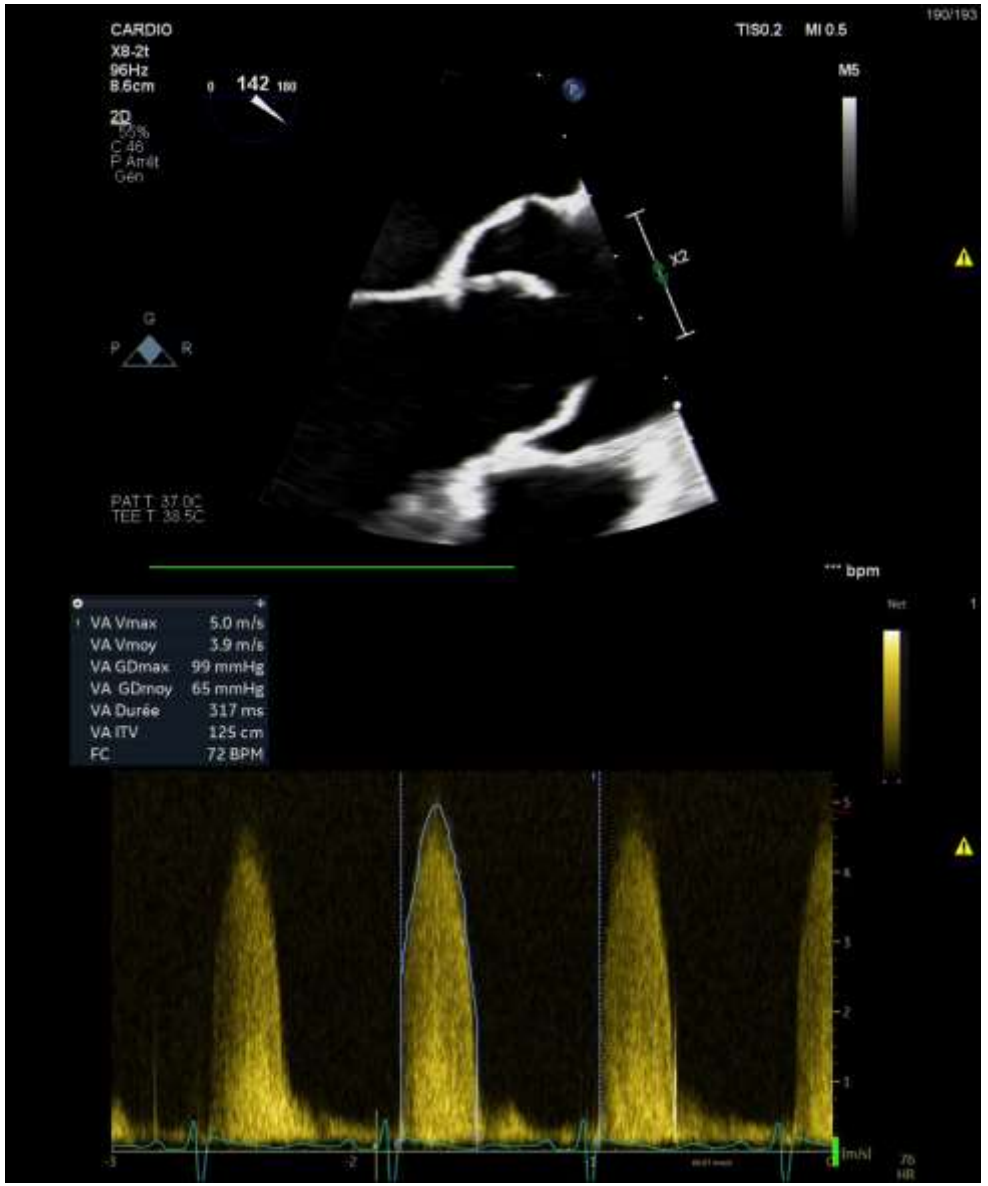
- But …do not get fooled by appearances
- Discrepency between visual opening and hemodynamic severity

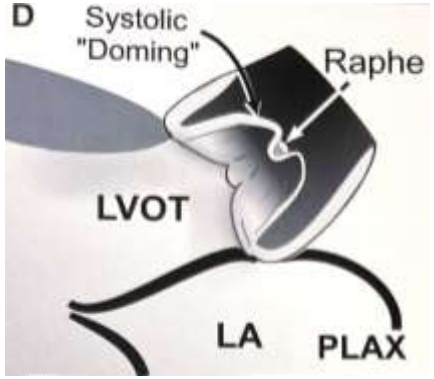


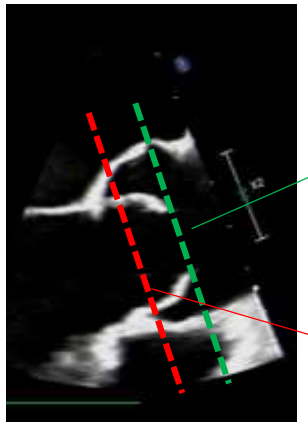


2nd step

Attention aux unicuspidies

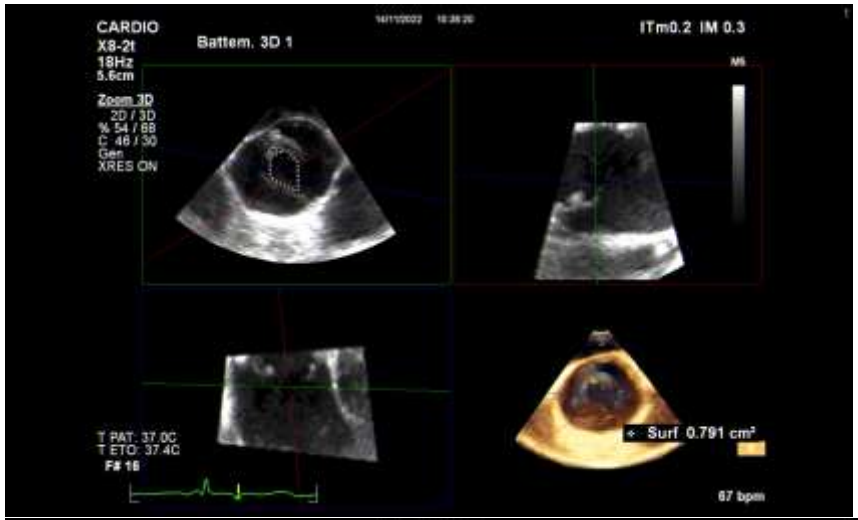


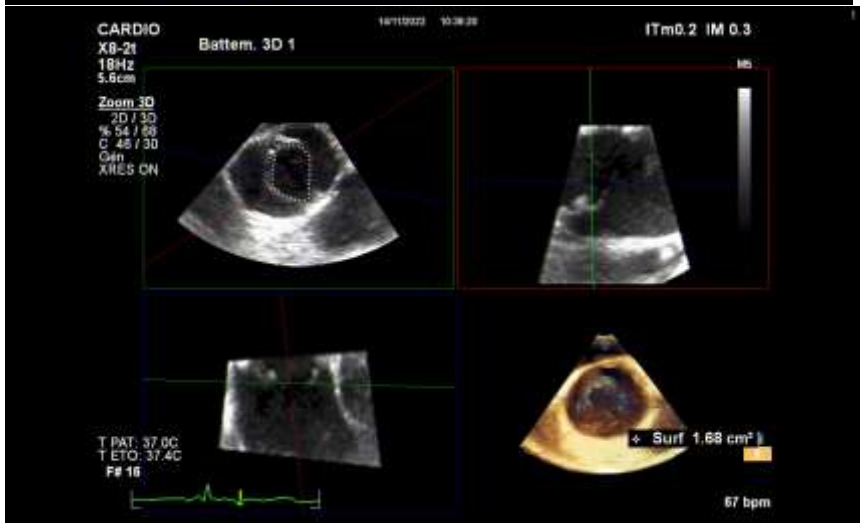

D
Systolic
"Doming"
Raphe
LVOT
LA
PLAX



0,8cm²

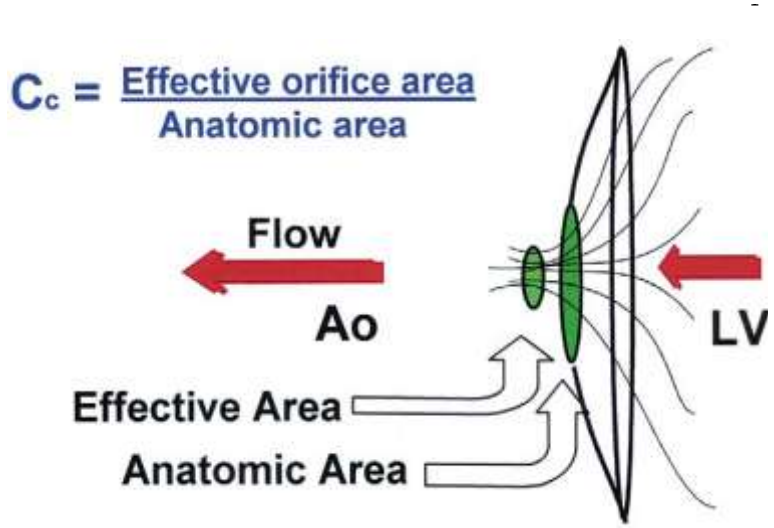
1,7cm²


CARDIO
X8-2t
18Hz
5.6cm
Battem. 3D 1
ITm0.2 IM 0.3
Zoom 3D
2D / 3D
% 54 / 68
C 46 / 30
Gen
XRES ON
T PAT: 37.0C
T ETO: 37.4C
F# 16
Surf 0.791 cm²
67 bpm

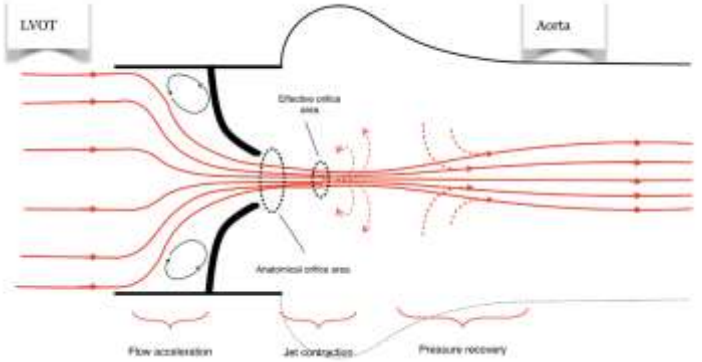

CARDIO
X8-2t
18Hz
5.6cm
Battem. 3D 1
ITm0.2 IM 0.3
Zoom 3D
2D / 3D
% 54 / 68
C 46 / 30
Gen
XRES ON
T PAT: 37.0C
T ETO: 37.4C
F# 16
Surf 1.68 cm²
67 bpm

Discrepencies between anatomic and effective valve area: Role of the shape of the valve in 3D

Different Coefficient of contraction TAV/BAV



For a given flow rate and anatomic area, a lower Cc increases velocity and pressure gradient.



	Domed	Intermediate	Flattened
Anatomic area			
BAV / TAV			
1.0 cm²	0.9	0.85	0.76
0.75 cm²	0.88	0.83	0.74
0.5 cm²	0.85	0.81	0.71

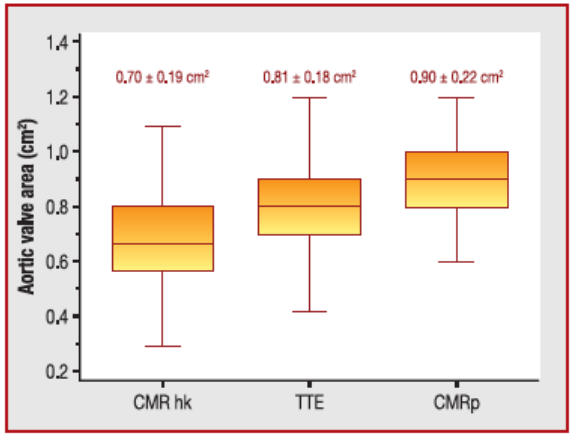
Figure 4. Coefficients of contraction according to valve shape and orifice size.

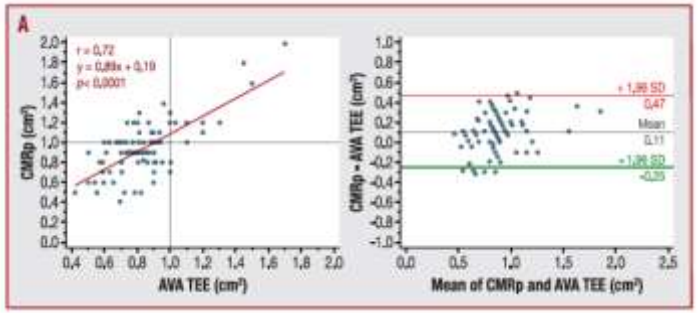
Gilon et al, J Am Coll Cardiol 2002;40:1479–86

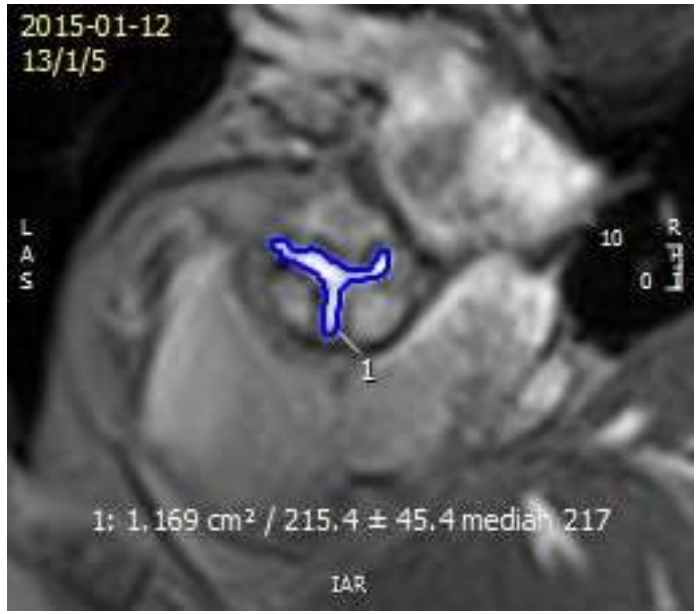
Usefulness of 3-Tesla cardiac magnetic resonance imaging in the assessment of aortic stenosis severity in routine clinical practice

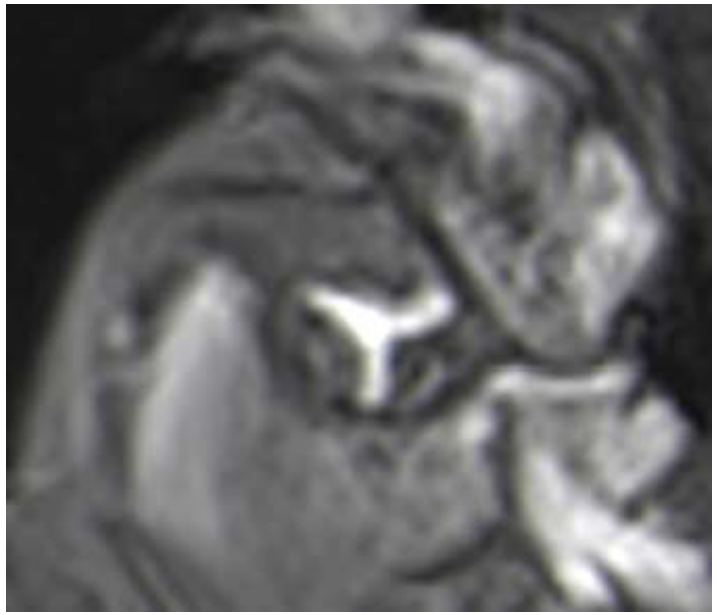
Apport de l'IRM cardiaque 3-Tesla pour l'évaluation de la sévérité de la sténose aortique en pratique clinique

Franck Levy[a,*], Laura Iacuzio[a], Filippo Civaia[a], Stephane Rusek[a], Carine Dommerc[a], Nicolas Hugues[a], Clara Alexandrescu[a], Vincent Dor[a], Christophe Tribouilloy[b], Gilles Dreyfus[a]







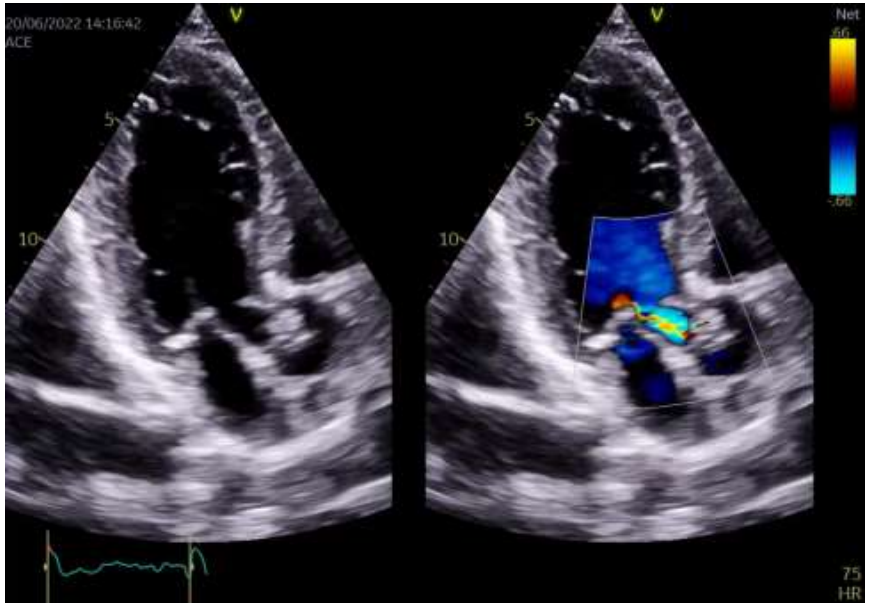


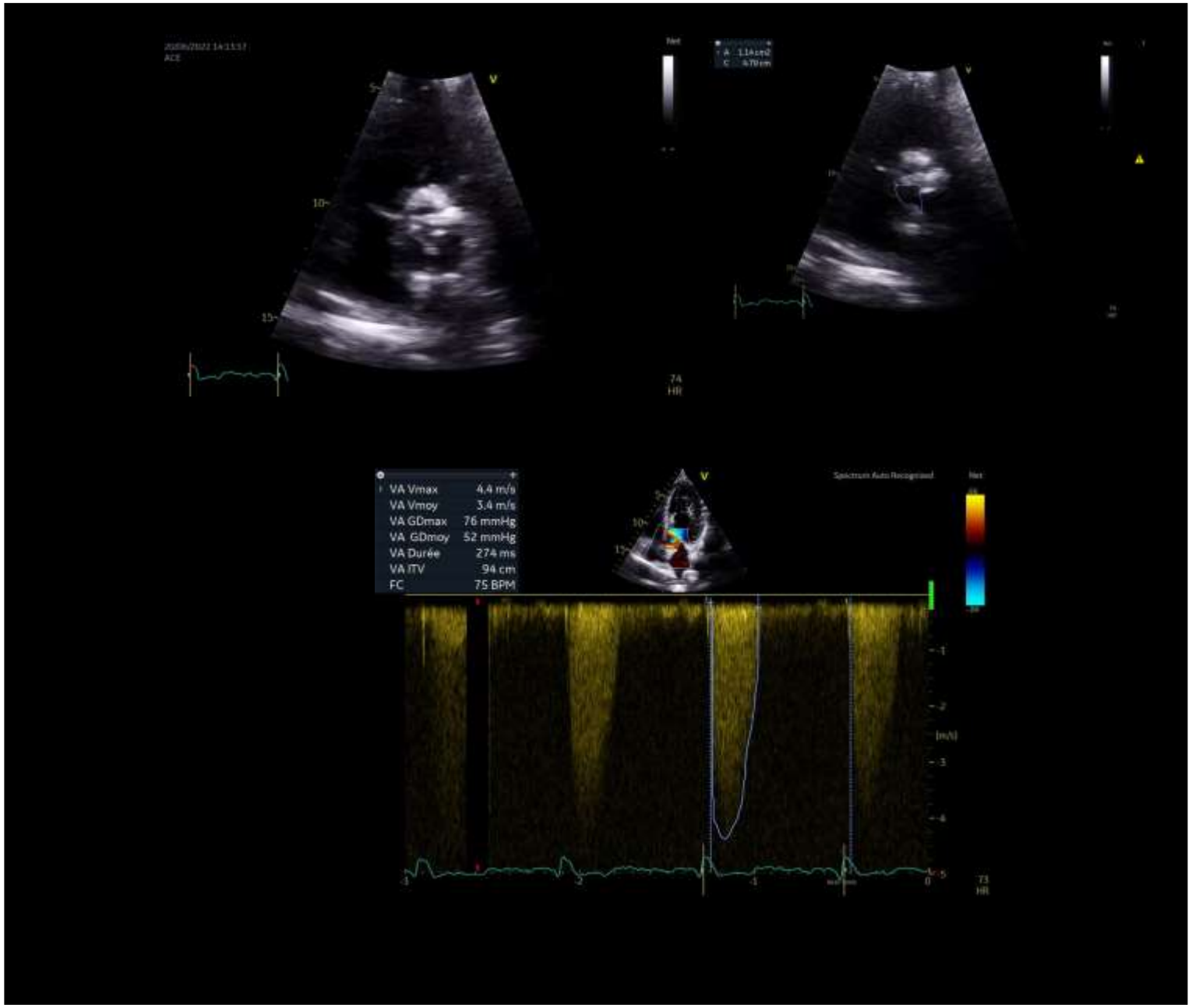
Arch Cardiovasc Dis. 2016 Sep 28.

2nd step

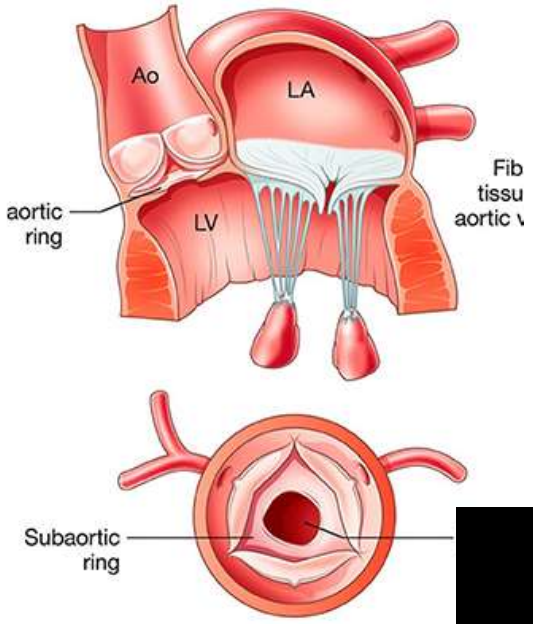
Look at the valve and around

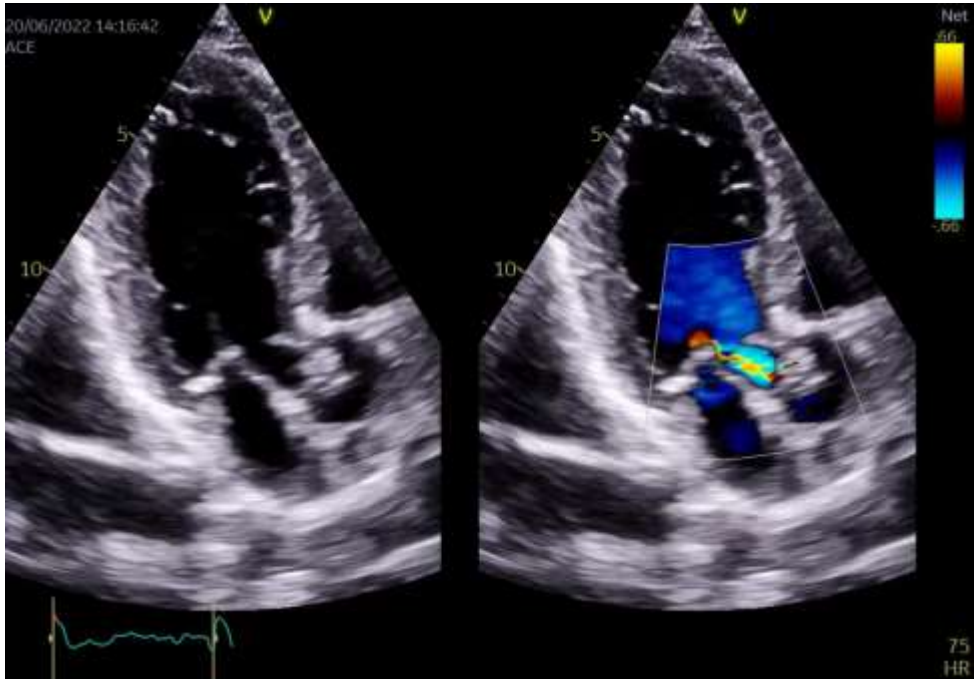
- Before and after the valve

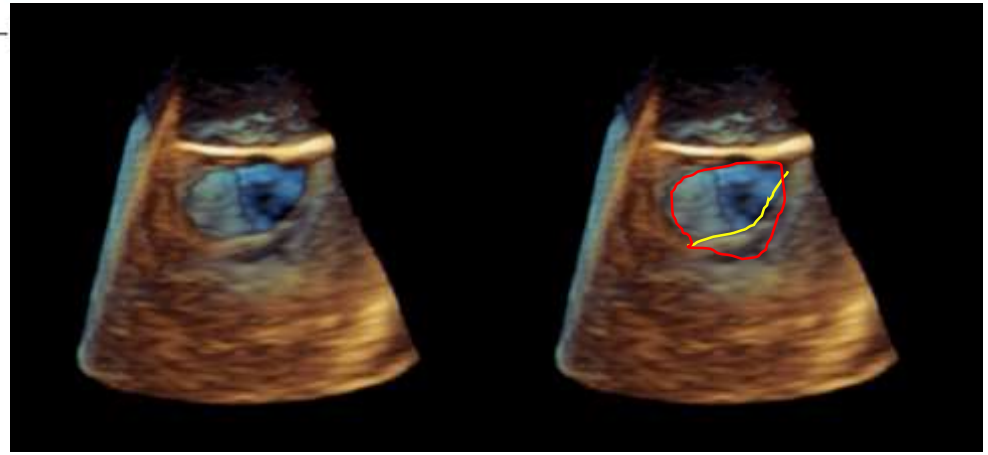


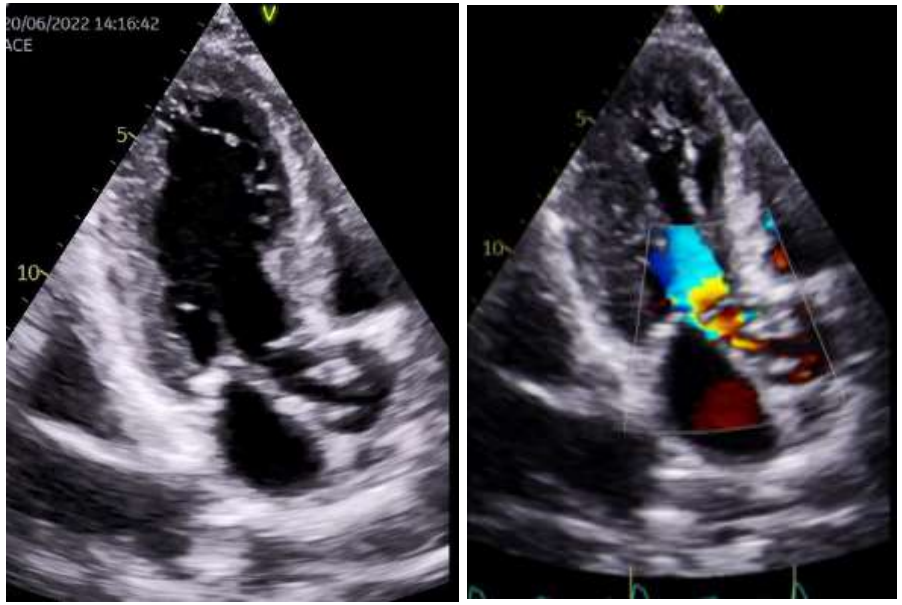


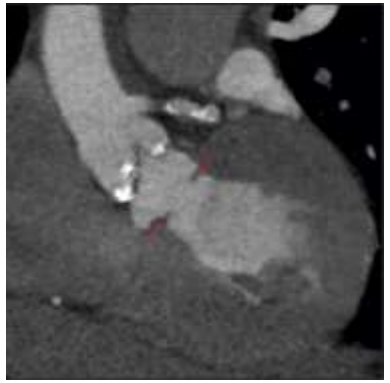
Subaortic ring









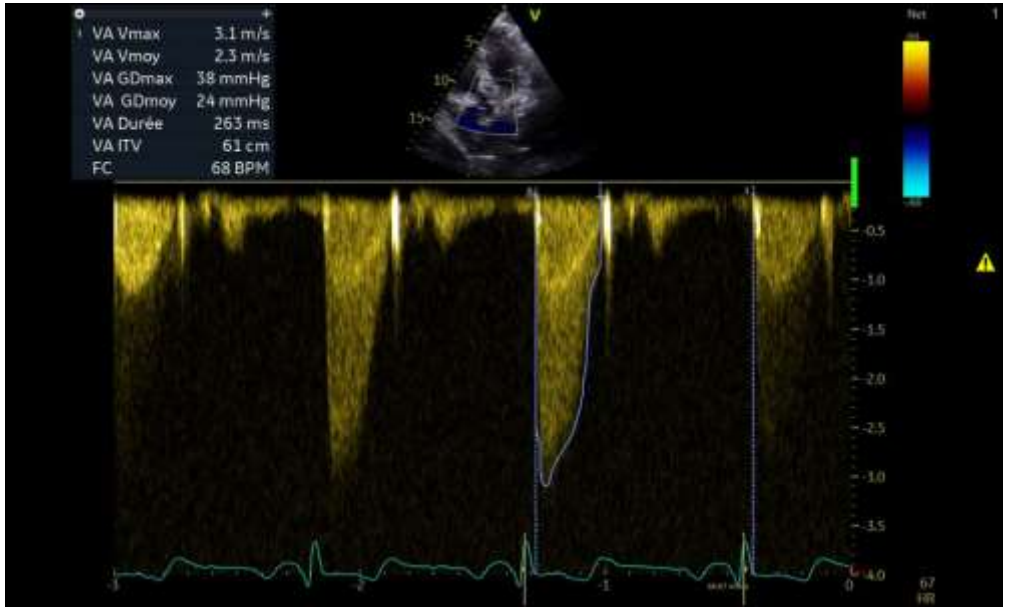


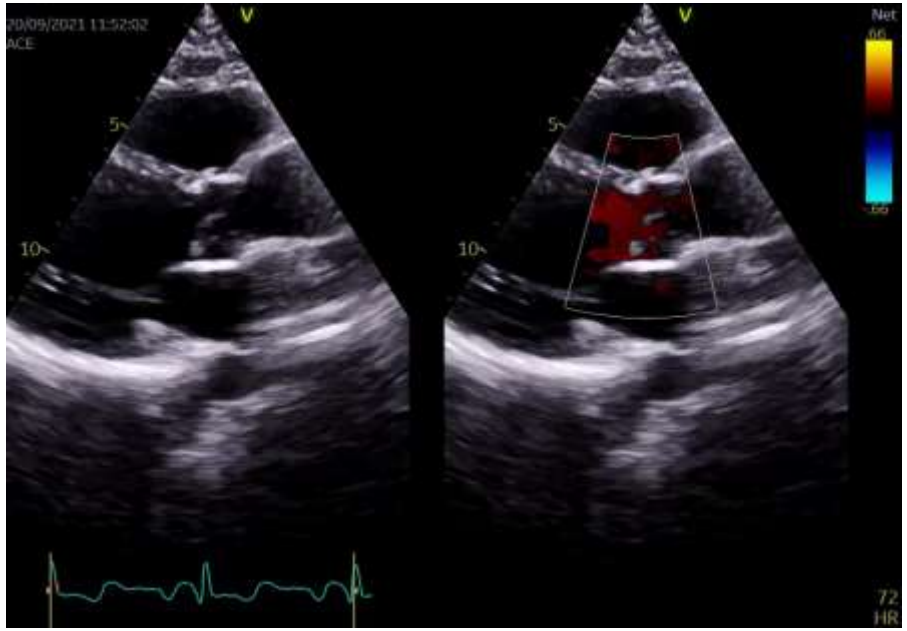
Aortic stenosis: mechanism?

- Subvalvular
- Valvular
- Supravalvular

Supravalvular AS

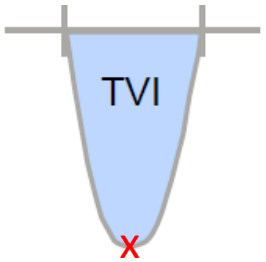
- Uncommon, usually a congenital abnormality
- Flow acceleration above the AV
  - typically at the sinotubular junction
  - single discrete narrowing
  - long tubular hypoplasia



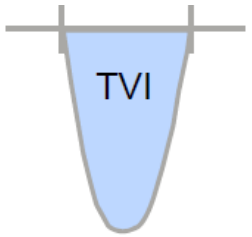


Aortic stenosis

V max

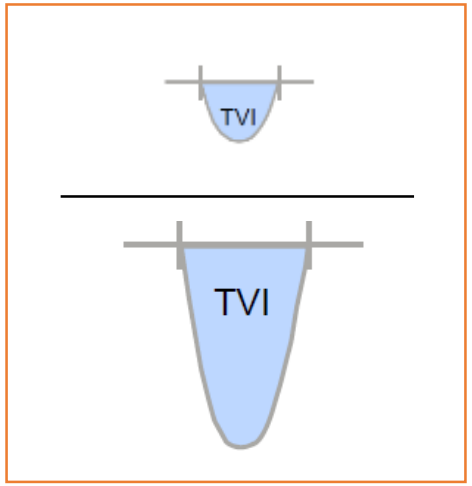


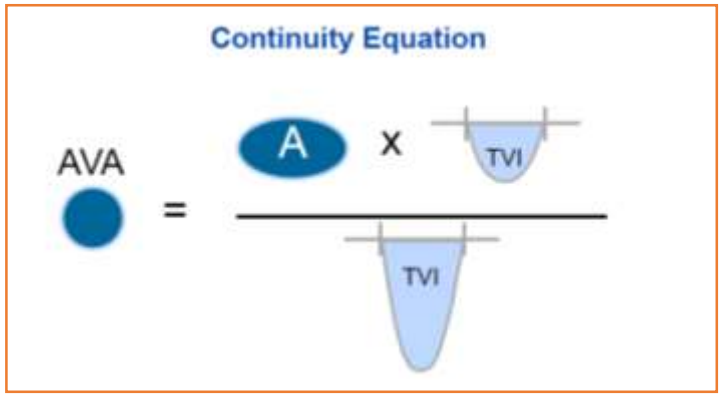
Gradient moyen

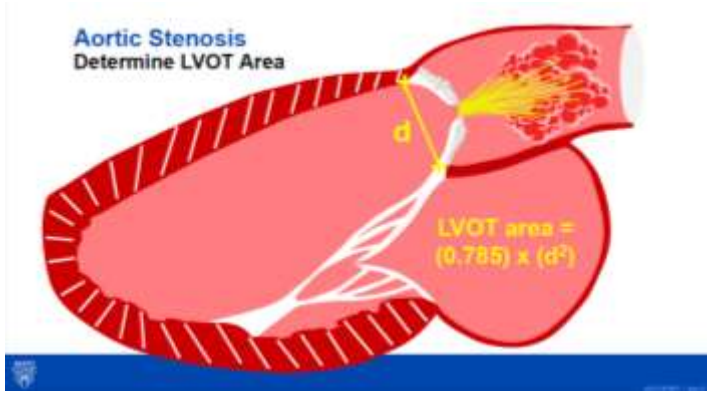


Surface valvulaire

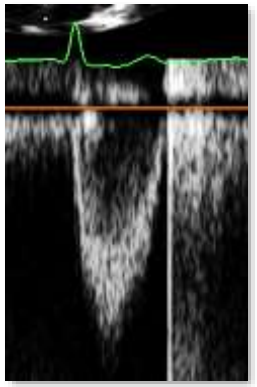
IP





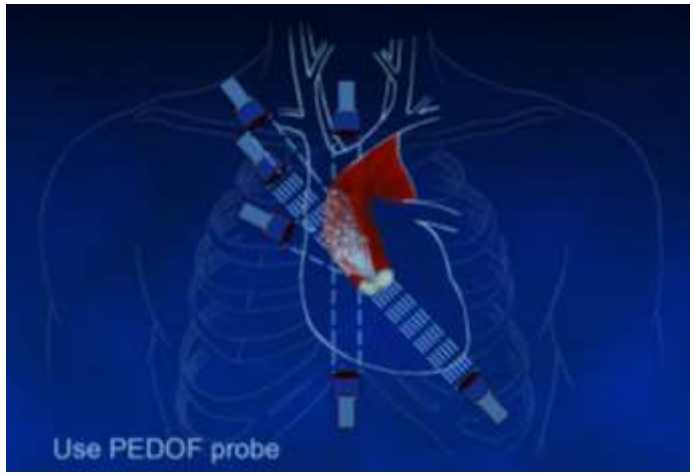


LVOT



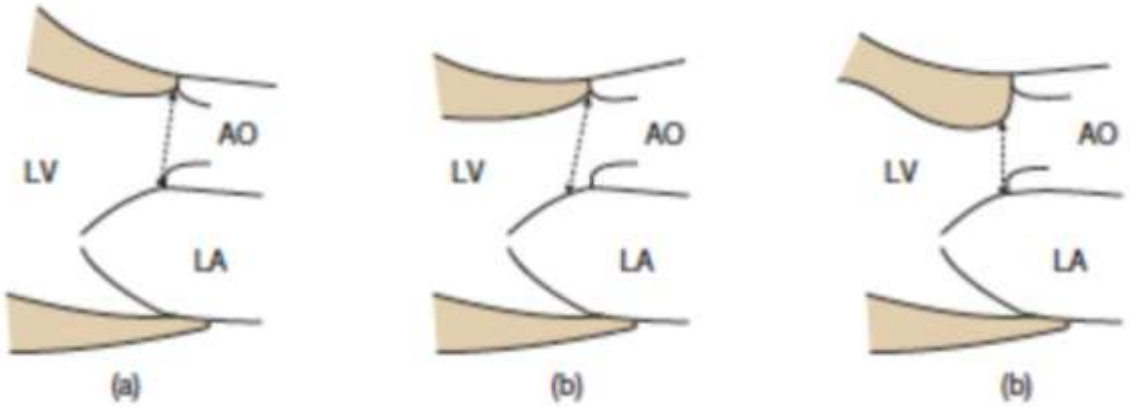
VTI ss Ao

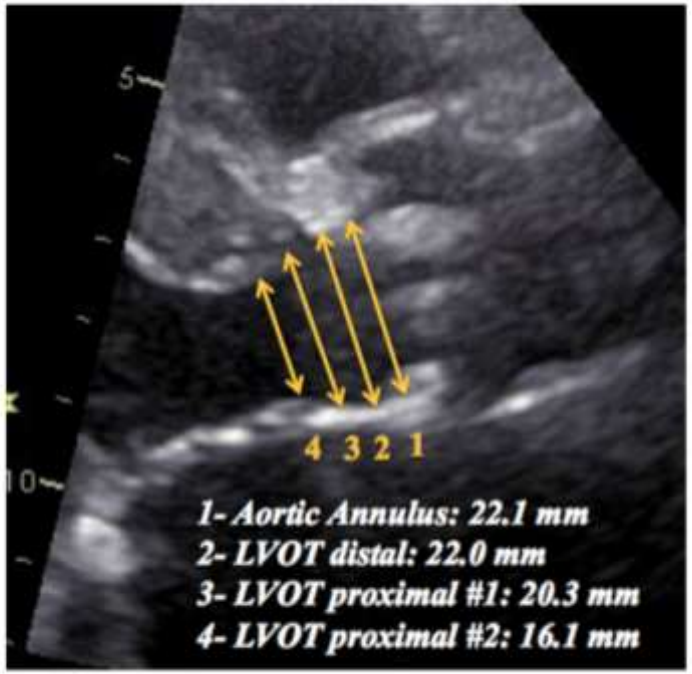
Recueil du flux

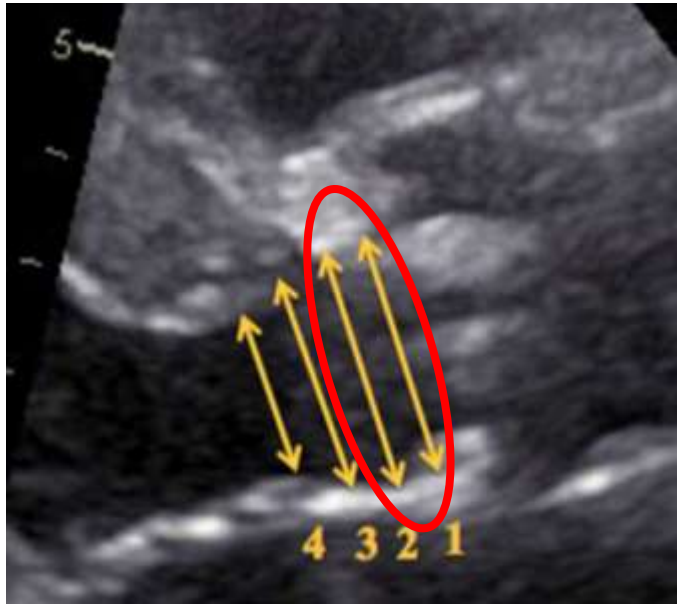


Conditions hémodynamiques

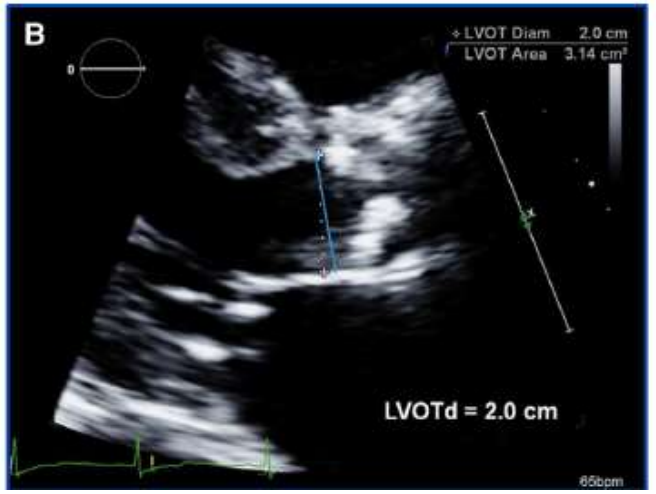
How to measure LVOT diameter?



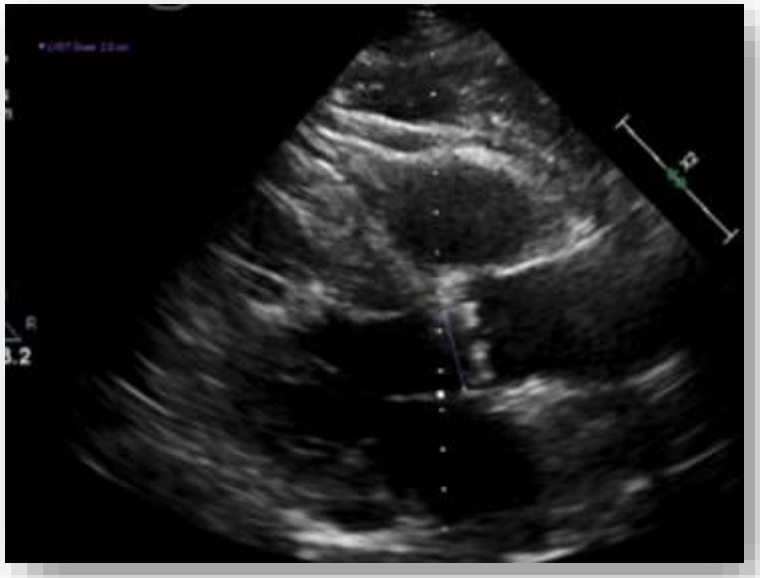


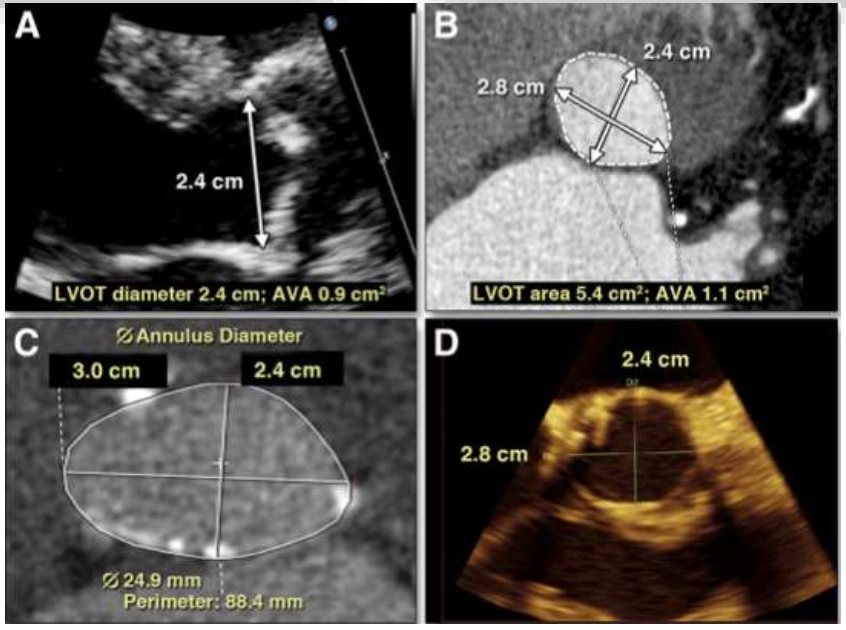


Calcifications



LVOT diameter should be corroborated with other methods





What is the normal LVOT diameter?

WASE: World Alliance Societies of Echo

1904 healthy subjects (48% of women)

	Men				Women			
Age	18-40 yrs		41-65 yrs		>65 yrs		18-40 yrs		41-65 yrs		>65 yrs	
	LNL	UNL	LNL	UNL	LNL	UNL	LNL	UNL	LNL	UNL	LNL	UNL
LVOT diam (cm)	1.9	2.6	1.9	2.5	1.8	2.5	1.7	2.3	1.7	2.2	1.6	2.2
LVOT VTI (cm)	13.5	26.3	13.8	27.3	13.3	27.5	14.2	28.2	14.3	29.6	13.6	29.4
AV VTI (cm)	16.0	29.7	15.5	31.6	16.2	35.2	17.0	32.7	16.6	33.4	17.3	37.0
LVOT VTI/AV VTI	0.68	1.10	0.66	1.11	0.59	1.14	0.61	1.07	0.60	1.10	0.59	1.05
AV PGmean (mmHg)	1.64	4.70	1.52	4.97	1.42	5.54	1.69	5.06	1.56	5.34	1.75	6.19
AV Vmax (m/s)	0.88	1.53	0.87	1.64	0.81	1.64	0.89	1.57	0.88	1.64	0.91	1.73
AV Area (cm^2)	2.22	5.07	2.02	4.65	1.89	4.50	1.50	3.66	1.64	3.69	1.56	3.63
AV Area/BSA (cm^2/m^2)	1.23	2.57	1.06	2.46	1.06	2.38	1.00	2.22	0.99	2.17	0.91	2.22

> 65 ans

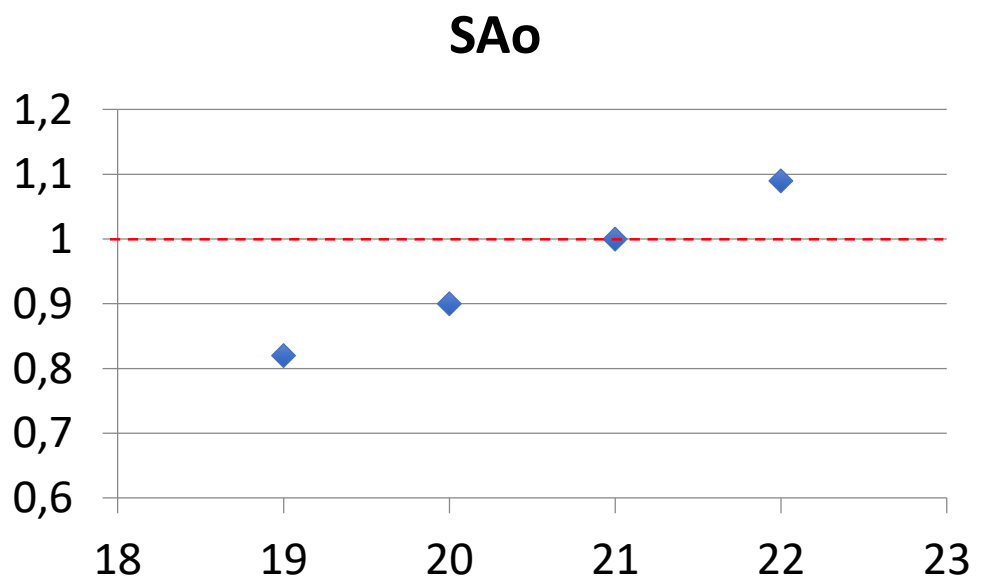
	♂	♀
LVOT	1.8 - 2.5	1.6 - 2.2
VTI ss Ao	13 - 27	13 - 29

European Heart Journal - Cardiovascular Imaging, jeac220, 2022

Importance de la mesure de l'anneau aortique

Anneau		SAo	Sao I	IP
19mm	Vti 21/ 73	0.82	0.48	0.29
20mm	Vti 21/ 73	0.9	0.53	0.29
21mm	Vti 21/ 73	1	0.59	0.29
22mm	Vti 21/ 73	1.09	0.64	0.29

1mm = 0,1 cm² !



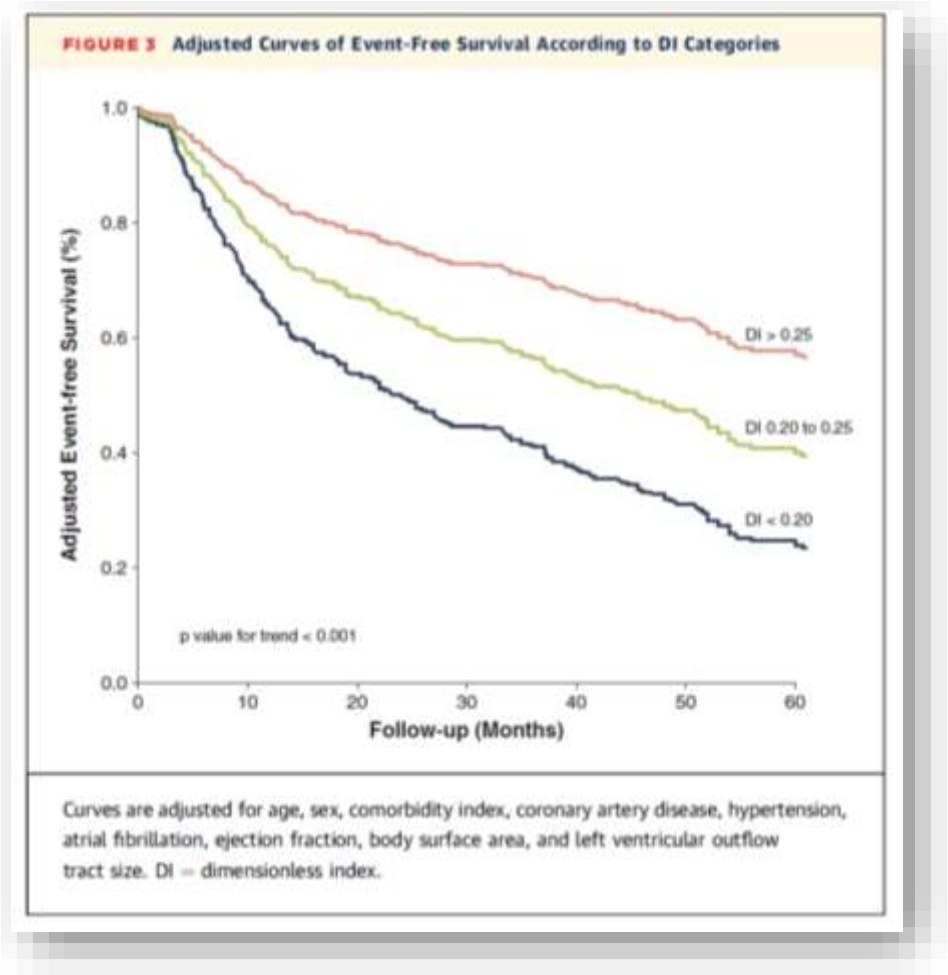
Usefulness of Doppler velocity index in PLFLGAS

LVOT TVI / Ao TVI

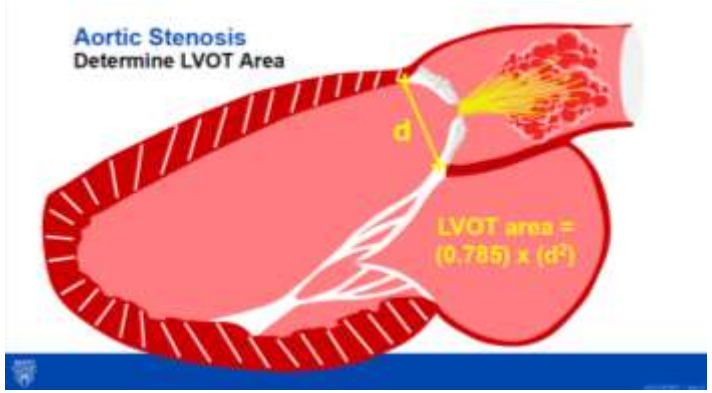
IP does not rely on the estimation of LVOTd

If IP < 0.25: results are consistent with AVA

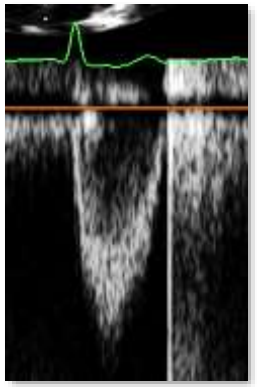
If IP > 0.25: suggestive of non severe AS



Rusinaru et al. J Am Coll Cardiol Img 2015;8:766–75

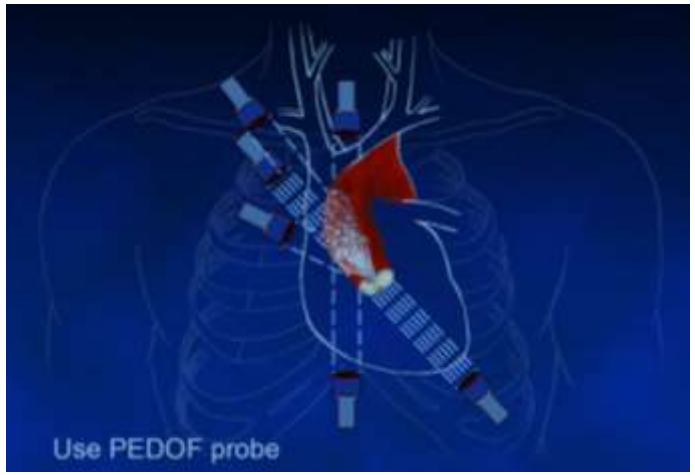


LVOT



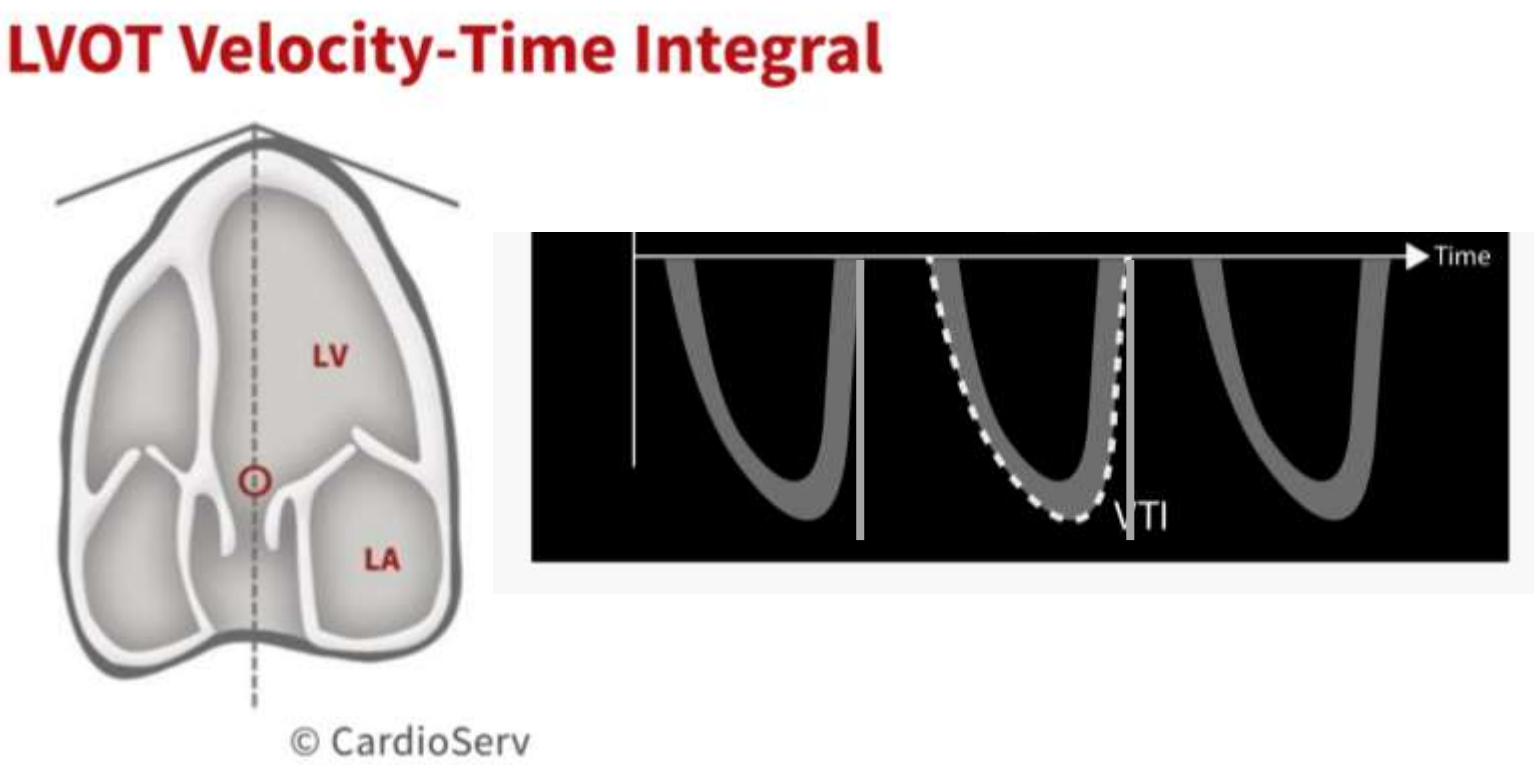
VTI ss Ao

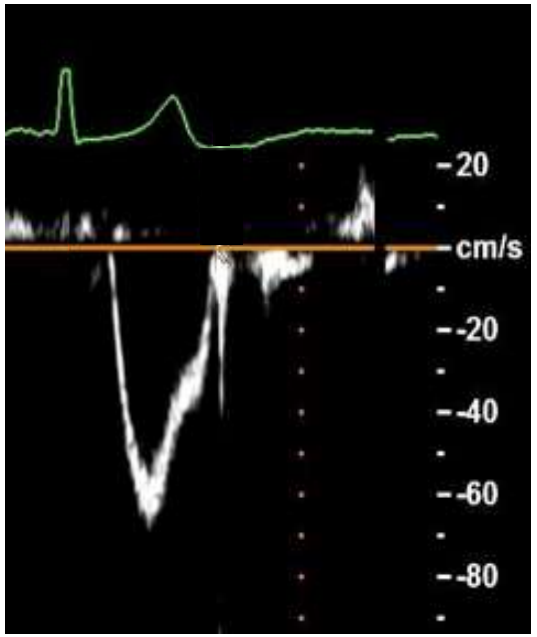
Recueil du flux



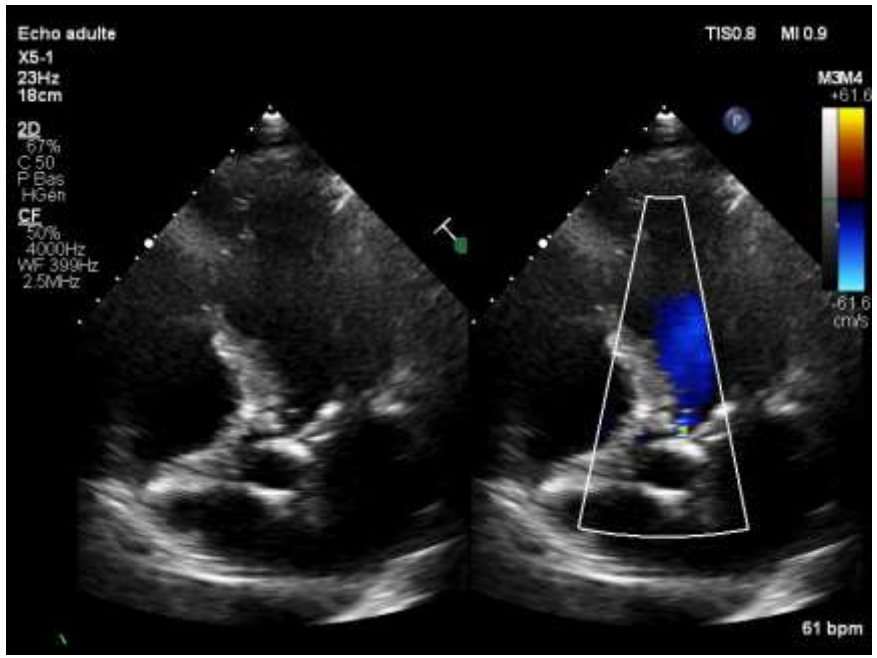
Conditions hémodynamiques

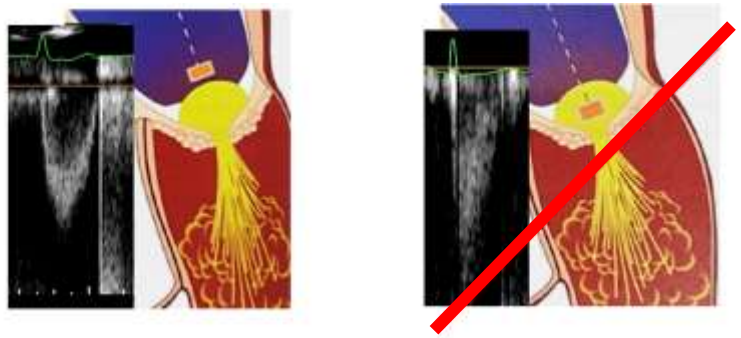
LVOT pulse wave doppler

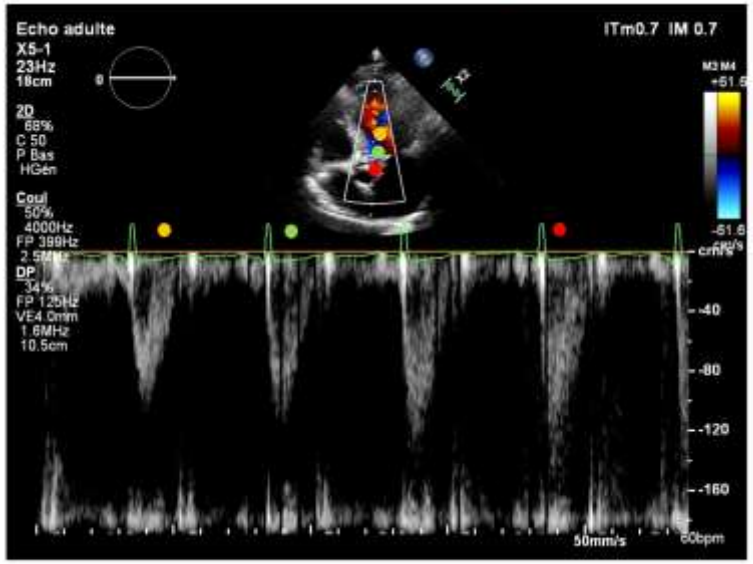


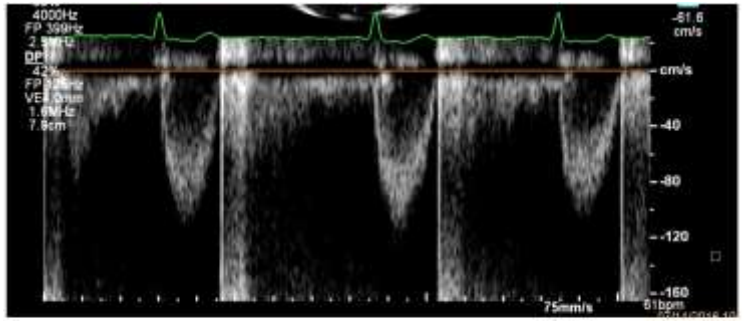


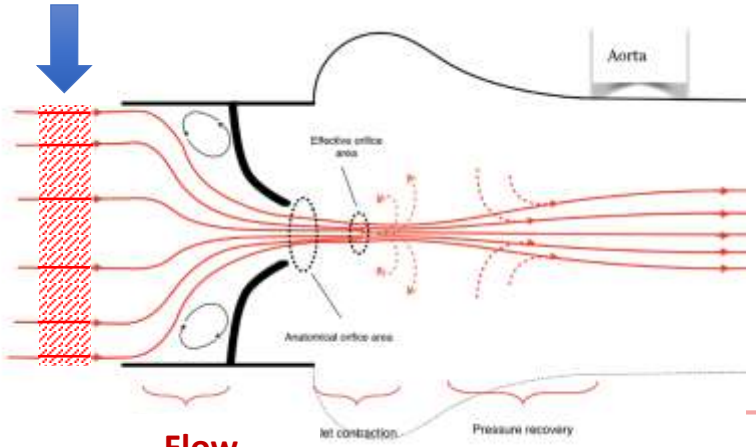
How to record LVOT flow?









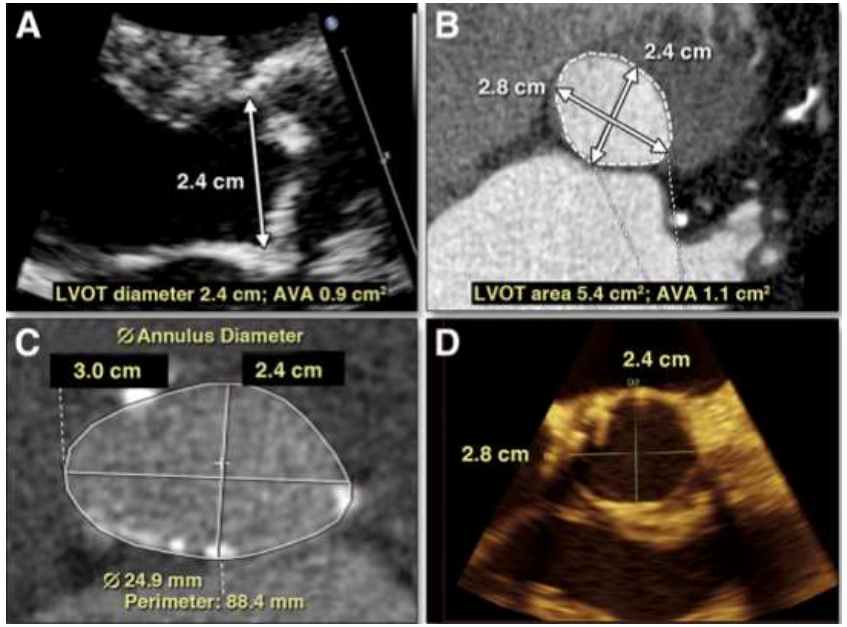


Flow acceleration

Risk of overestimation of the severity of AS

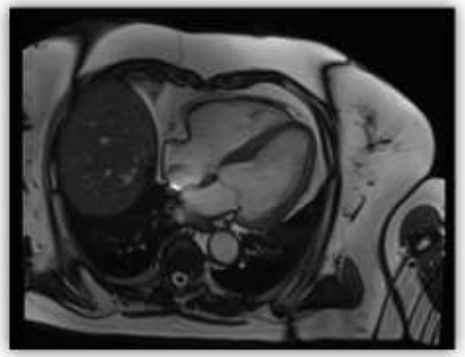
Underestimation of LVOT diameter (LV stroke volume) and hence of AVA

But what is the geometry of the flow in the lvot?



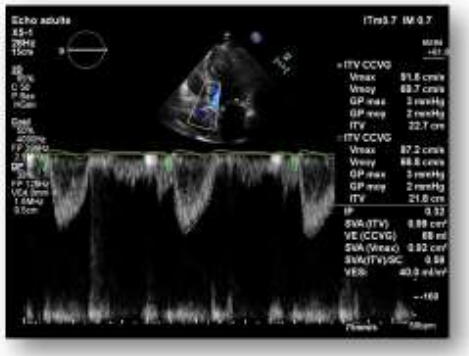
Tandon A. JACCi 2013;6:184.

SV should be corroborated with other methods: CMR



VTD 113ml soit 67ml/m²
VTS 37ml soit 22ml/m²
FE 67%

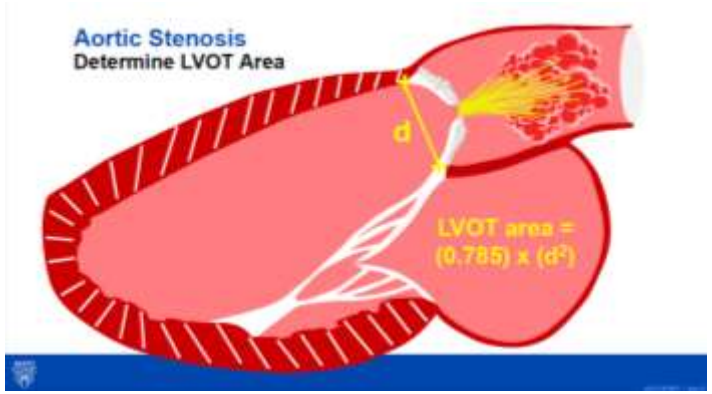
Svi 45ml/m² sc



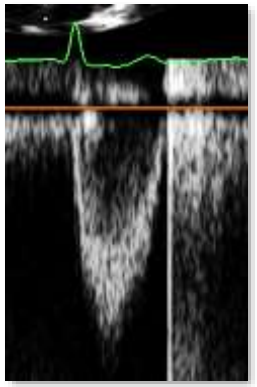
Svi 40ml/m² sc

Paradoxical LFLG AS

1. • Eliminer une **erreur de mesure** ou de recueil
   - (Anneau aortique, VTI)
2. • Confirmer le **bas débit et le contexte**
   - (IRM, Simpson, Amylose, strain, acfa, RM IM IT femme…)
3. • Confirmer le **bas gradient**
   - (parasternale droite….)
4.

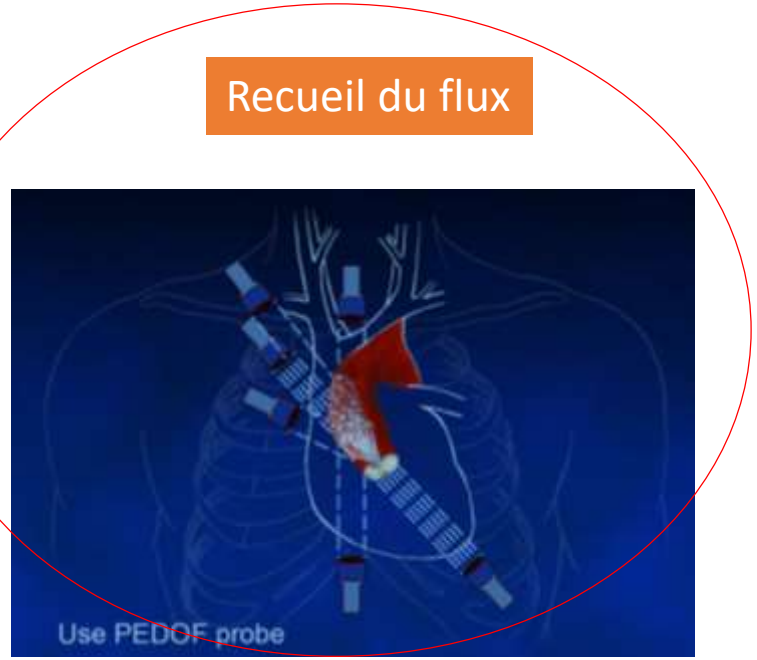


LVOT



VTI ss Ao

Recueil du flux

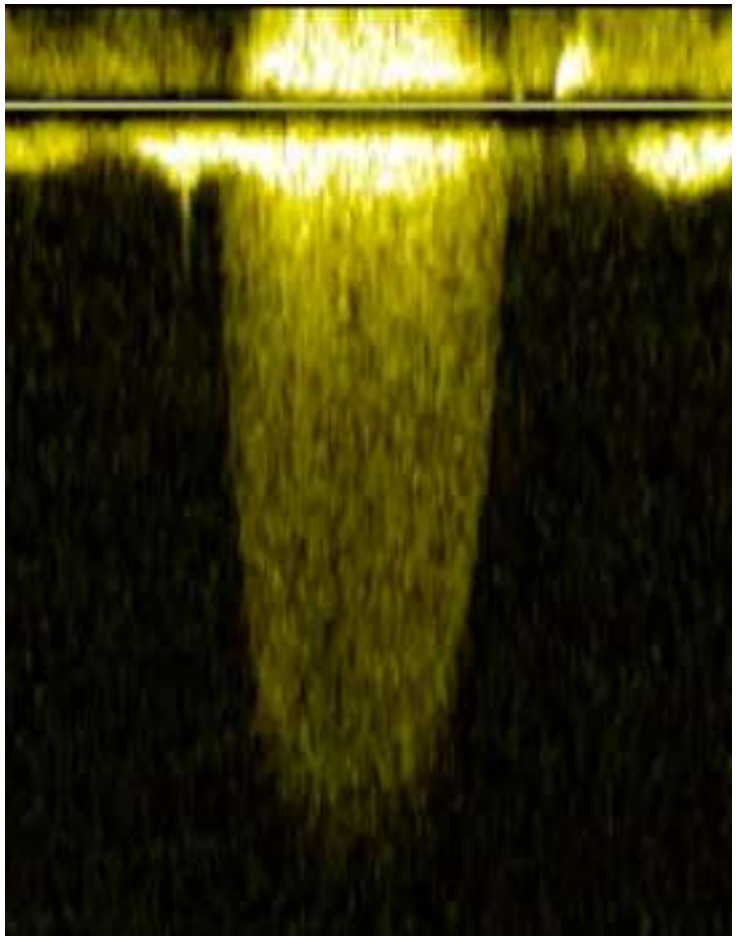


Conditions hémodynamiques

Doppler waveform

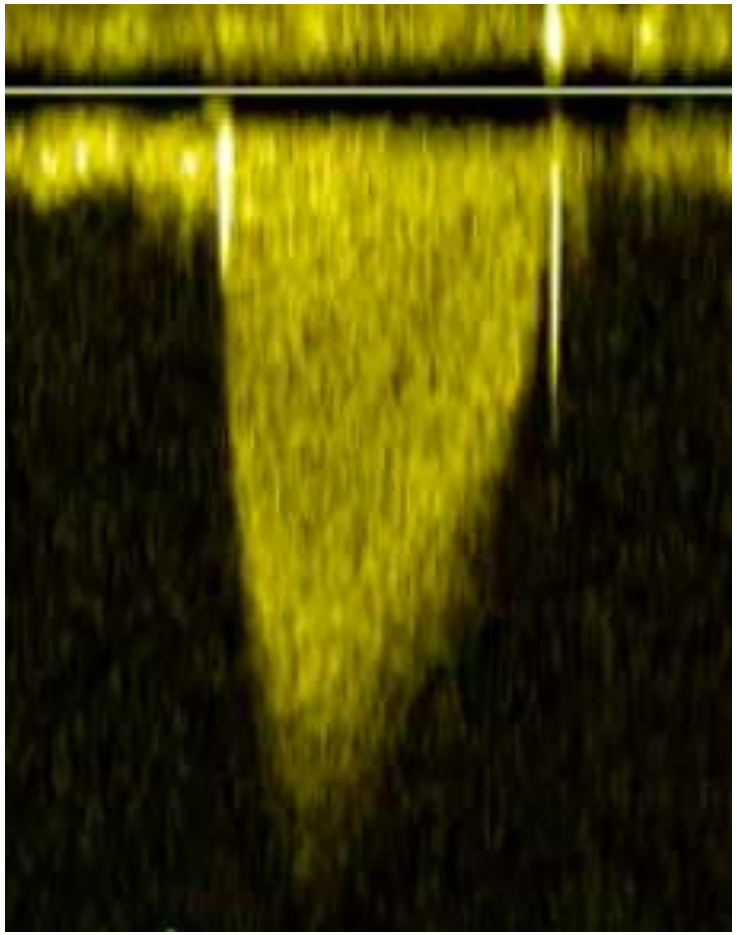
- Severe AS

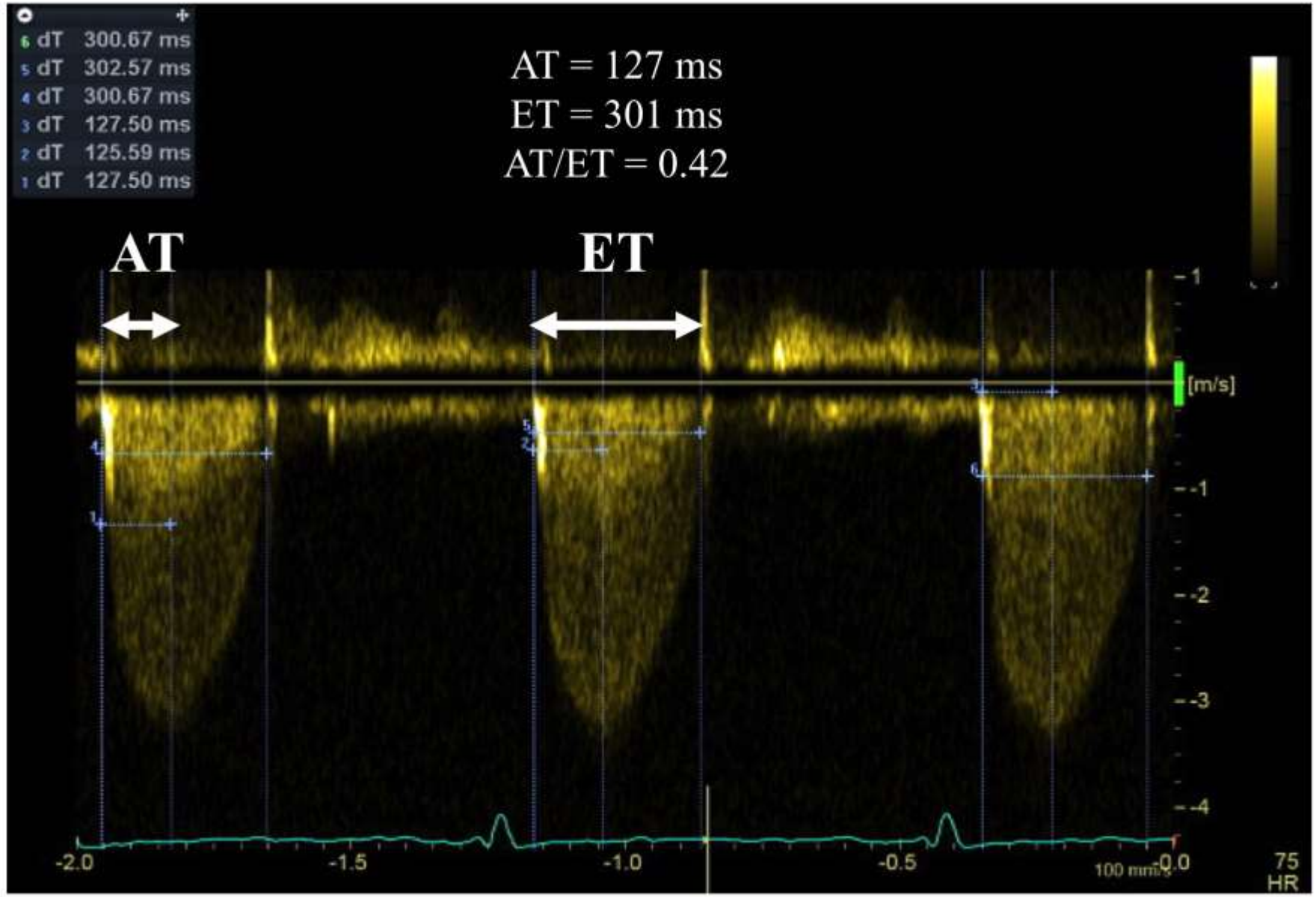
Pic tardif, sommet arrondi



- Moderate AS

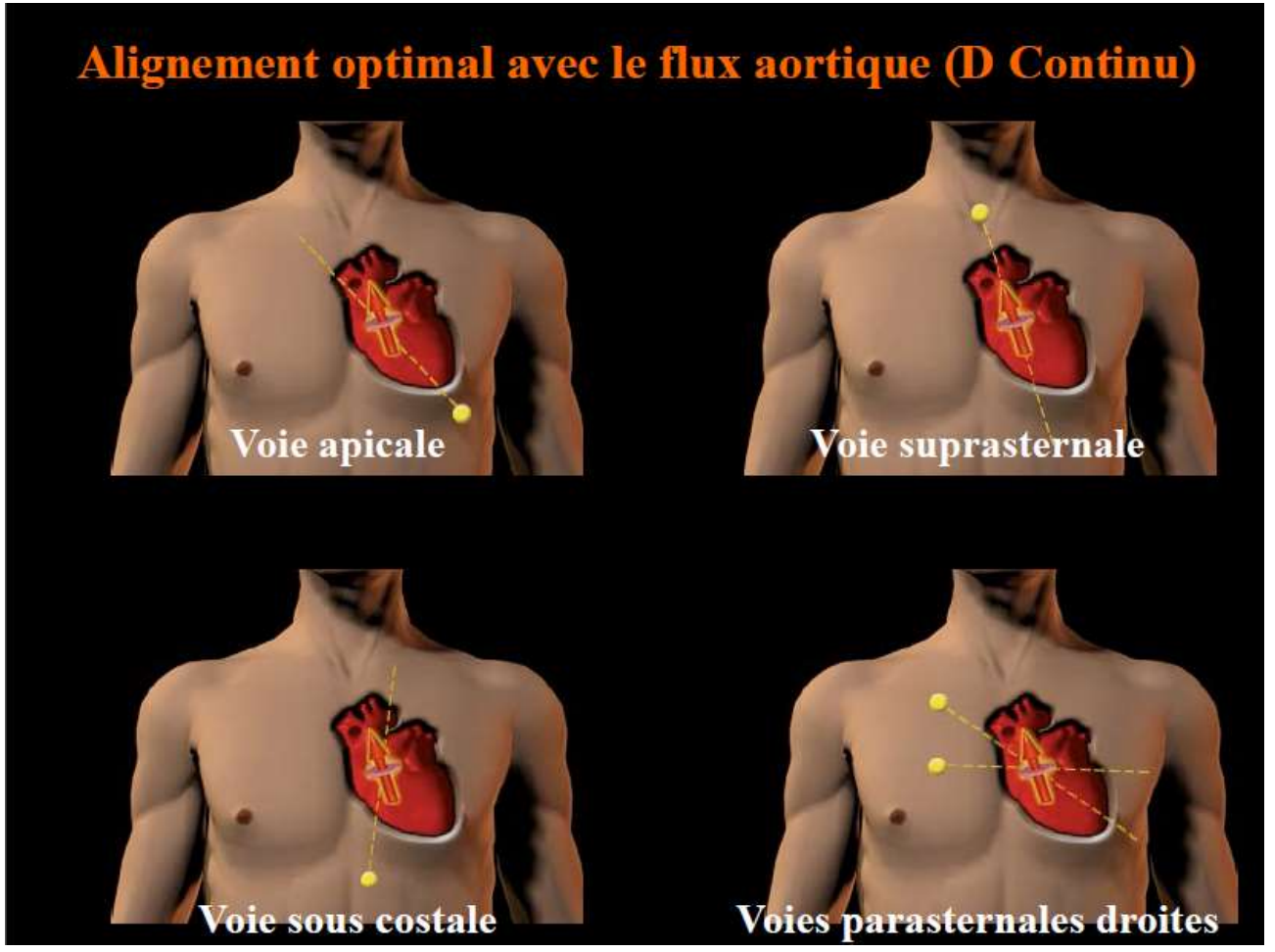
Pic précoce, triangulaire



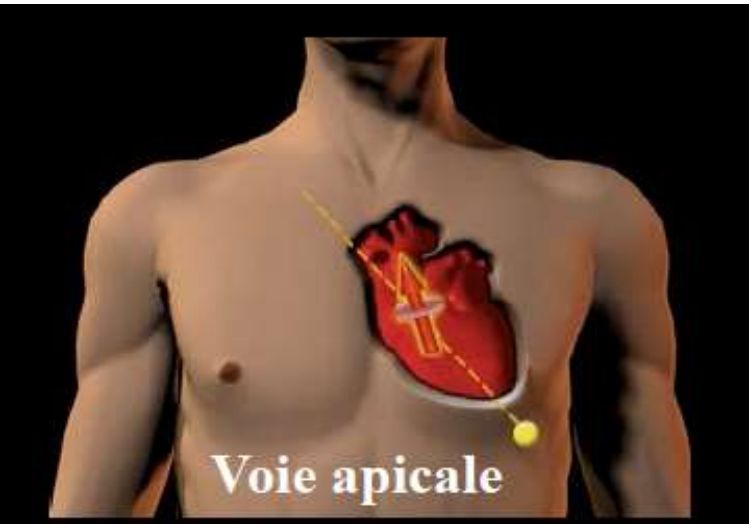

6 dT 300.67 ms
5 dT 302.57 ms
4 dT 300.67 ms
3 dT 127.50 ms
2 dT 125.59 ms
1 dT 127.50 ms
AT = 127 ms
ET = 301 ms
AT/ET = 0.42
AT
ET
[m/s]
-2.0
-1.5
-1.0
-0.5
-0.0
100 mm/s
75
HR

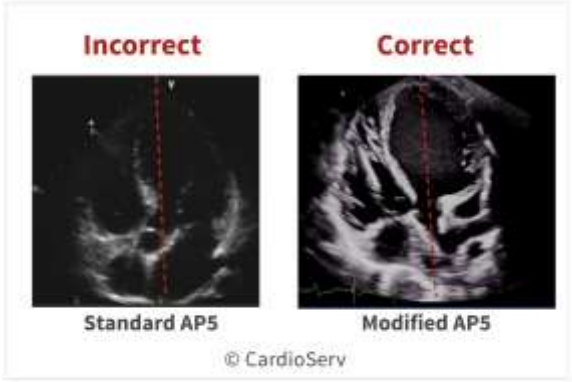
Importance de la sonde pedoff

- Flux aortique: utiliser toutes les fenêtres
- Reporter la fenêtre où le flux max a été enregistré

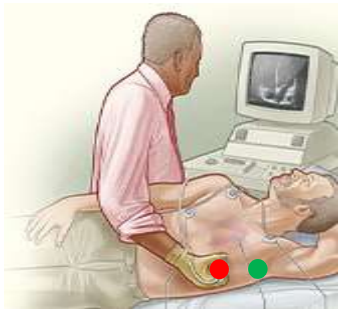


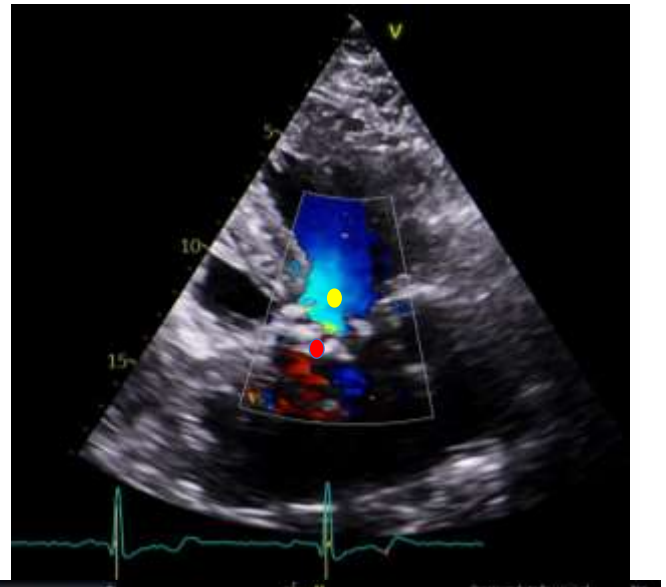
Quelle coupe 5 cavités est susceptible de donner le meilleur alignement ?

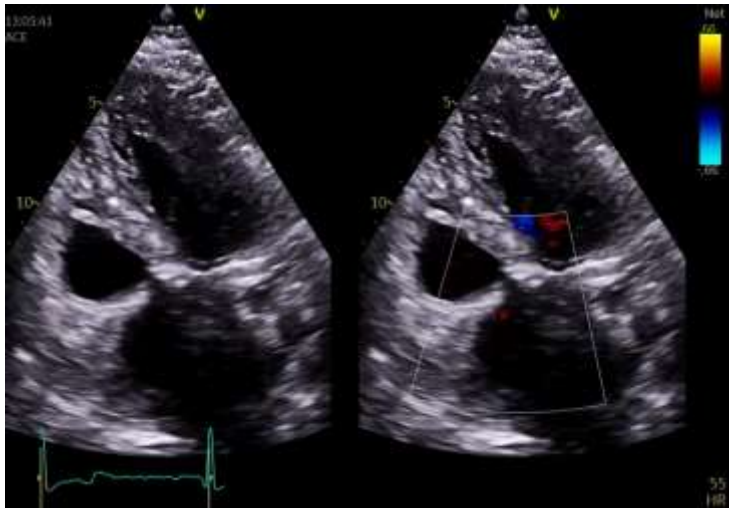


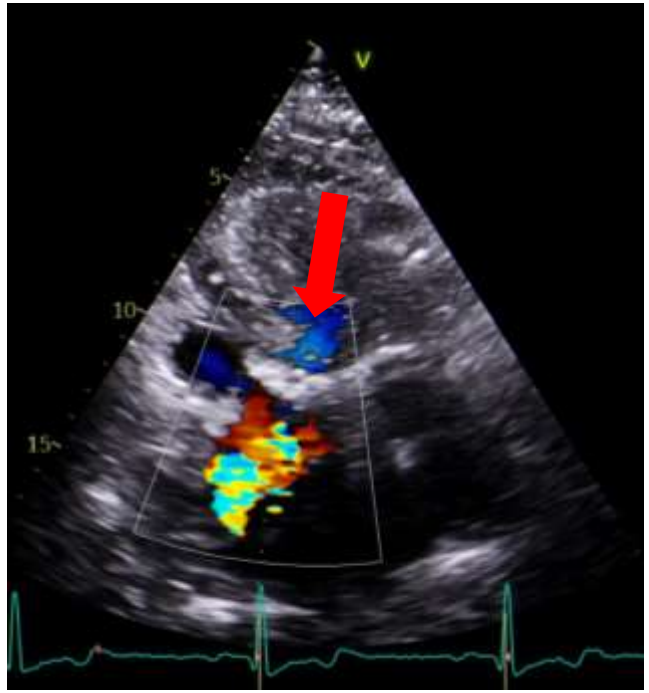


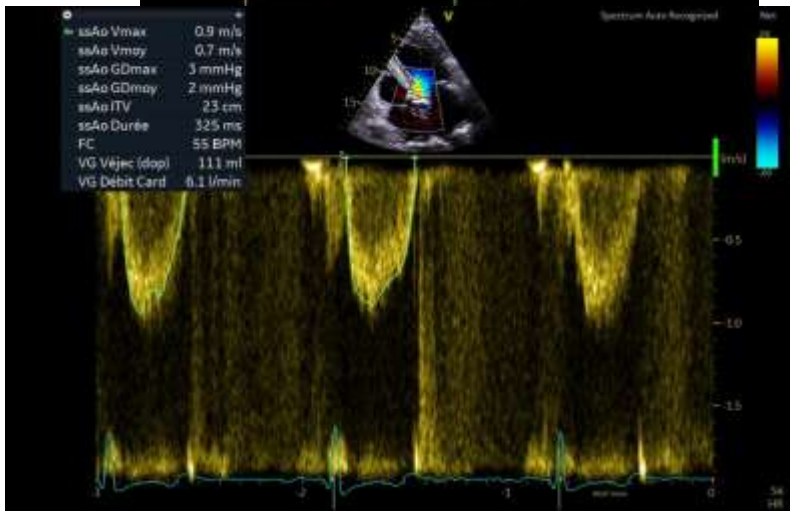
« 5 cavités » dans l'aisselle, un EIC plus haut

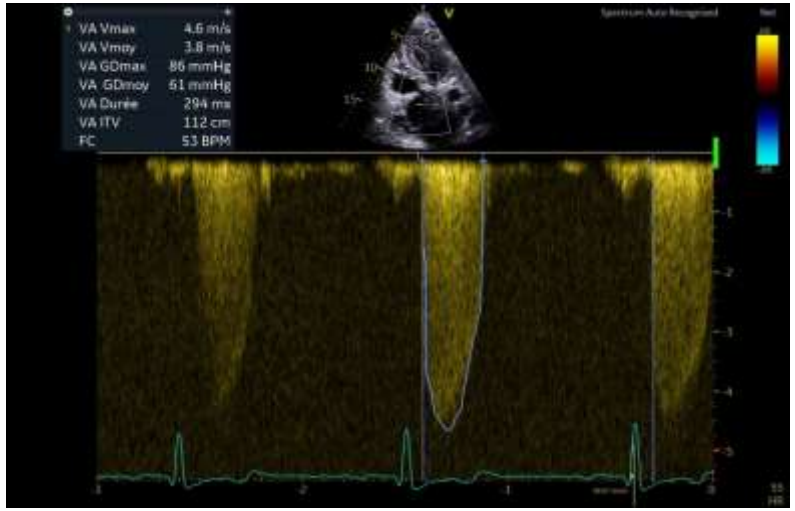








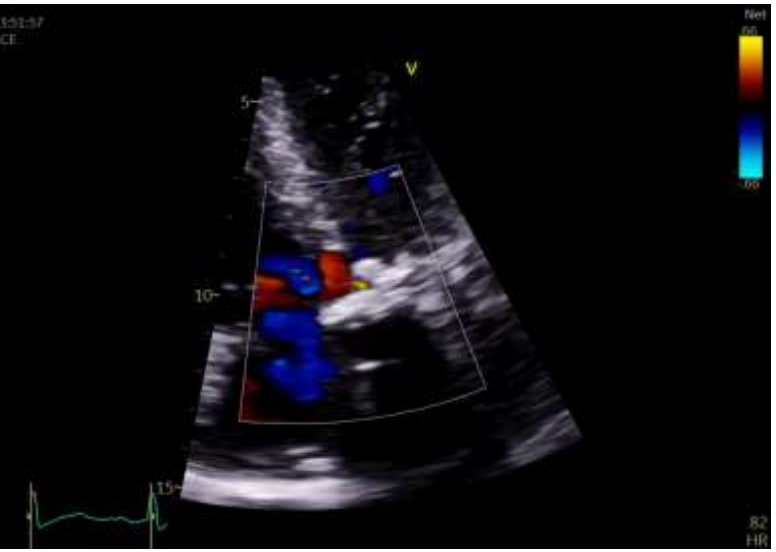


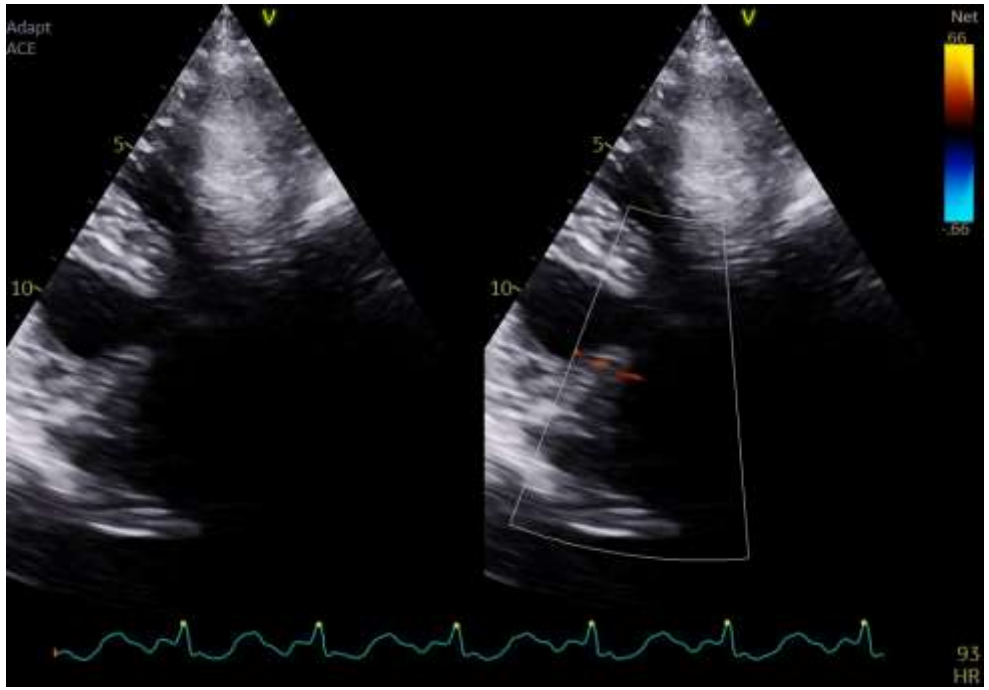


Usefulness of color doppler

Correct visualization of color doppler in ascending aorta

Repérage zone de convergence et flux couleur



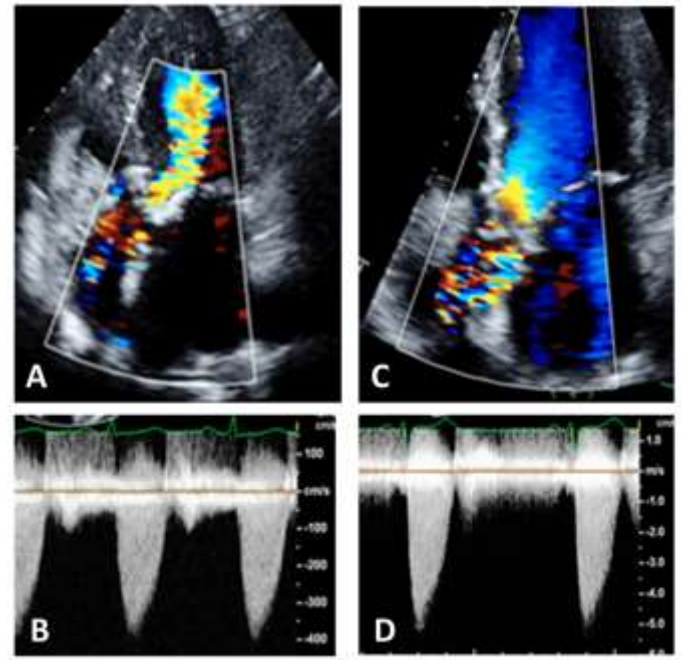


Balayage pour dégager le flux couleur dans l'aorte ascendante

Review

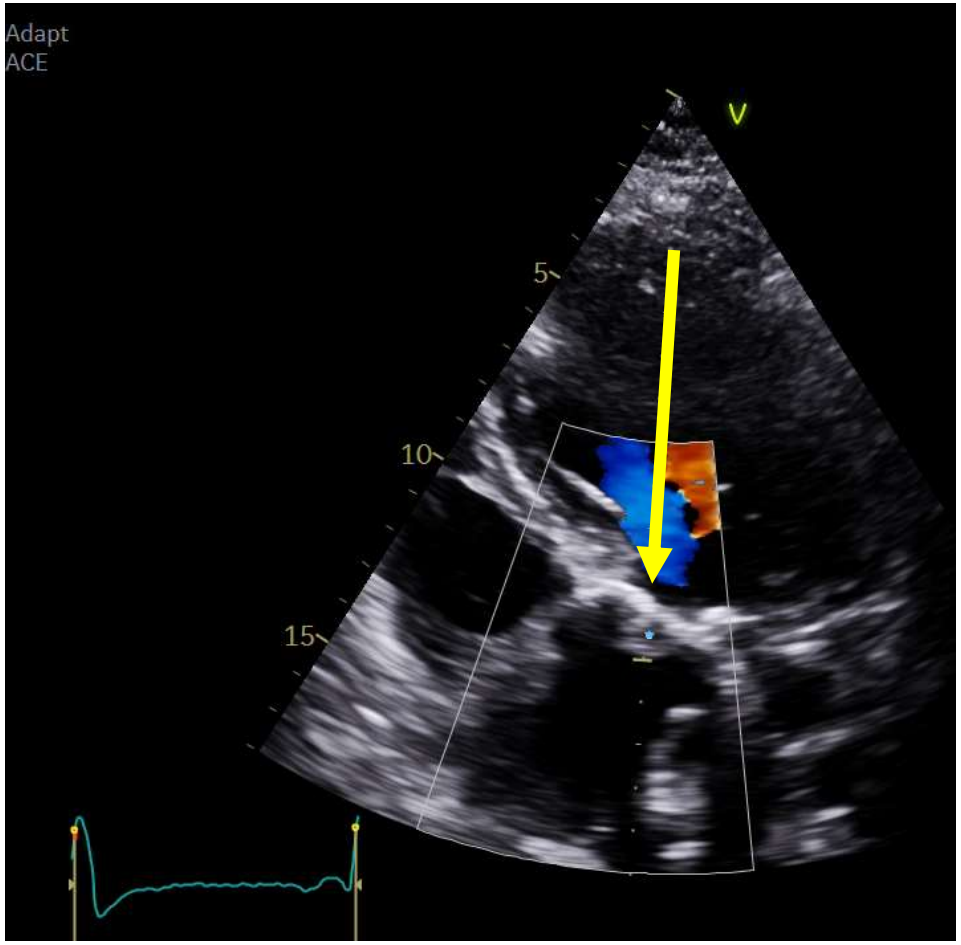
Pitfalls and Tips in the Assessment of Aortic Stenosis by Transthoracic Echocardiography

Grazia Canciello [1], Shabnam Pate [2], Anna Sannino [1,2], Felice Borrelli [1], Gaetano Todde [1], Paul Grayburn [2], Maria-Angela Losi [1,*] and Giovanni Esposito [1]



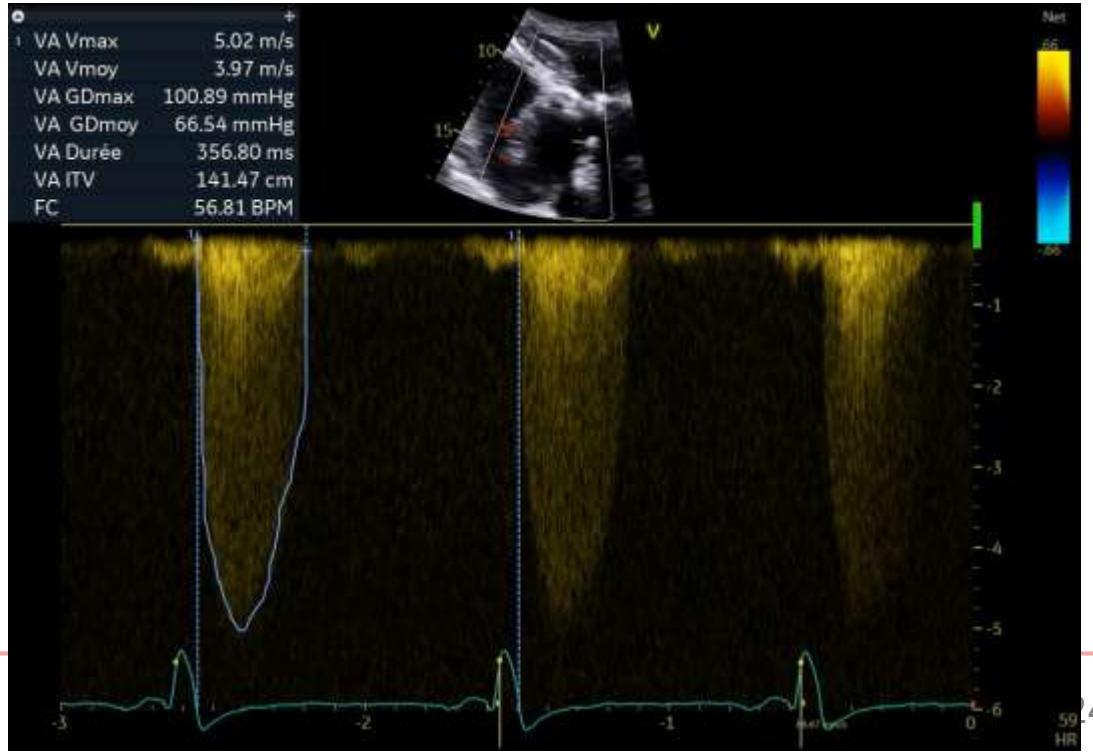
Diagnostics **2023**, *13*, 241

Color Flow

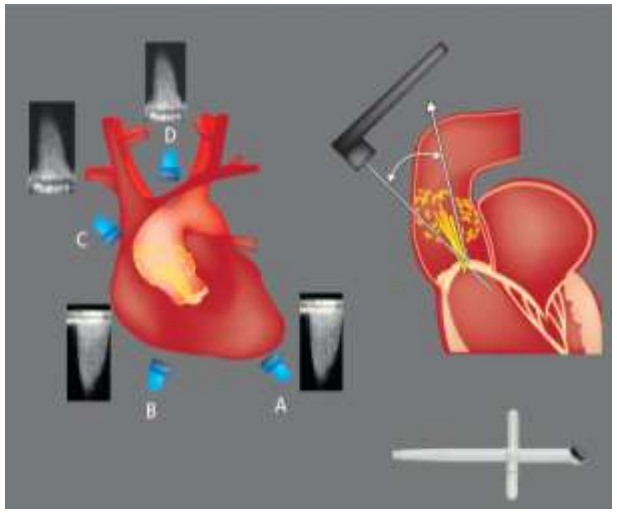

Adapt
ACE
V
5
10
15

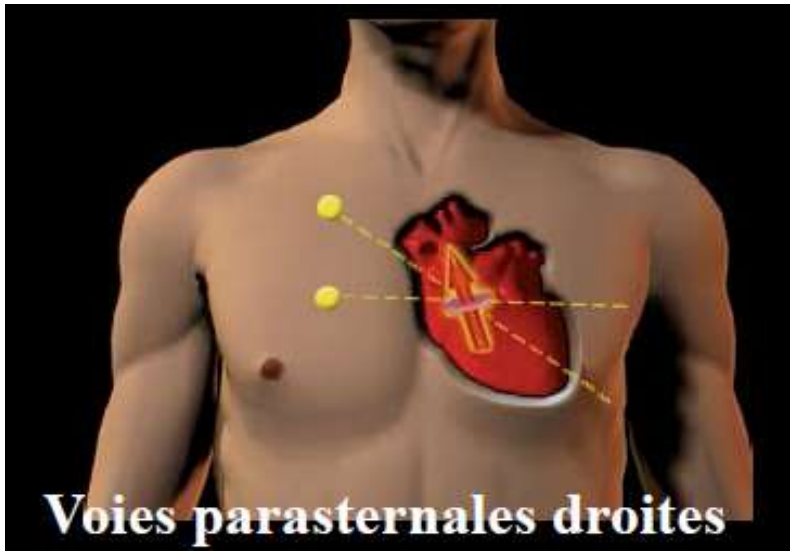

Adapt
ACE
Net
66
V
10
15
62
2.4sHR

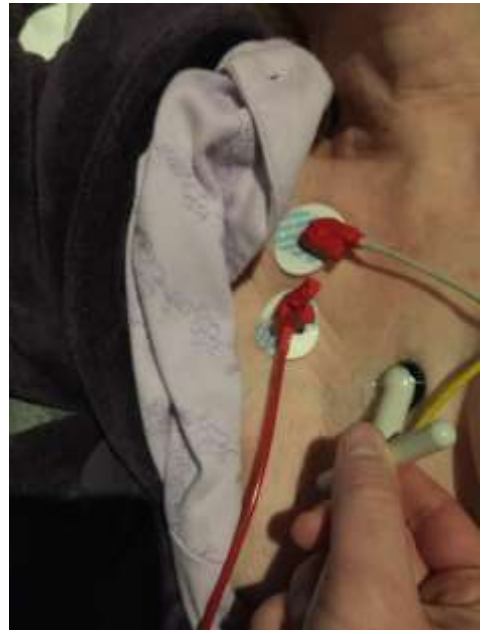

V
10

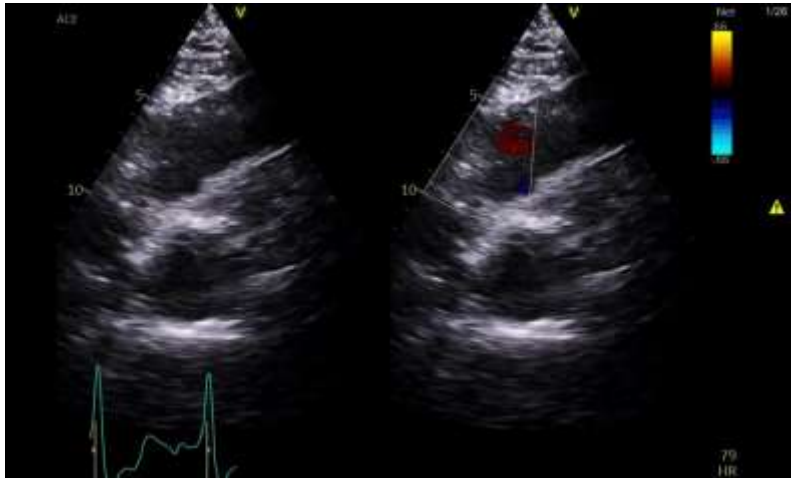

VA Vmax 5.02 m/s
VA Vmoy 3.97 m/s
VA GDmax 100.89 mmHg
VA GDmoy 66.54 mmHg
VA Durée 356.80 ms
VA ITV 141.47 cm
FC 56.81 BPM
V
10
15
Net
66
-1
-2
-3
-4
-5
-6
-3
-2
-1
0
59
HR

Pedoff et parasternale droite

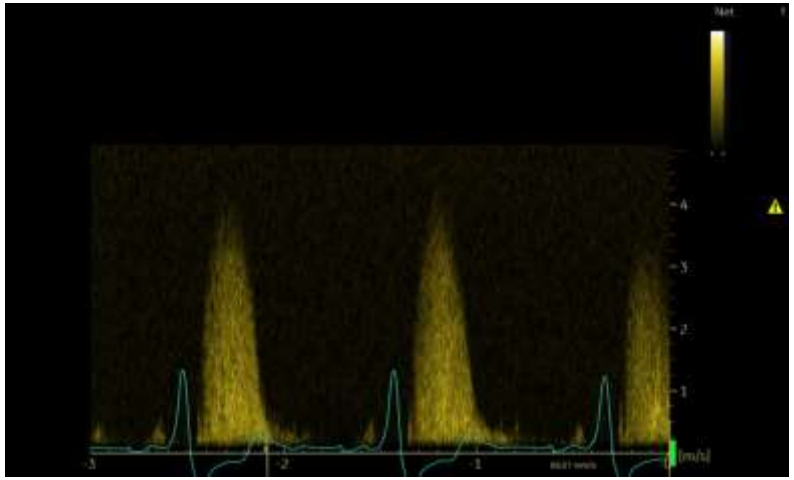






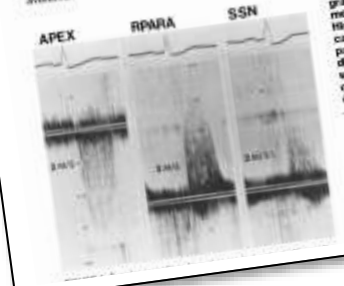


Avec la valve en plus…



Proofs…

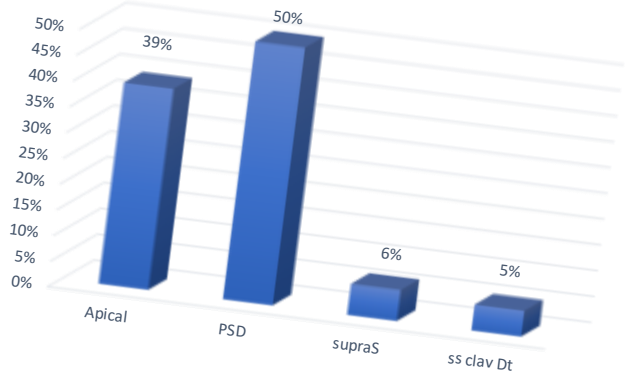
Value of Multiple Echocardiographic Views in the Evaluation of Aortic Stenosis in Adults by Continuous-Wave Doppler



Am J Cardiol 1985;55:445-449

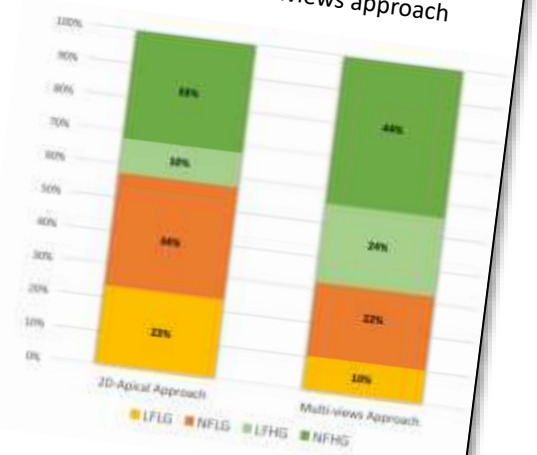
Doppler Imaging in Aortic Stenosis: The Importance of the Nonapical Imaging Windows to Determine Severity in a Contemporary Cohort

Vmax was most frequently obtained in the right parasternal window (50%), followed by the apex (39%).



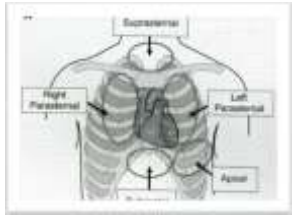
J Am Soc Echocardiogr 2015;28:780-5

Impact of multiviews approach



Ringle et al, ACVD, 2018

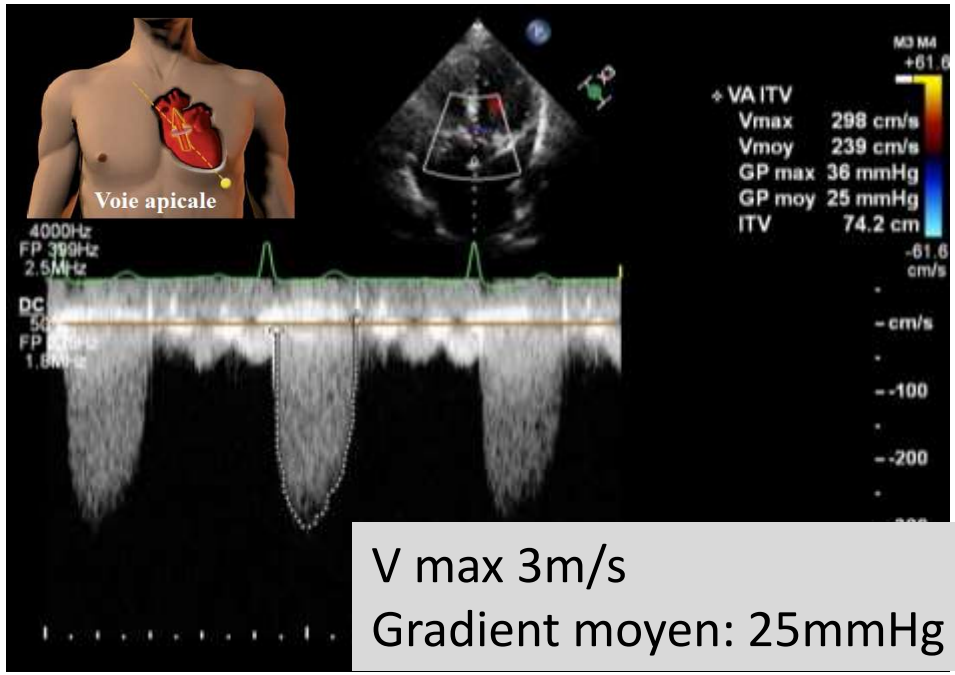
Caroline Cueff de Monchy[1], Laurent Lepage[1], Isabelle Boutron[2], Mohamed Leye[1], Delphine Detaint[1], Fabien Hvafil[1], Eric Brochet[1], Bernard Iung[1], Alec Vahanian[1], and David Messika-Zeitoun[1,3]*



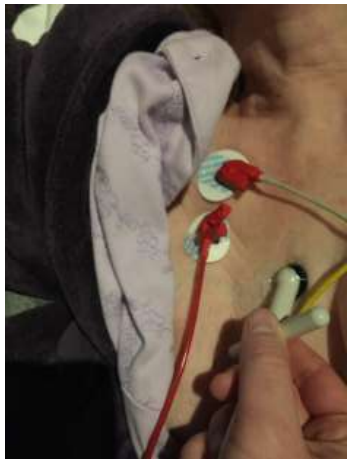
	Highest recorded	Apical view	Right parasternal view
Peak aortic velocity (m/s)	3.12 ± 0.80	2.92 ± 0.73	3.07 ± 0.85
MPG (mmHg)	25 ± 15	20 ± 13	25 ± 16
AVA (cm)²	1.36 ± 0.39	1.52 ± 0.45	1.37 ± 0.41

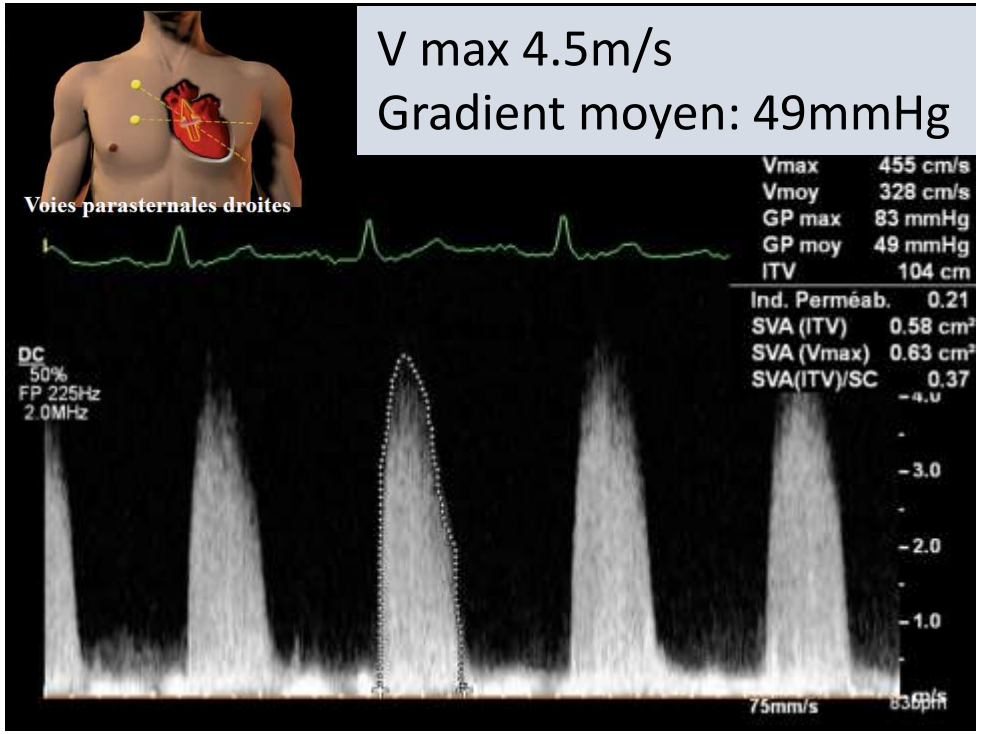
European Journal of Echocardiography (2009) 10, 420–424

Underestimation of the severity of AS:
Right parasternal view to the rescue

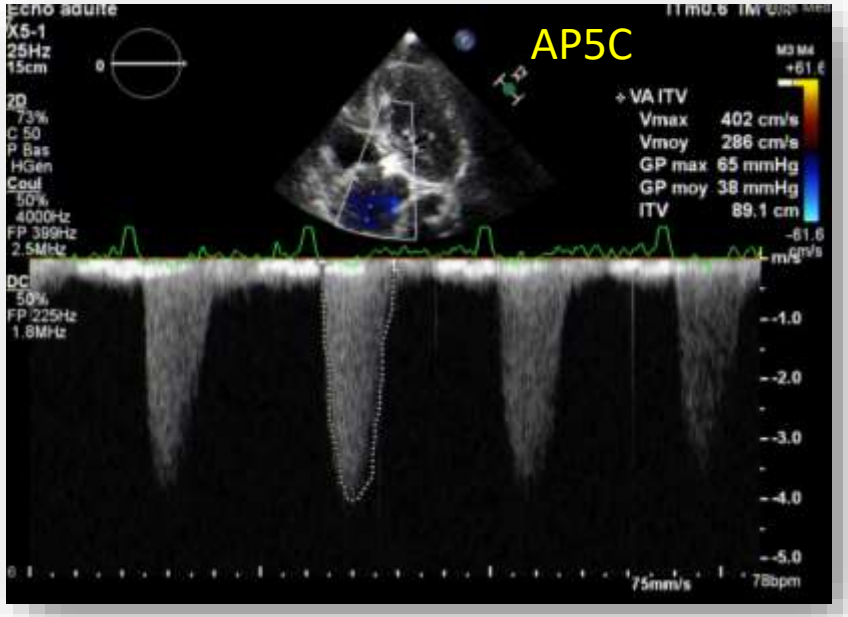


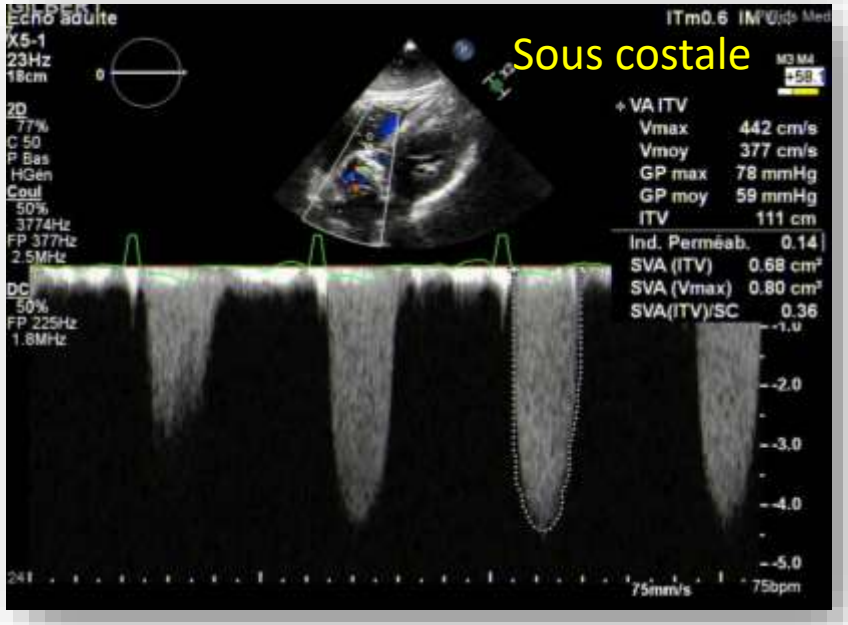
V max 3m/s
Gradient moyen: 25mmHg

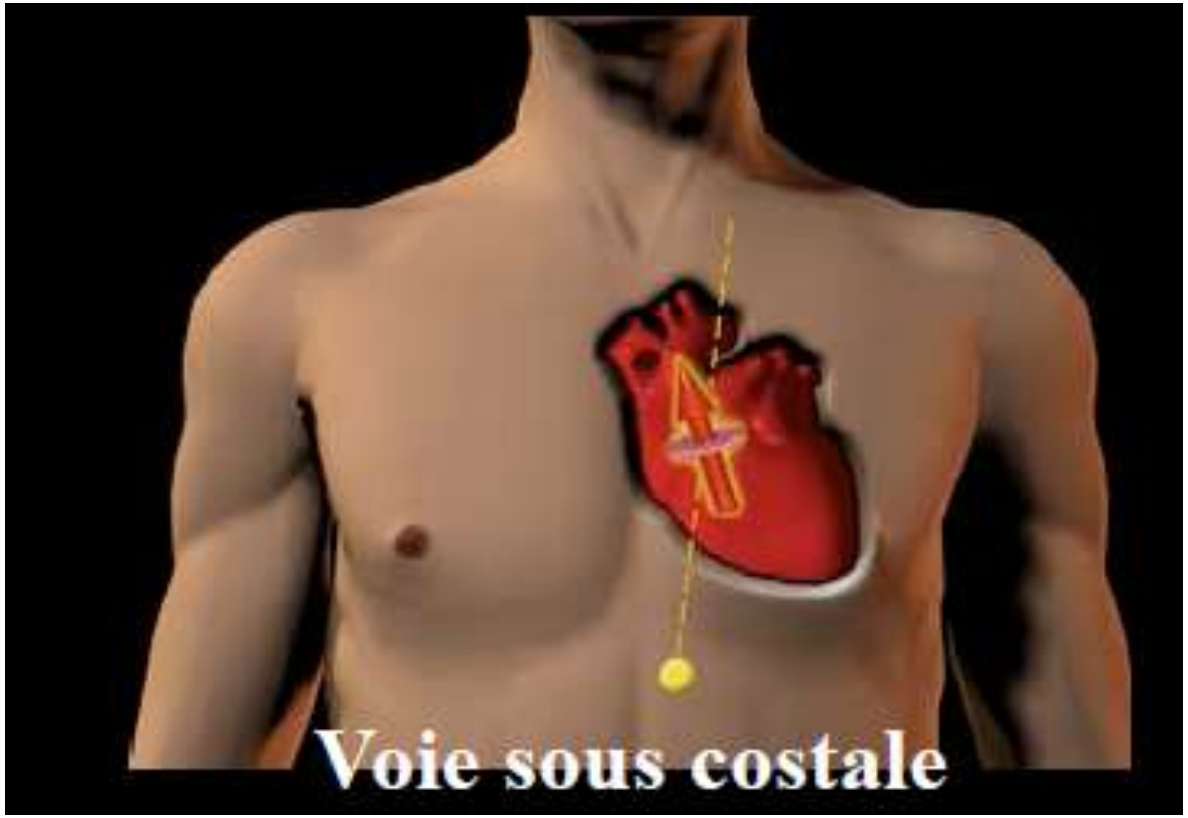


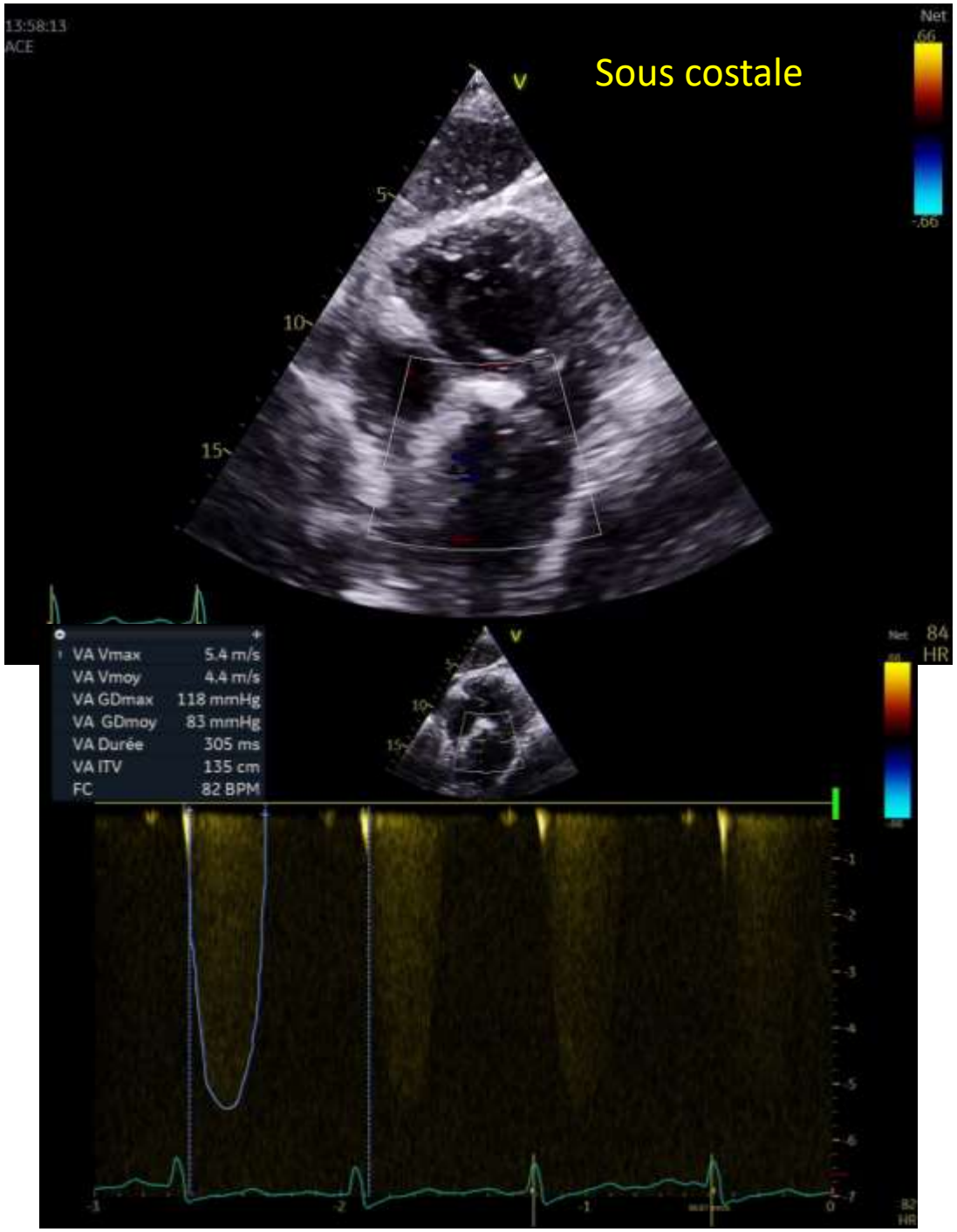


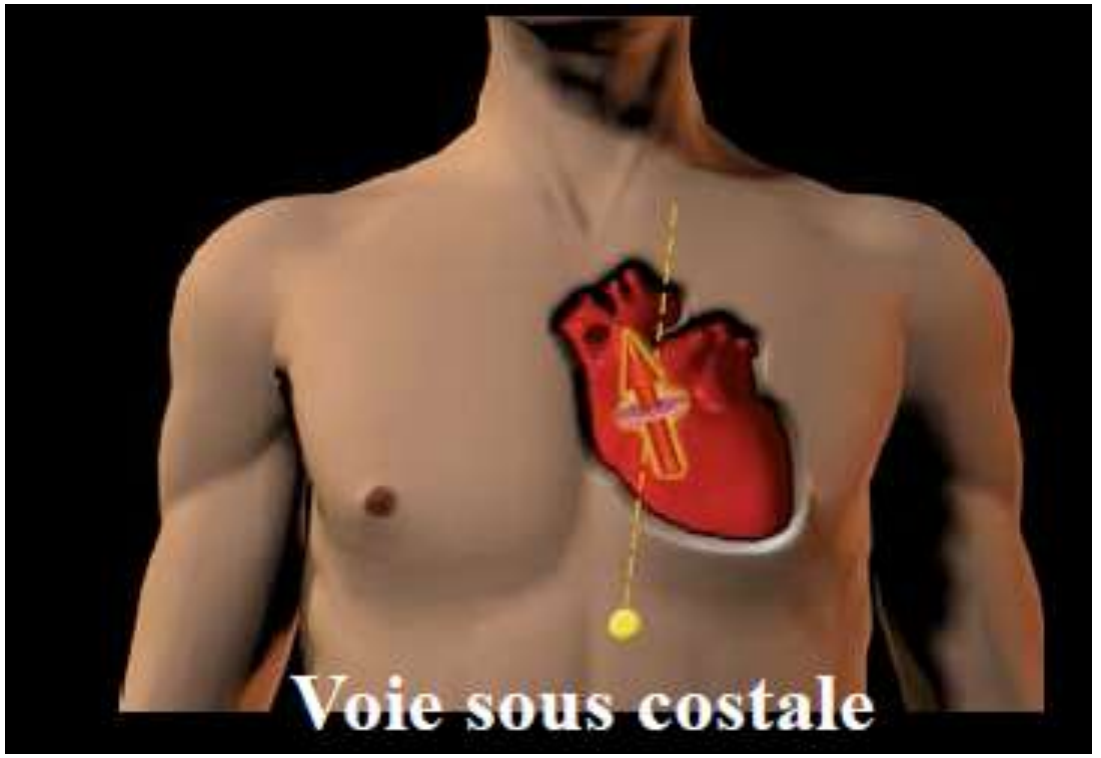
V max 4.5m/s
Gradient moyen: 49mmHg


AP5C
VA ITV
Vmax 402 cm/s
Vmoy 286 cm/s
GP max 65 mmHg
GP moy 38 mmHg
ITV 89.1 cm
75mm/s
78bpm

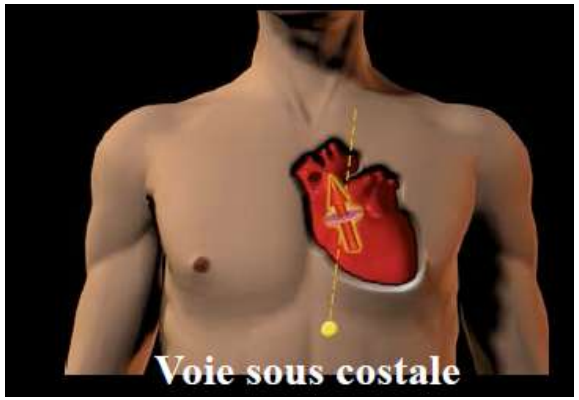

Sous costale
VA ITV
Vmax 442 cm/s
Vmoy 377 cm/s
GP max 78 mmHg
GP moy 59 mmHg
ITV 111 cm
Ind. Perméab. 0.14
SVA (ITV) 0.68 cm²
SVA (Vmax) 0.80 cm²
SVA(ITV)/SC 0.36
75mm/s
75bpm

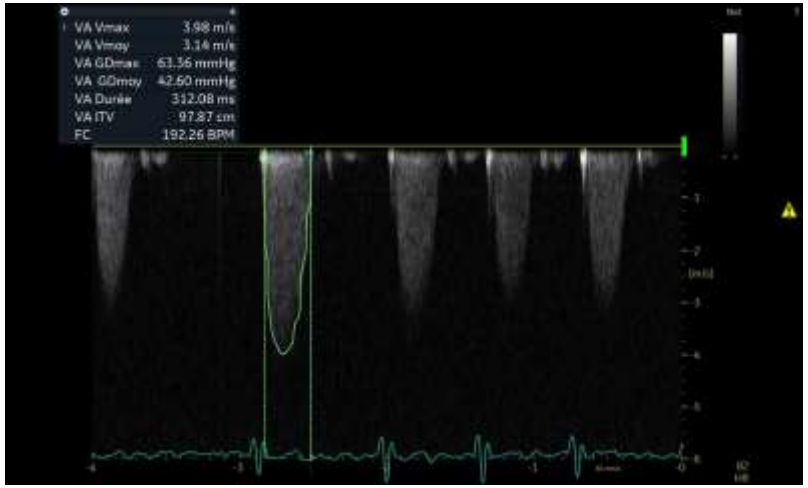

Voie sous costale


Sous costale
13:58:13
ACE
Net
66
-66
5
10
15
VA Vmax 5.4 m/s
VA Vmoy 4.4 m/s
VA GDmax 118 mmHg
VA GDmoy 83 mmHg
VA Durée 305 ms
VA ITV 135 cm
FC 82 BPM
84
HR


Voie sous costale

Pedoff : subcostal





Paradoxical LFLG AS

1. Eliminer une **erreur de mesure** ou de recueil
   - (Anneau aortique, VTI)
2. Confirmer le **bas débit et le contexte**
   - (IRM, Simpson, Amylose, strain, acfa, RM IM IT femme…)
3.
4.

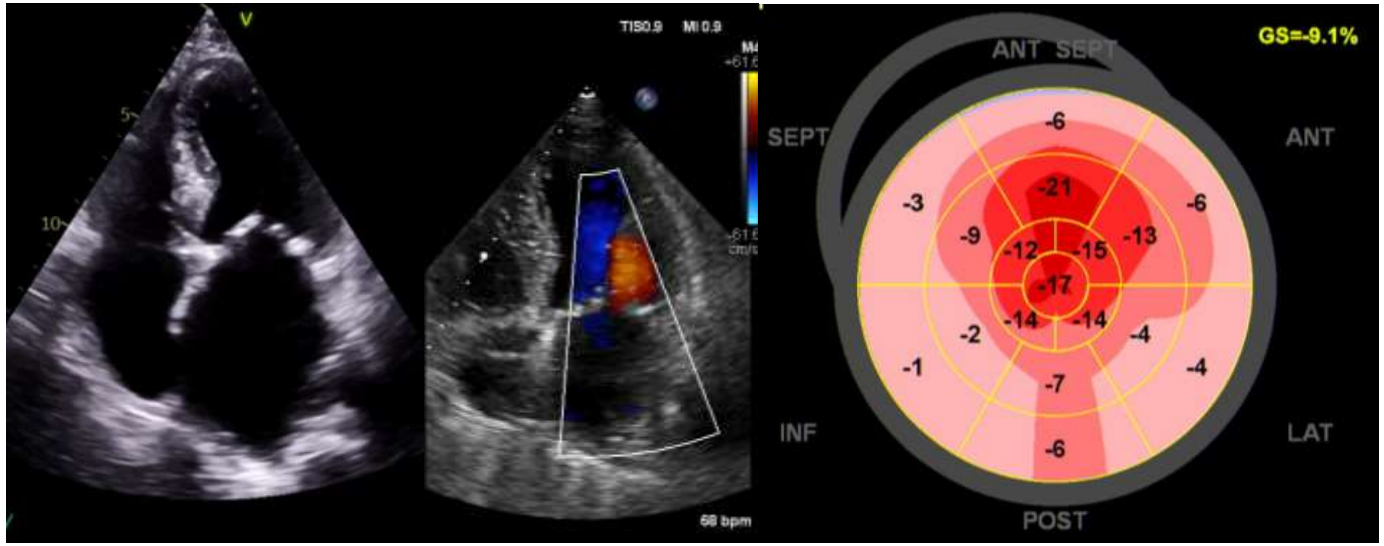
Paradoxical LF MG AS: why?

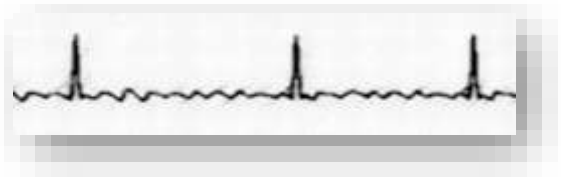
Réduction du flux transaortique

- Communication interauriculaire ou ventriculaire
- Insuffisance mitrale significative
- Rétrécissement mitral
- Insuffisance tricuspide sévère, dysfonction VD
- Amylose
- Acfa

Erreurs de mesure

- CCVG
- Mauvais alignement du flux
- Restitution de pression





Attention à la FA !

MAYO CLINIC

Circulation: Cardiovascular Imaging
Volume 14, Issue 7, July 2021; Page e012453
https://doi.org/10.1161/CIRCIMAGING.120.012453

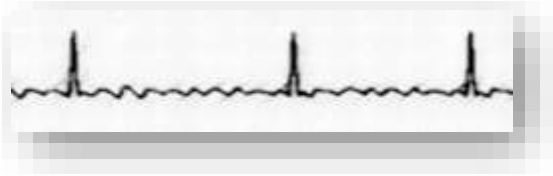
American Heart Association.

ORIGINAL ARTICLE

High Prevalence of Severe Aortic Stenosis in Low-Flow State Associated With Atrial Fibrillation

See Editorial by Anthony and Griffin

Said Alsidawi, MD, Sana Khan, MD, Sorin V. Pislaru, MD, PhD, Jeremy J. Thaden, MD, Edward A. El-Am, MD, Christopher G. Scott, MS, Kareem Morant, MD, Didem Oguz, MD, Sushil A. Luis, MBBS, Ratnasari Padang, MBBS, PhD, Colleen E. Lane, MD, Robert B. McCully, MD, Patricia A. Pellikka, MD, Jae K. Oh, MD, and Vuyisile T. Nkomo, MD, MPH



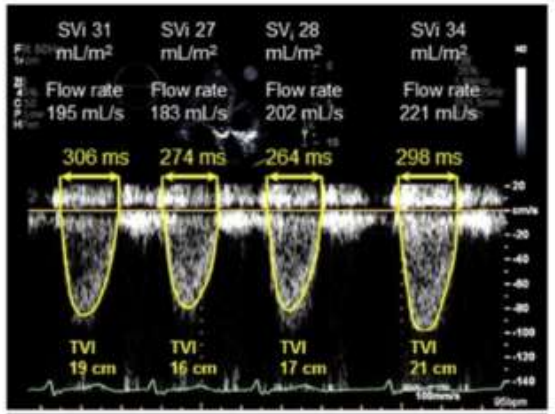
AF reduces stroke volume

MG underestimates severity of AS

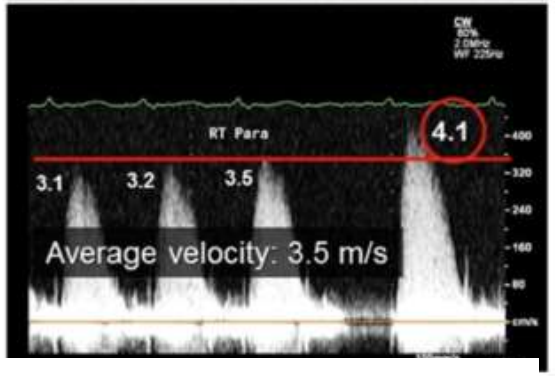
Excess mortality in AF (LG and HG)

AF LG is as calcified as SR HG AS

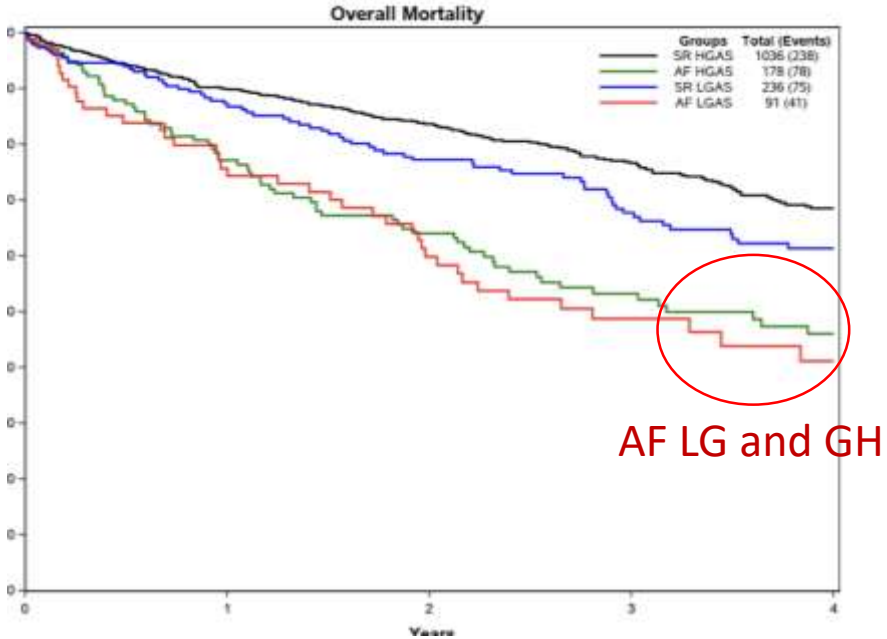
Delayed AVR!



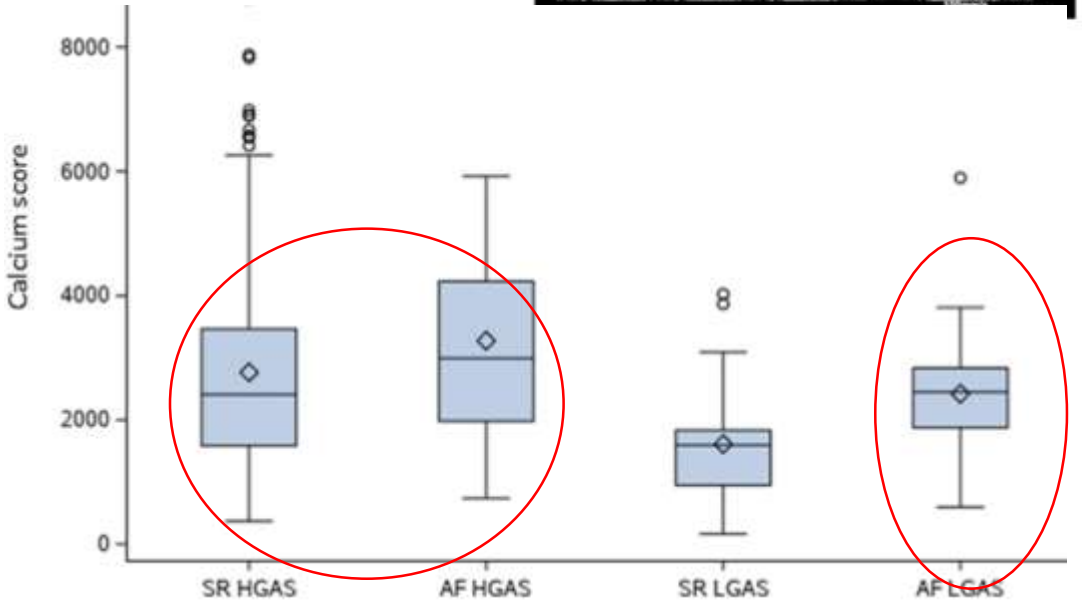
LVOT signals



Aortic valve signals

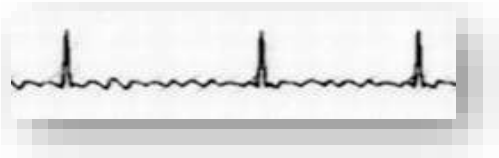


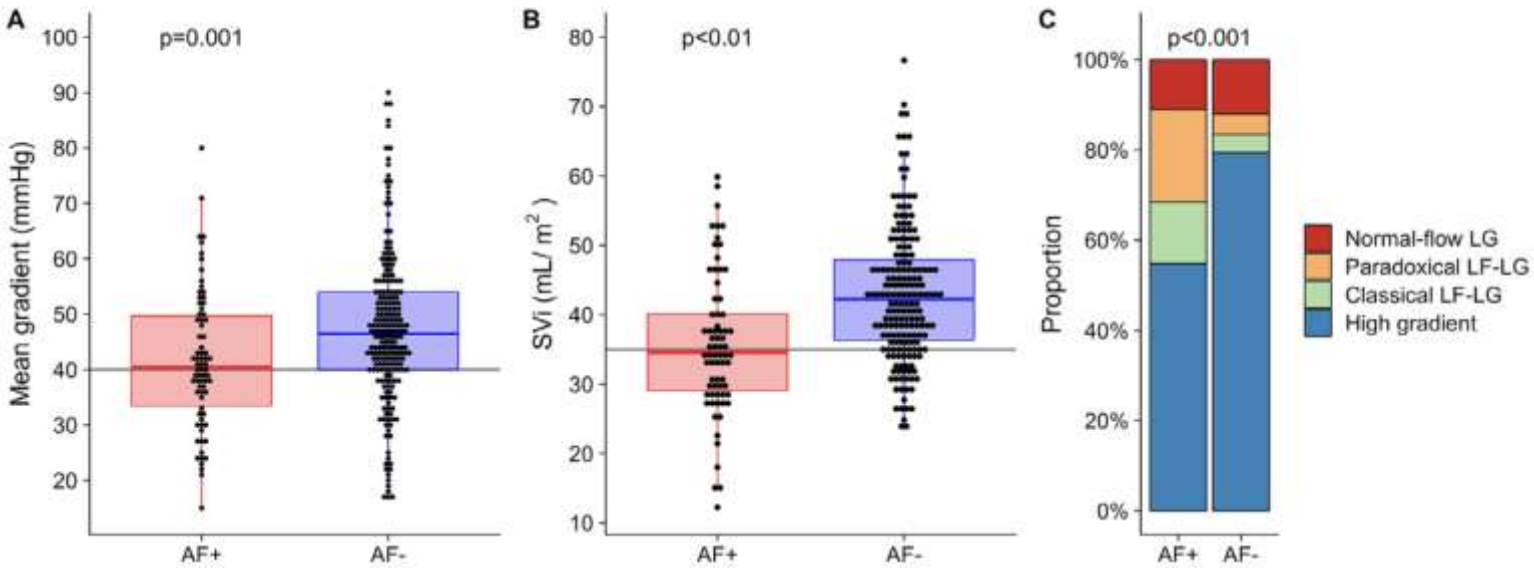
AF LG and GH



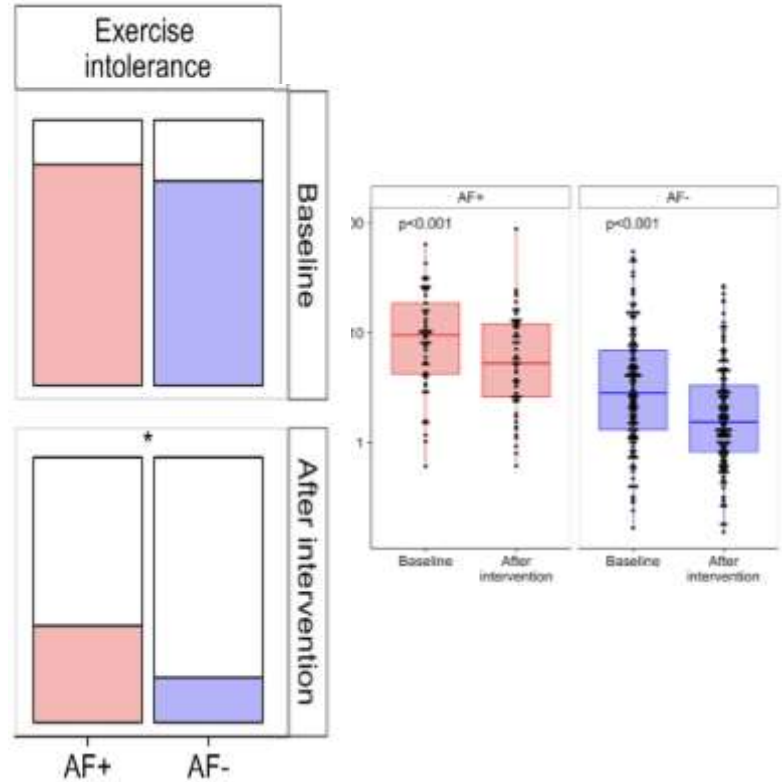
Impact of Atrial Fibrillation on the Symptoms and Echocardiographic Evaluation of Patients With Aortic Stenosis

N=279 from Helsinki





LF LG is more frequent in AF



More symptoms and higher BNP levels after AVR

Am J Cardiol 2024;211:122–129

Attention à la FA !

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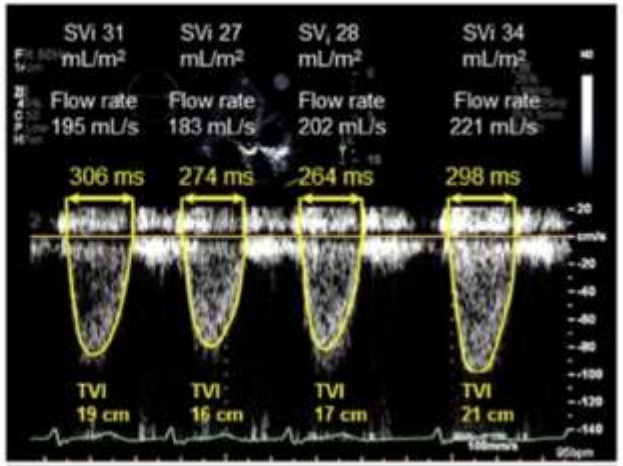
CLINICAL PERSPECTIVE

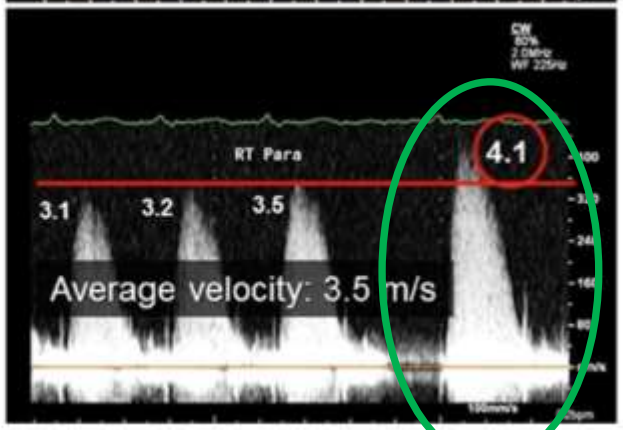
The results of this study have important implications for clinical practice. From an evaluation standpoint, in the setting of low-gradient aortic stenosis (AS), the presence of atrial fibrillation (AF) should prompt consideration of different management given the marked differences in aortic valve calcium scores and outcomes according to the presence of this rhythm. Furthermore, utilizing the single-highest signal to diagnose severe AS would not only be accurate, but also simpler. This study also shows that the excess mortality in patients with AF compared with sinus rhythm is explained by more than older age and clinical comorbidities, and AF should probably be factored into decision-making about timing or urgency of aortic valve replacement. Symptoms of AF are similar to those associated with AS; it has been shown previously that symptomatic patients with combined severe AS and AF are sometimes not referred to aortic valve replacement because clinicians think the symptoms are due to AF and not AS. There is, therefore, an opportunity to improve the evaluation, management, and potentially outcomes in patients with AS and concomitant AF by drawing attention to the fact that AS severity is grossly underestimated when the mean gradient is obtained during AF, and that this—along with blaming AF for symptoms—may be delaying timely recognition of symptomatic severe AS and timely referral to potentially life-saving aortic valve replacement.

MAYO CLINIC

LVOT signals



Aortic valve signals



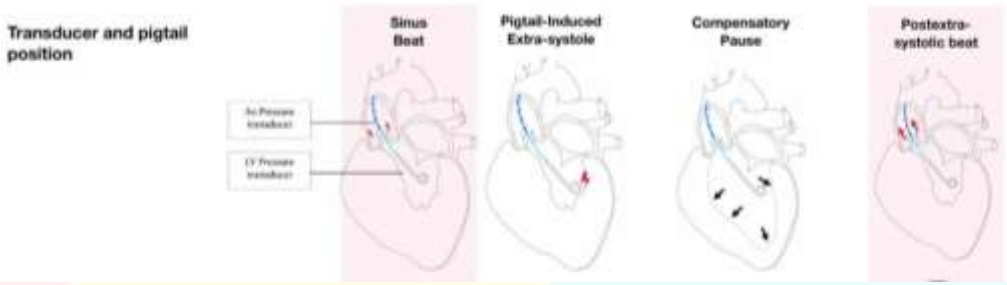
« Furthermore, utilizing the single-highest signal to diagnose severe AS would not only be accurate, but also simpler. »

Post extrasystolic beats may help !

ORIGINAL ARTICLE

Catheter-Induced Postextrasystolic Potentiation in the Assessment of Severity of Low-Gradient Aortic Valve Stenosis

Payam Dehghani, MD; Jyotpal Singh, PhD; Zachary Singer, MD; Jeffrey Booker, MD; Andrea J. Lavoie, MD; Rodney H. Zimmermann, MD; Jay S. Shavadia, MD; John G. Webb, MD; Marie-Annick Clavel, DVM, PhD; Philippe Pibarot, DVM, PhD



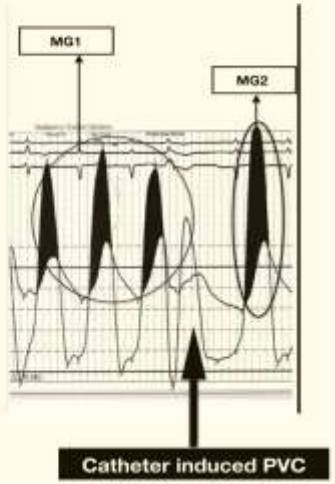
Really ?

Patient Selection

1. Mean LV/Ao Gradient < 40mmHg
2. AVA < 1.0cm2
3. Sinus rhythm
4. Absence of LVOT dynamic obstruction

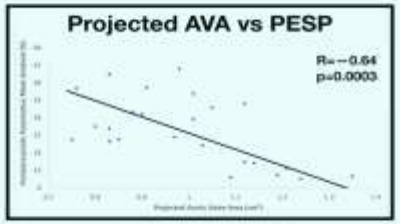
Postextrasystolic Potentiation (PESP) measurement

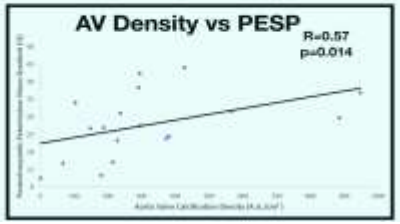
%PESP=(MG2-MG1)/MG1x100



Diagnostic Accuracy of PESP for Severe AV stenosis as determined by DSE and MDCT

	AUC	Sensitivity	Specificity	PPV	NPV
PESP > 20%	0.88; p=0.001	100%	77%	83%	100%



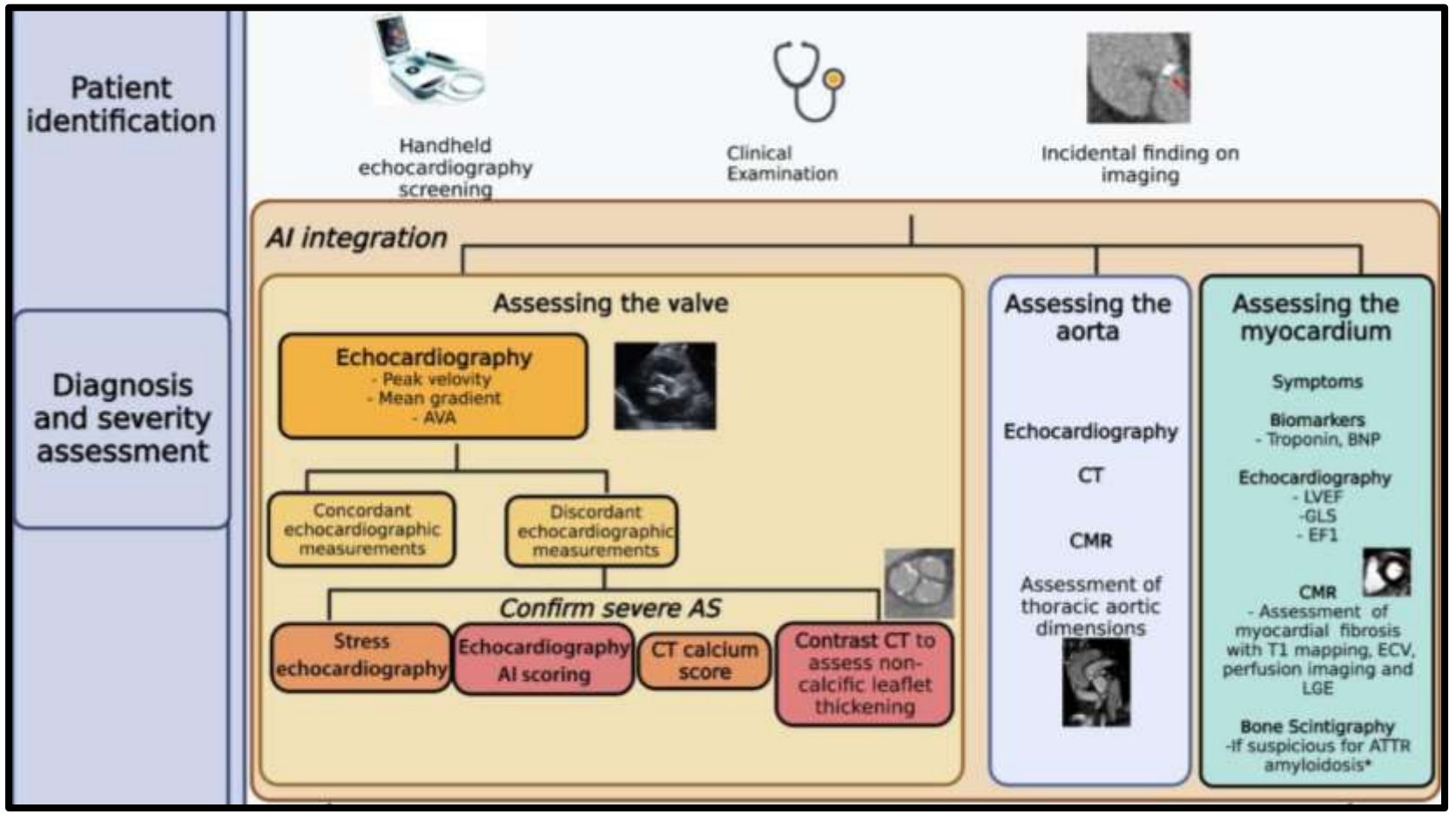


>20% increase in MG post esv predicts severe AS !

< 20% rules out severe AS

(10.1161/CIRCINTERVENTIONS.123.012892)

What's next?



Improved understanding of disease pathology and drug development

Contrast enhanced CT

- Calcific and non-calcific leaflet thickening

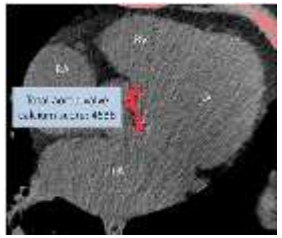
PET imaging to measure disease activity

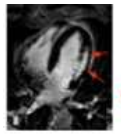
- 18F-NaF - *calcium*

- 68Ga-FAPI- *fibrosis*

- 18F-GP1- *thrombus formation*

-68Ga-DOTATATE- *inflammation*





European Heart Journal - Cardiovascular Imaging (2023) 24, 1430–1443

Paradoxical LFLG AS

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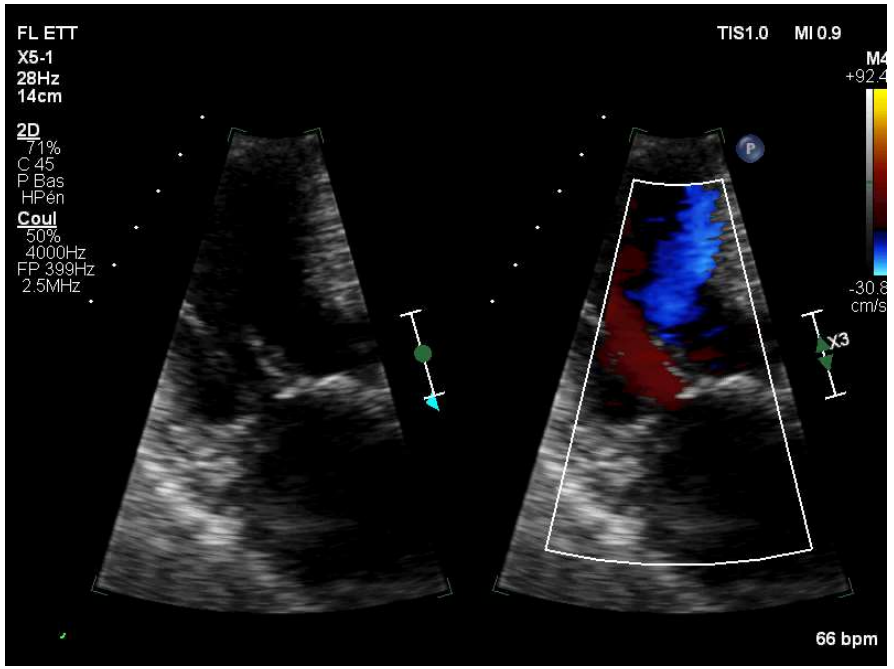
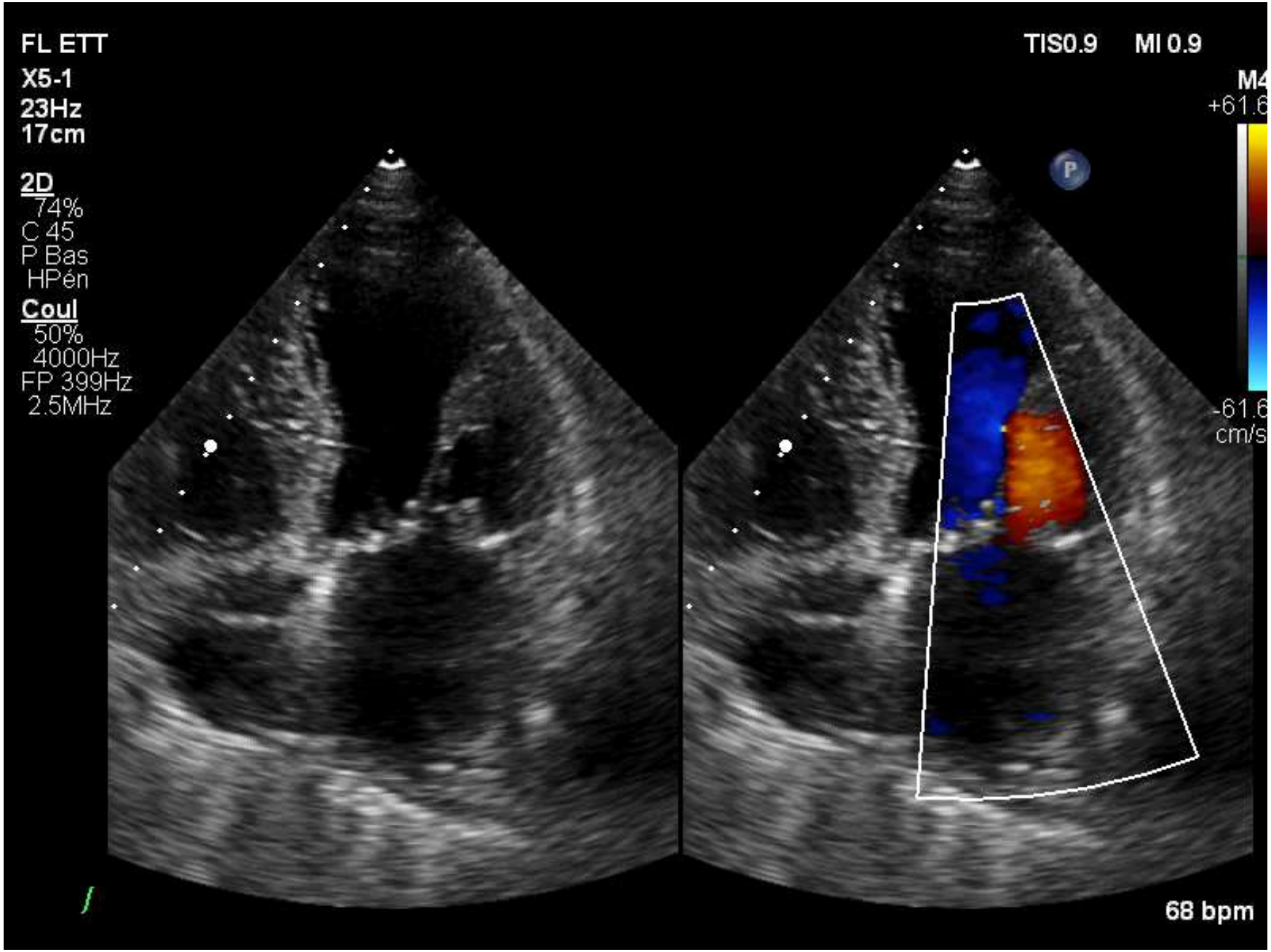
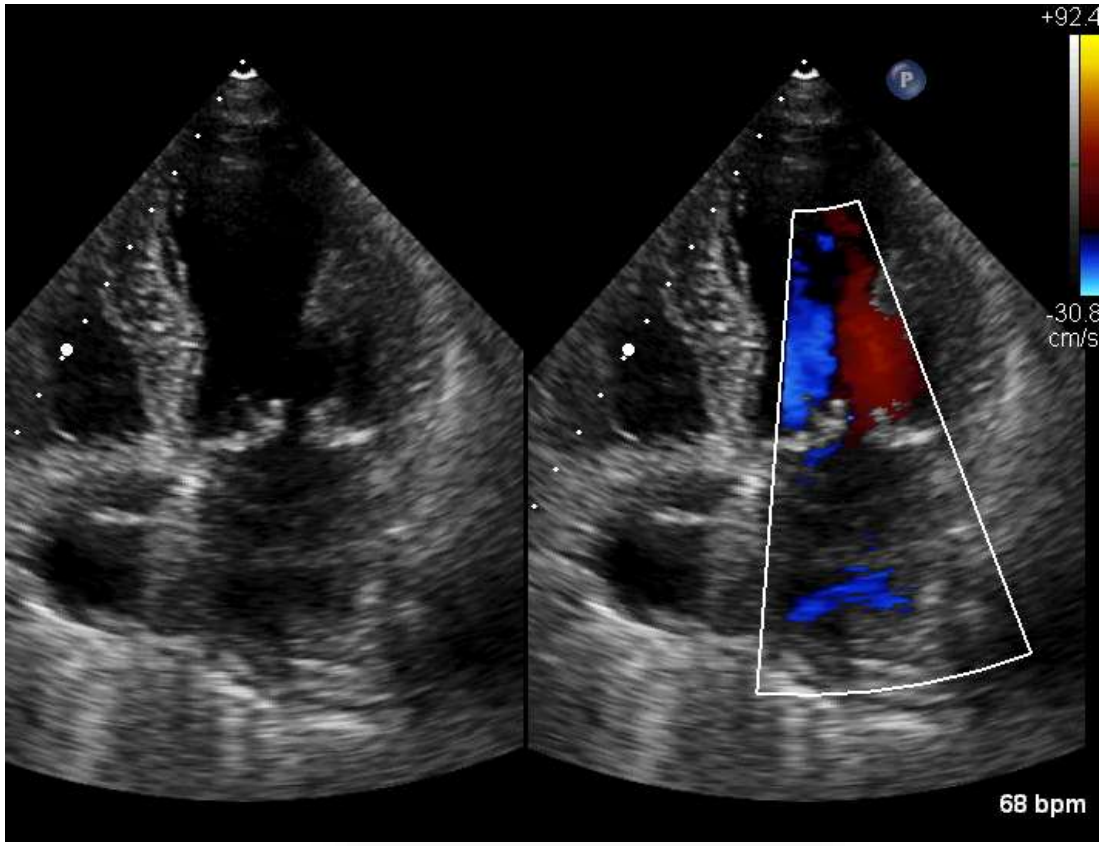
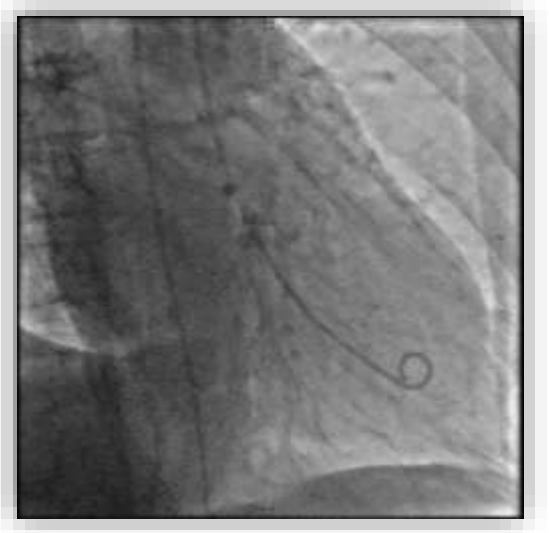
   - (Anneau aortique, VTI)
2. • Confirmer le **bas débit et le contexte**
   - (IRM, Simpson, Amylose, strain, acfa, RM IM IT femme…)
3. • Confirmer le **bas gradient**
   - (parasternale droite….)
4. • Score calcique


FL ETT
X5-1
28Hz
15cm
2D
75%
C 45
P Bas
HPén
Coul
50%
4000Hz
FP 399Hz
2.5MHz
ITm1.0 IM 0.9
+92.4
-30.8
cm/s
X3
Rayon IM 0.8 cm
Taux flux IM 123.8 ml/s
ORE IM 0.20 cm²
Volume IM 38 ml
67bpm

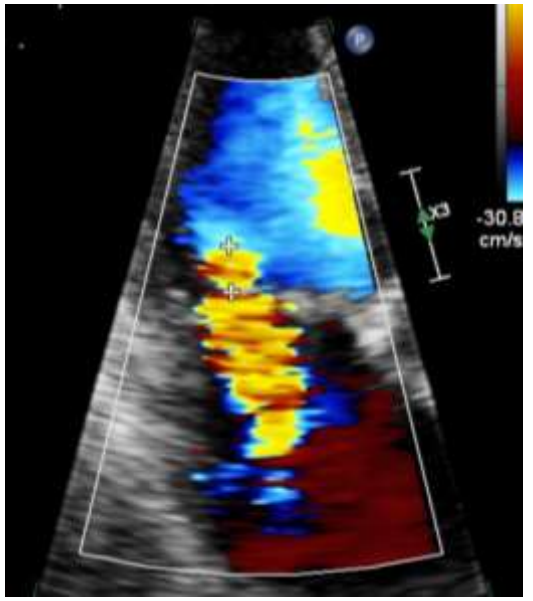

FL ETT
X5-1
28Hz
14cm
2D
71%
C 45
P Bas
HPén
Coul
50%
4000Hz
FP 399Hz
2.5MHz
TIS1.0 MI 0.9
M4
+92.4
-30.8
cm/s
X3
66 bpm

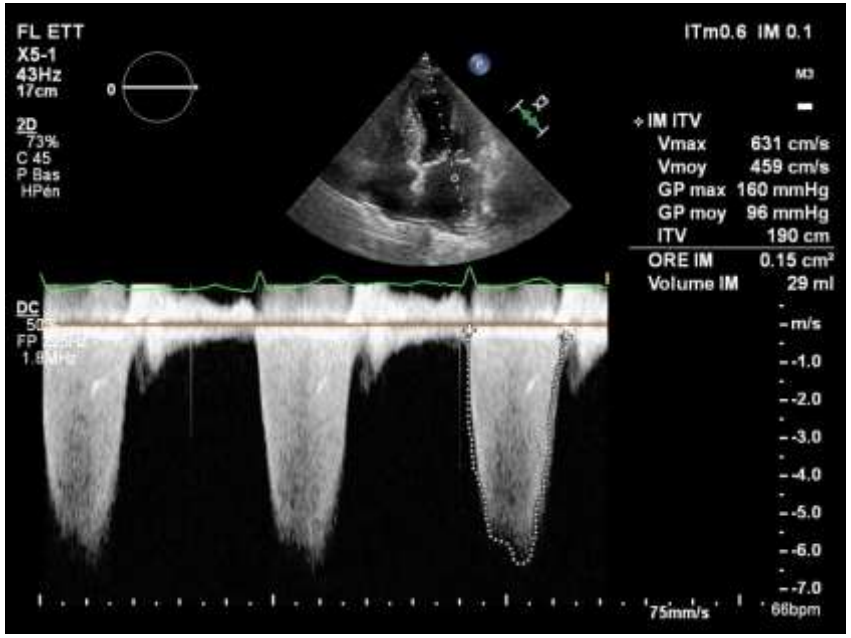

FL ETT
X5-1
23Hz
17cm
2D
74%
C 45
P Bas
HPén
Coul
50%
4000Hz
FP 399Hz
2.5MHz
TIS0.9
MI 0.9
M4
+61.6
-61.6
cm/s
68 bpm


+92.4
-30.8
cm/s
68 bpm

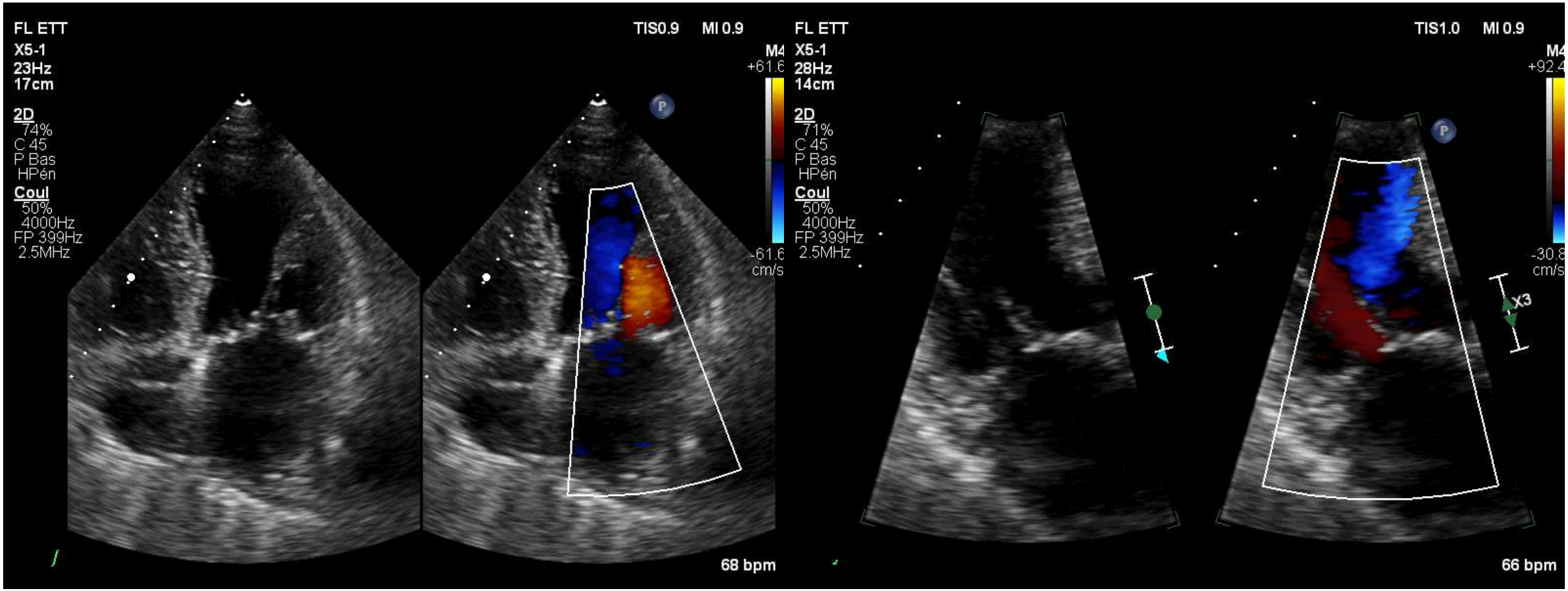


SOR 0,25cm²


-30.8
cm/s


FL ETT
X5-1
43Hz
17cm
2D
73%
C 45
P Bas
HPen
ITm0.6 IM 0.1
IM ITV
Vmax 631 cm/s
Vmoy 459 cm/s
GP max 160 mmHg
GP moy 96 mmHg
ITV 190 cm
ORE IM 0.15 cm²
Volume IM 29 ml
DC
m/s
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
75mm/s
68bpm

Quel mécanisme pour cette IM?

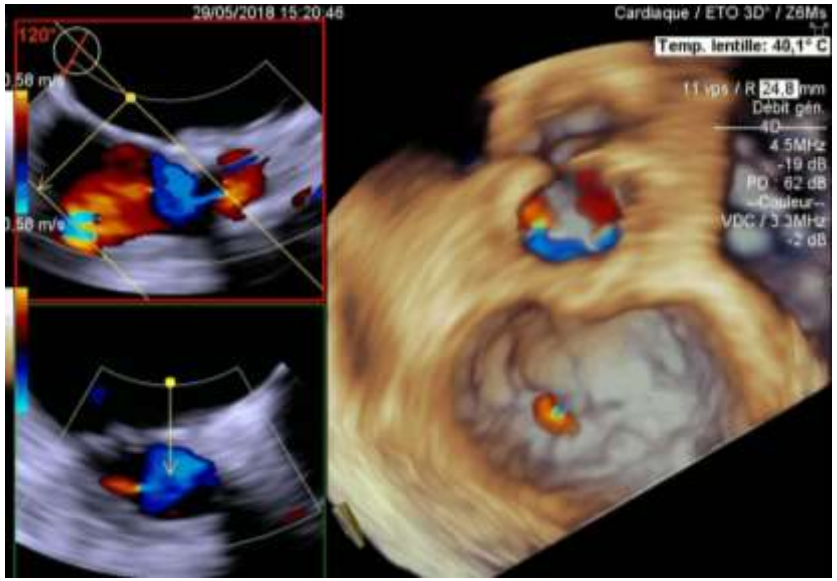


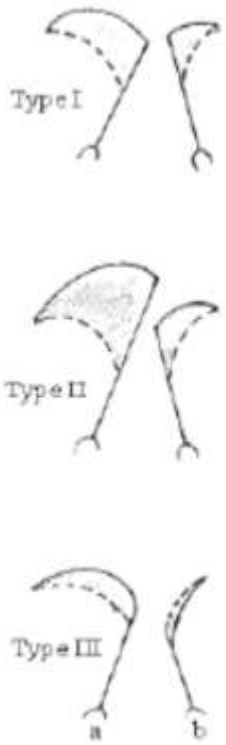

29/05/2018 13:52:42
Cardiaque / ETO 3D° / Z6Ms
120°
210°
Temp. lentille: 40,5° C
23 ips / 120 mm
VM°
2D
H5.5MHz / -18 dB
PD : 62 dB


Temp. le
13 vp


29/05/2018 15:20:19
0dB / IM : 0,68 / TIM : 0,41
Cardiaque / ETO 3D° / Z6Ms
120°
Temp. lentille: 40,5° C
13 vps / R 28,4 mm
VM°
4D
4.5MHz
-20 dB
PD : 62 dB


0°
90°
Cardiaque / ETO 3D° / Z6Ms
Temp. lentille: 40,3° C
23 ips / 120 mm
VM°
2D
H5.5MHz / -12 dB
PD : 62 dB


29/05/2018 15:20:46
Cardiaque / ETO 3D° / Z6Ms
120°
Temp. lentille: 40,1° C
11 vps / R 24,8 mm
Débit gén.
4D
4.5MHz
-19 dB
PD : 62 dB
Couleur
-2 dB



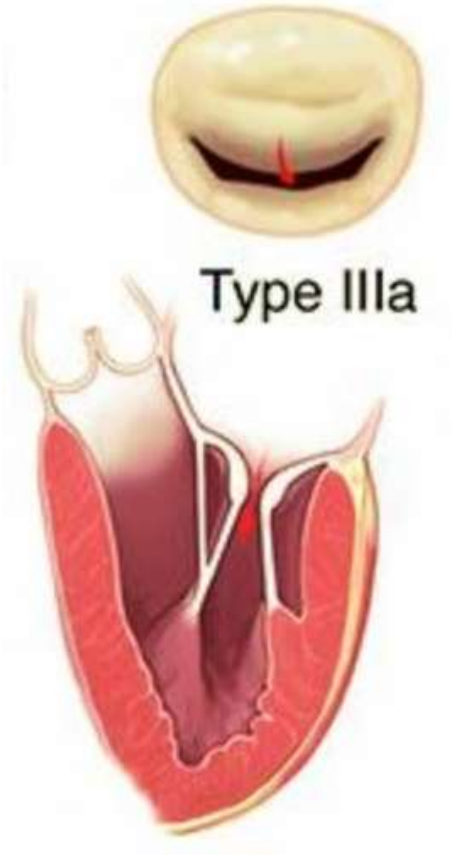
Type I: Normal Leaflet Motion

Annular dilation
Leaflet perforation

Type II: Leaflet Prolapse

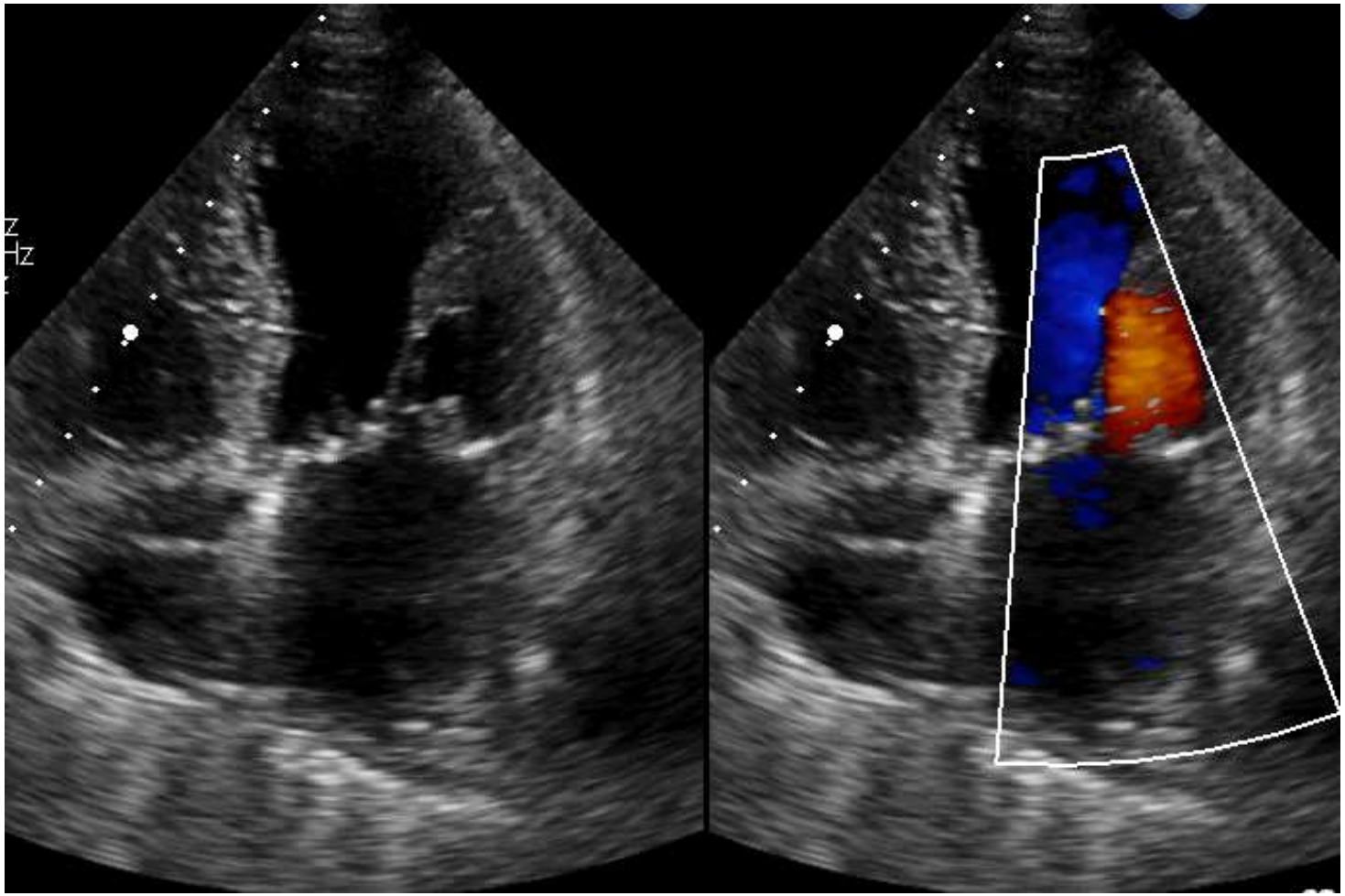
Chordal Rupture
Chordal Elongation
Papillary muscle rupture
Papillary muscle elongation

Type III: Restricted Leaflet Motion
Type IIIa: During diastole
Type IIIb: During systole



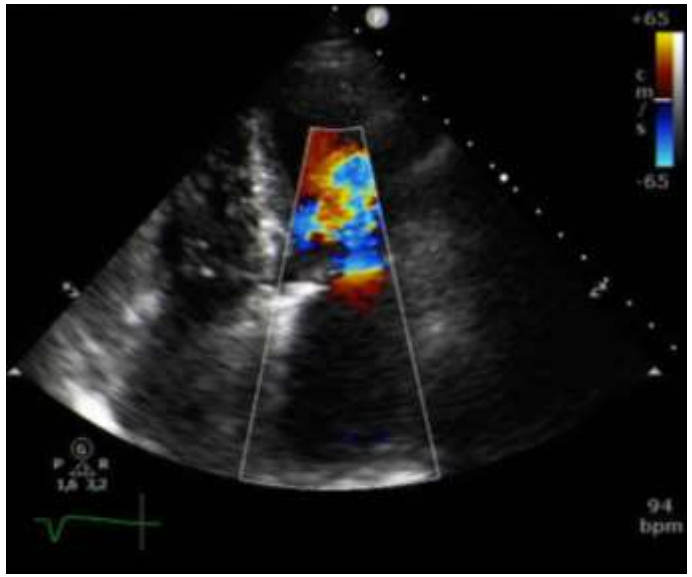
post-RAA, anorexigènes

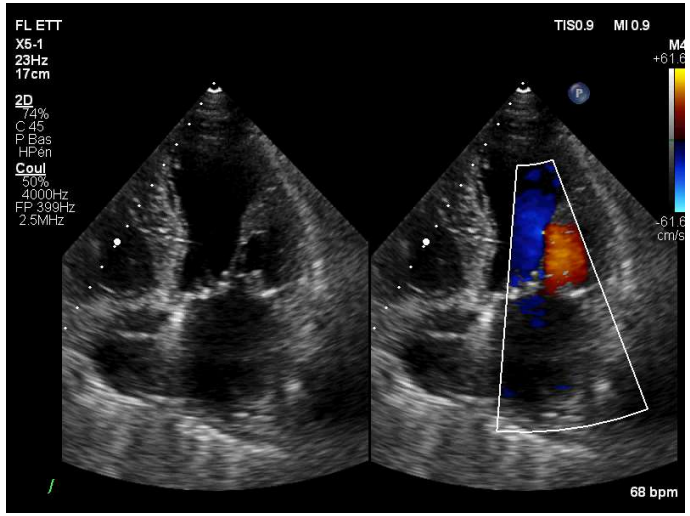
restrictif en systole et diastole
rétraction de cordages et valvulaire

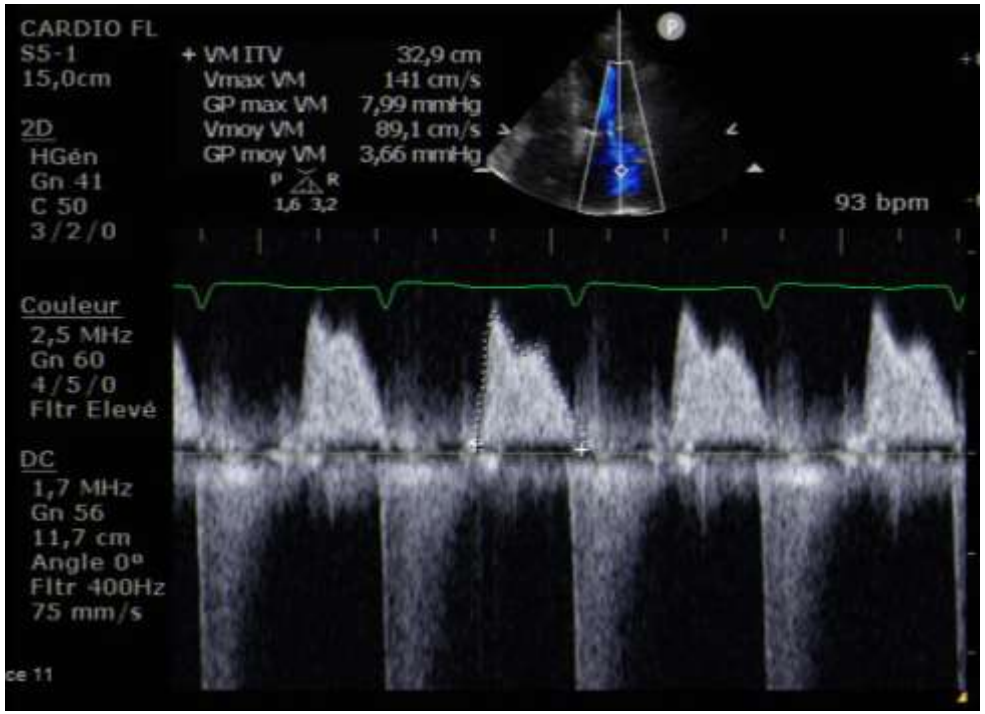


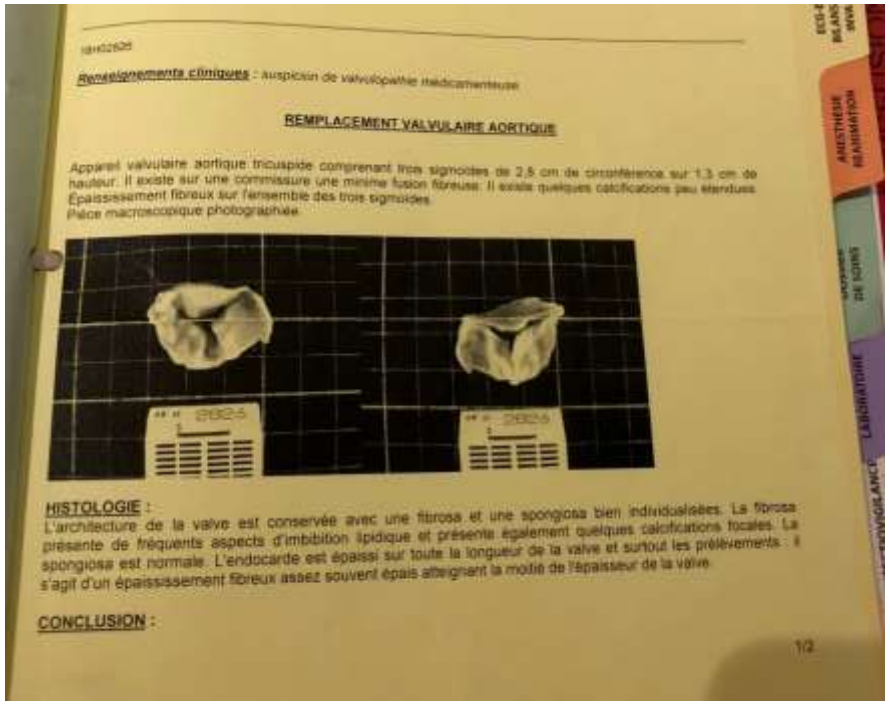

Temp. le
13 vp

Atteinte mixte sténosante et fuyante de la valve mitrale









Renseignements cliniques : suspicion de valvulopathie médicamenteuse

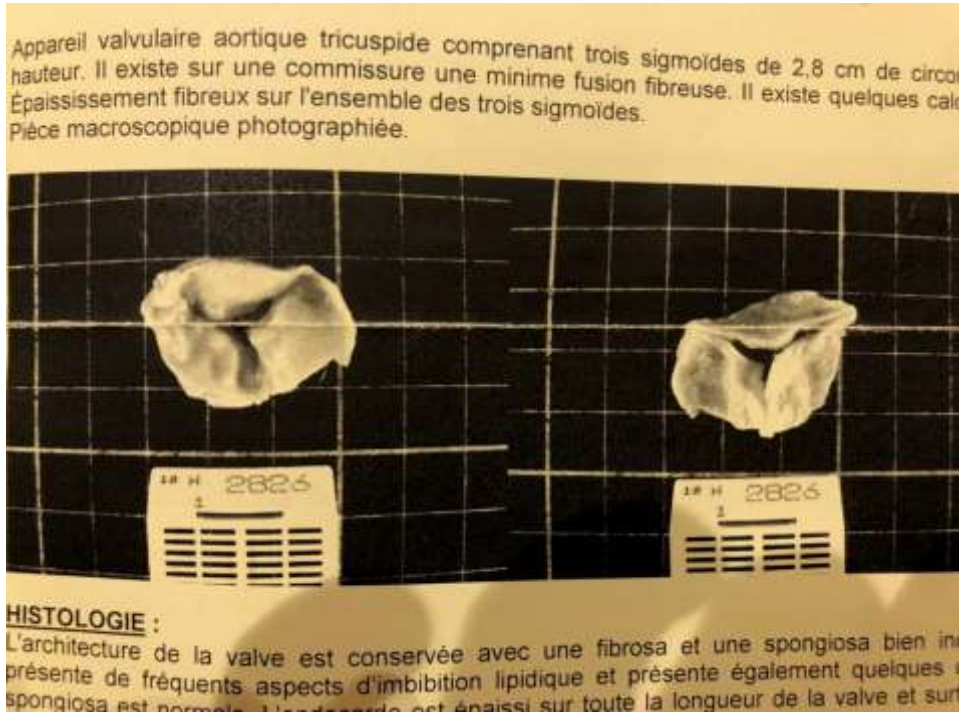
REMPLACEMENT VALVULAIRE AORTIQUE

Appareil valvulaire aortique tricuspide comprenant trois sigmoïdes de 2,8 cm de circonférence sur 1,3 cm de hauteur. Il existe sur une commissure une minime fusion fibreuse. Il existe quelques calcifications peu étendues. Épaississement fibreux sur l'ensemble des trois sigmoïdes.
Pièce macroscopique photographiée.

HISTOLOGIE :
L'architecture de la valve est conservée avec une fibrosa et une spongiosa bien individualisées. La fibrosa présente de fréquents aspects d'imbibition lipidique et présente également quelques calcifications focales. La spongiosa est normale. L'endocarde est épaissi sur toute la longueur de la valve et surtout les prélèvements : il s'agit d'un épaississement fibreux assez souvent épais atteignant la moitié de l'épaisseur de la valve.

CONCLUSION :

1/2



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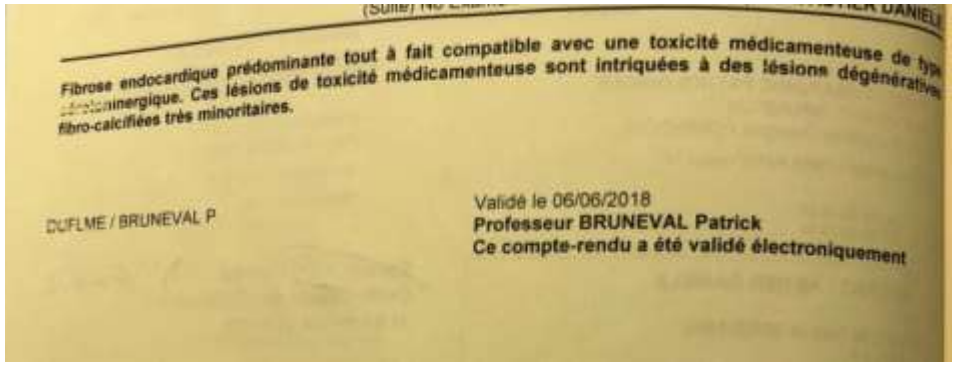
présente de fréquents aspects d'imbibition lipidique et présente également quelques
spongiosa est normale. L'endocarde est épaissi sur toute la longueur de la valve et sur

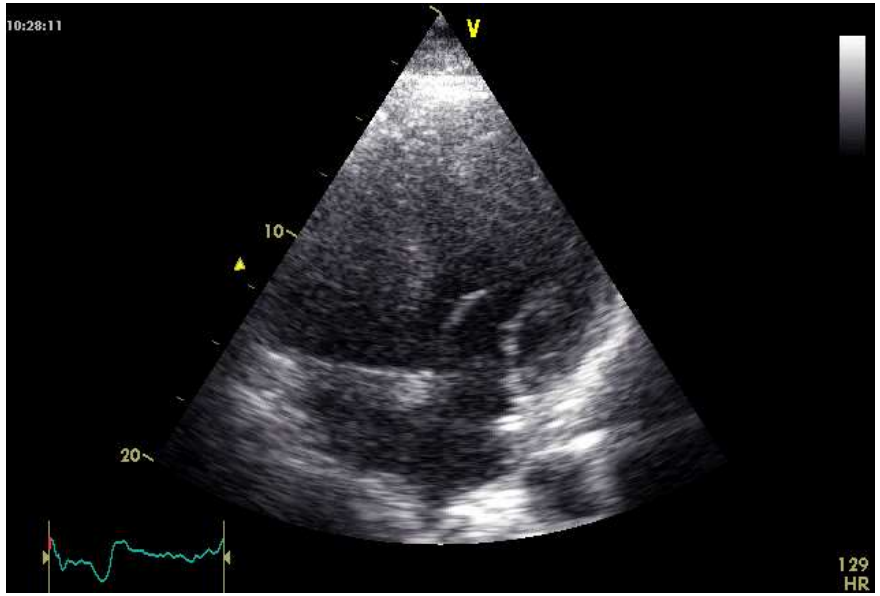


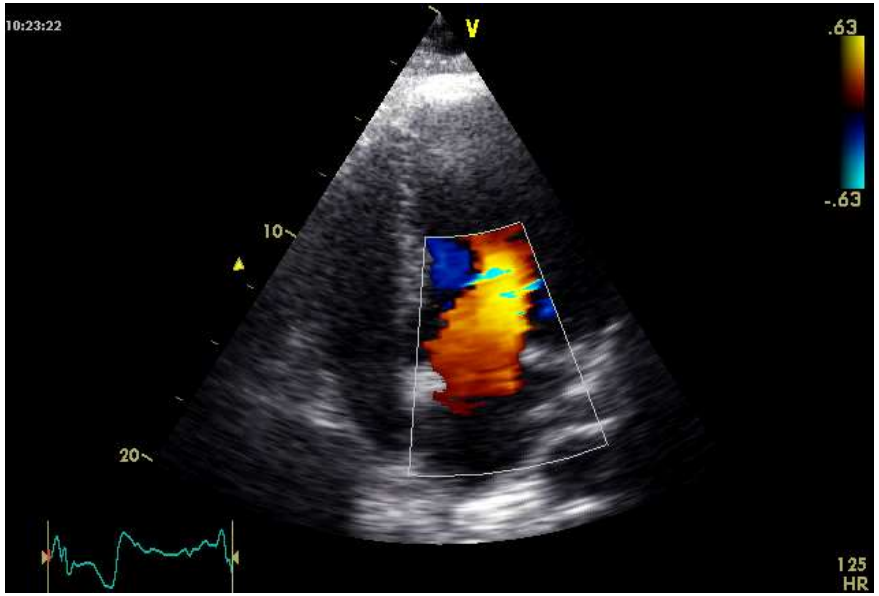
Fibrose endocardique prédominante tout à fait compatible avec une toxicité médicamenteuse de type ...ténoinergique. Ces lésions de toxicité médicamenteuse sont intriquées à des lésions dégénératives fibro-calcifiées très minoritaires.

DUFLME / BRUNEVAL P

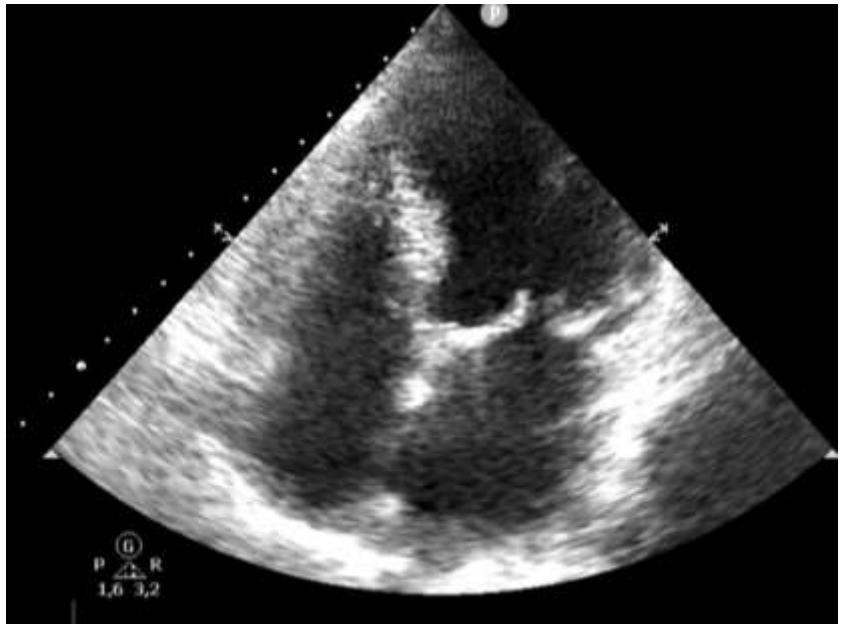
Validé le 06/06/2018
Professeur BRUNEVAL Patrick
Ce compte-rendu a été validé électroniquement

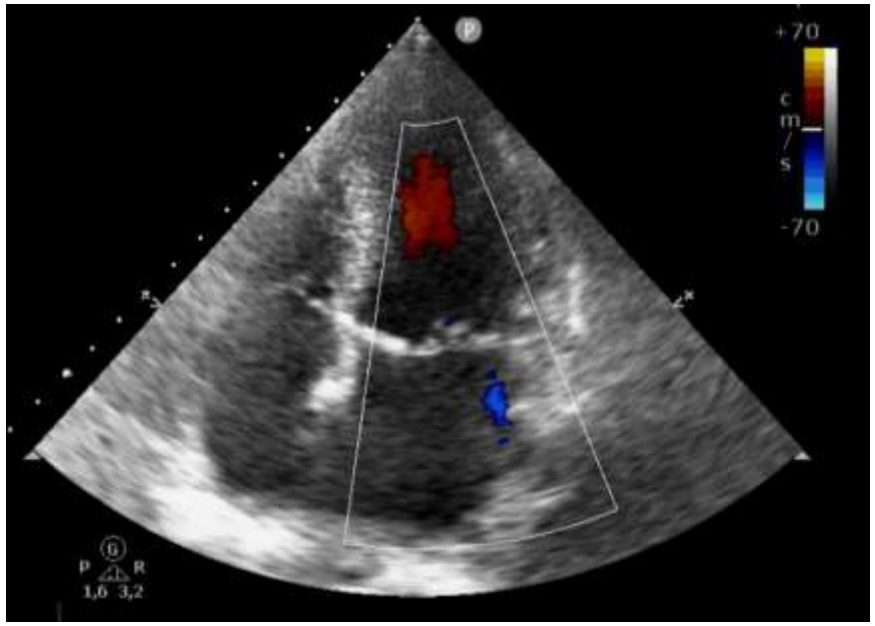
IM et benfluorex



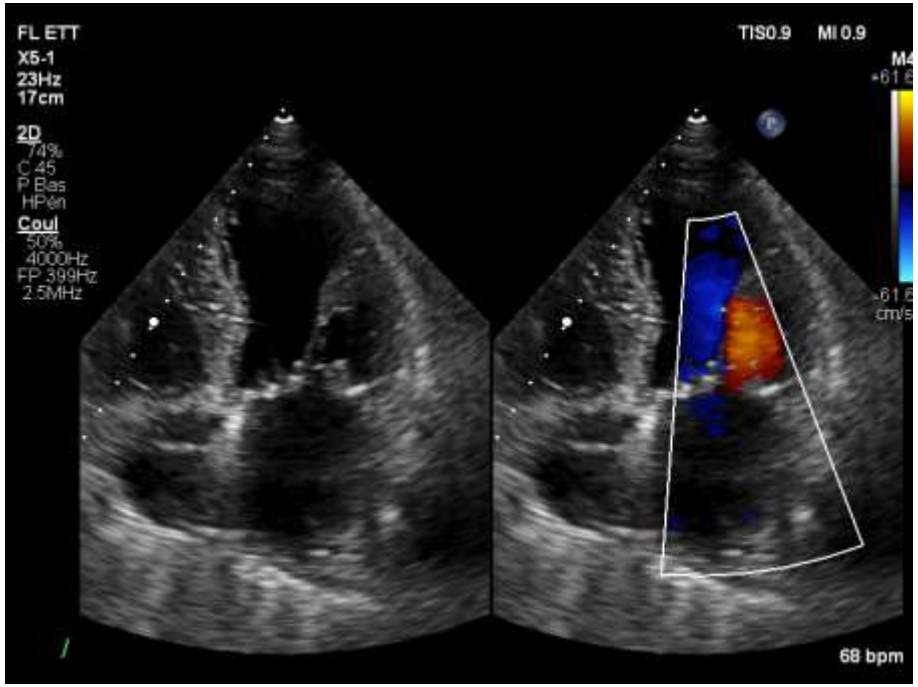


Après traitement diurétique IVSE

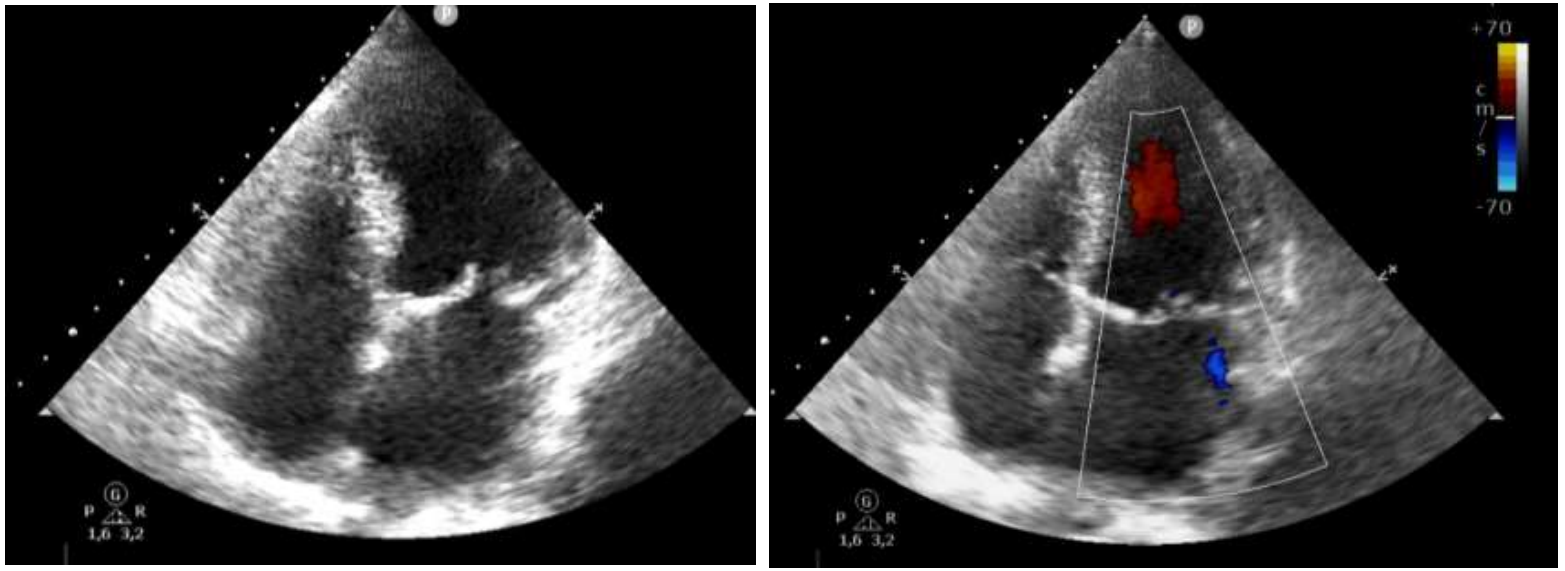




Avant


FL ETT
X5-1
23Hz
17cm
2D
74%
C 45
P Bas
HPén
Coul
50%
4000Hz
FP 399Hz
2.5MHz
TIS0.9 MI 0.9
68 bpm

Après


+70
cm/s
-70

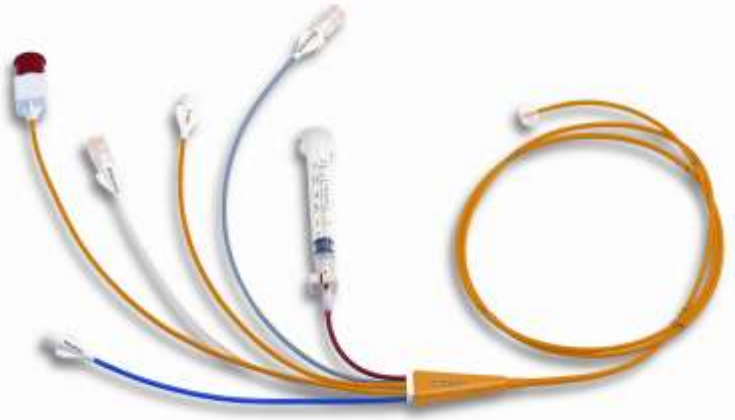
Kt droit

POD = 6, PSVD = 52,

PAP = 48/18 moyenne : 30 mmHg.

PCP = 16mmhg, pas d'onde v

DC = 3,67 l/mn, IC = 2,26 l/mn/m²



Definition	Characteristics*	Clinical group(s)[b]
PH	PAPm ≥25 mmHg	All
Pre-capillary PH	PAPm ≥25 mmHg PAWP ≤15 mmHg	1. Pulmonary arterial hypertension 3. PH due to lung diseases 4. Chronic thromboembolic PH 5. PH with unclear and/or multifactorial mechanisms
Post-capillary PH	PAPm ≥25 mmHg PAWP >15 mmHg	2. PH due to left heart disease 5. PH with unclear and/or multifactorial mechanisms
Isolated post-capillary PH (Ipc-PH)	DPG <7 mmHg and/or PVR ≤3 WU[c]	
Combined post-capillary and pre-capillary PH (Cpc-PH)	DPG ≥7 mmHg and/or PVR >3 WU[c]	

CO = cardiac output; DPG = diastolic pressure gradient (diastolic PAP - mean PAWP); mPAP = mean pulmonary arterial pressure; PAWP = pulmonary arterial wedge pressure; PH = pulmonary hypertension; PVR = pulmonary vascular resistance; WU = Wood units.

[a]All values measured at rest; see also section 7.
[b]According to Table 4.
[c]Wood Units are preferred to dynes.s.cm^{-5}.

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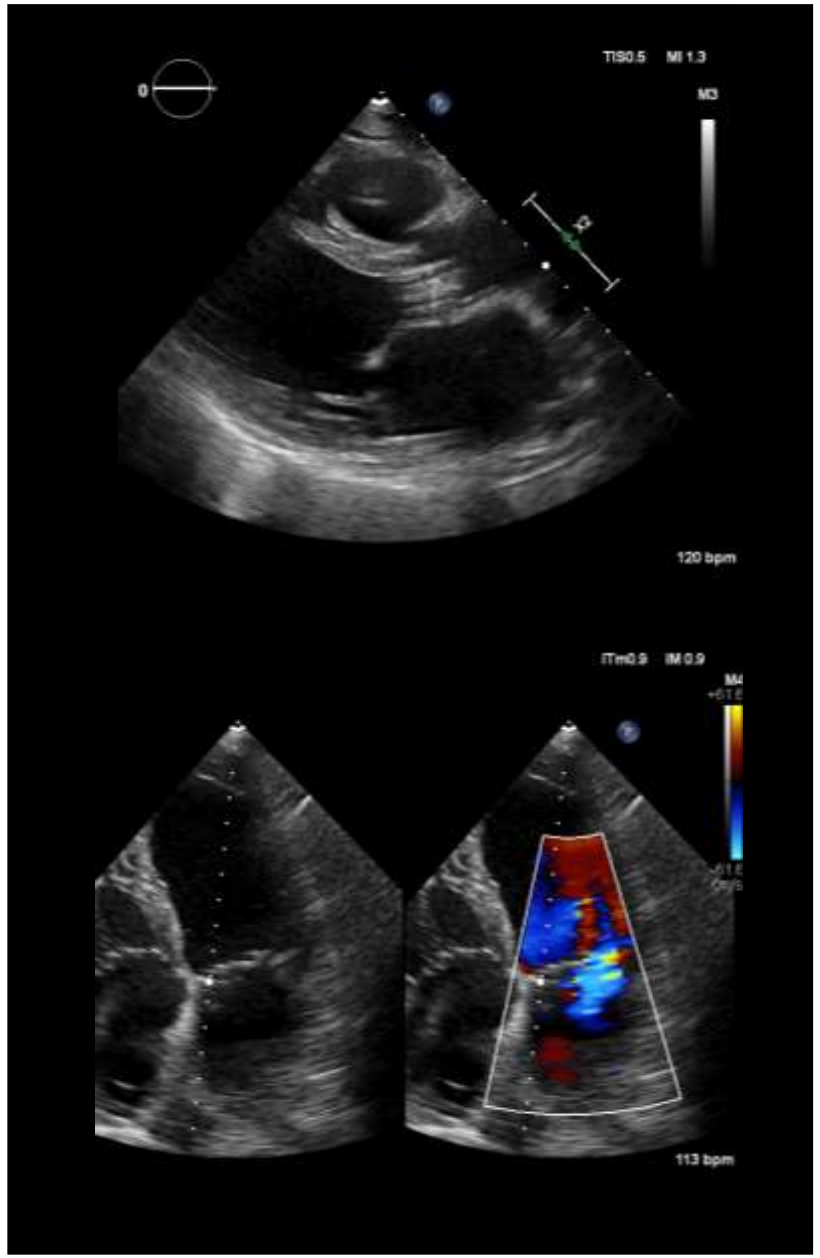
EUROPEAN SOCIETY OF CARDIOLOGY

European Heart Journal 2016;37:67–119 -doi:10.1093/eurheartj/ehv317
European Respiratory Journal 2015 46: 903-975;

Diastolic PG: 18-16=2

1



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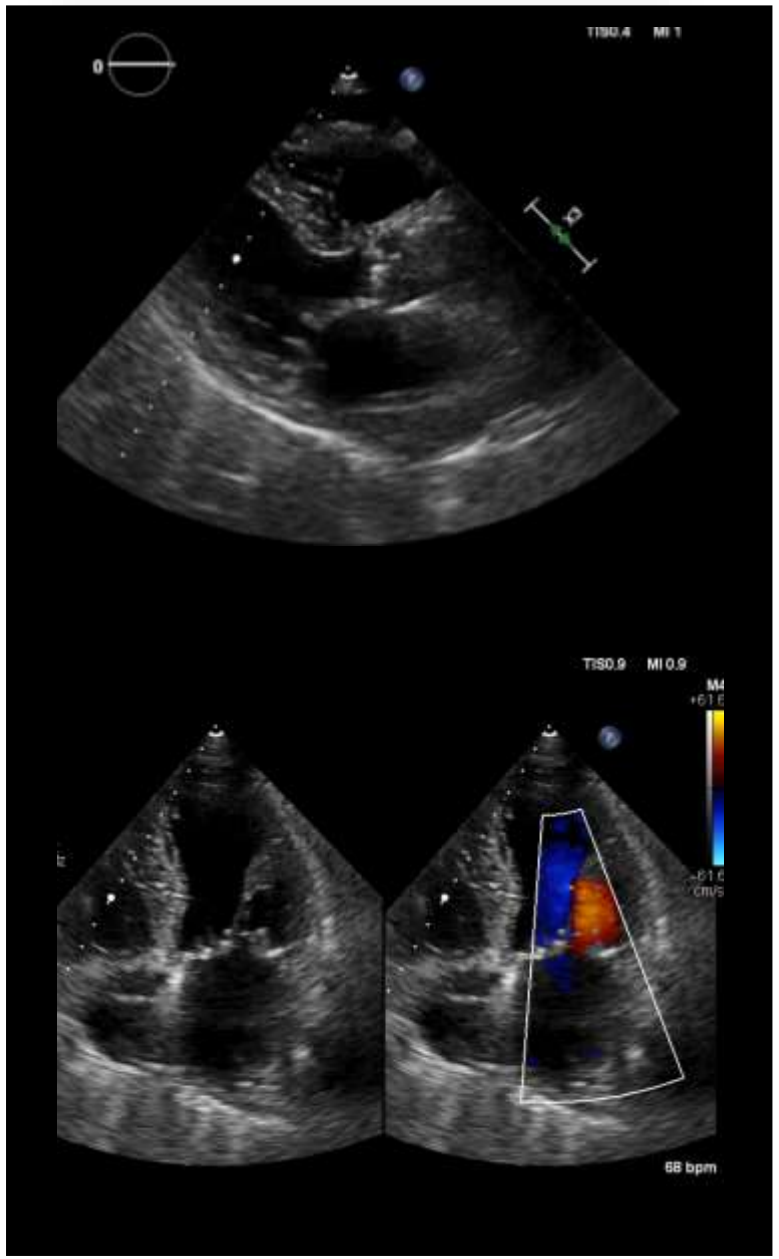

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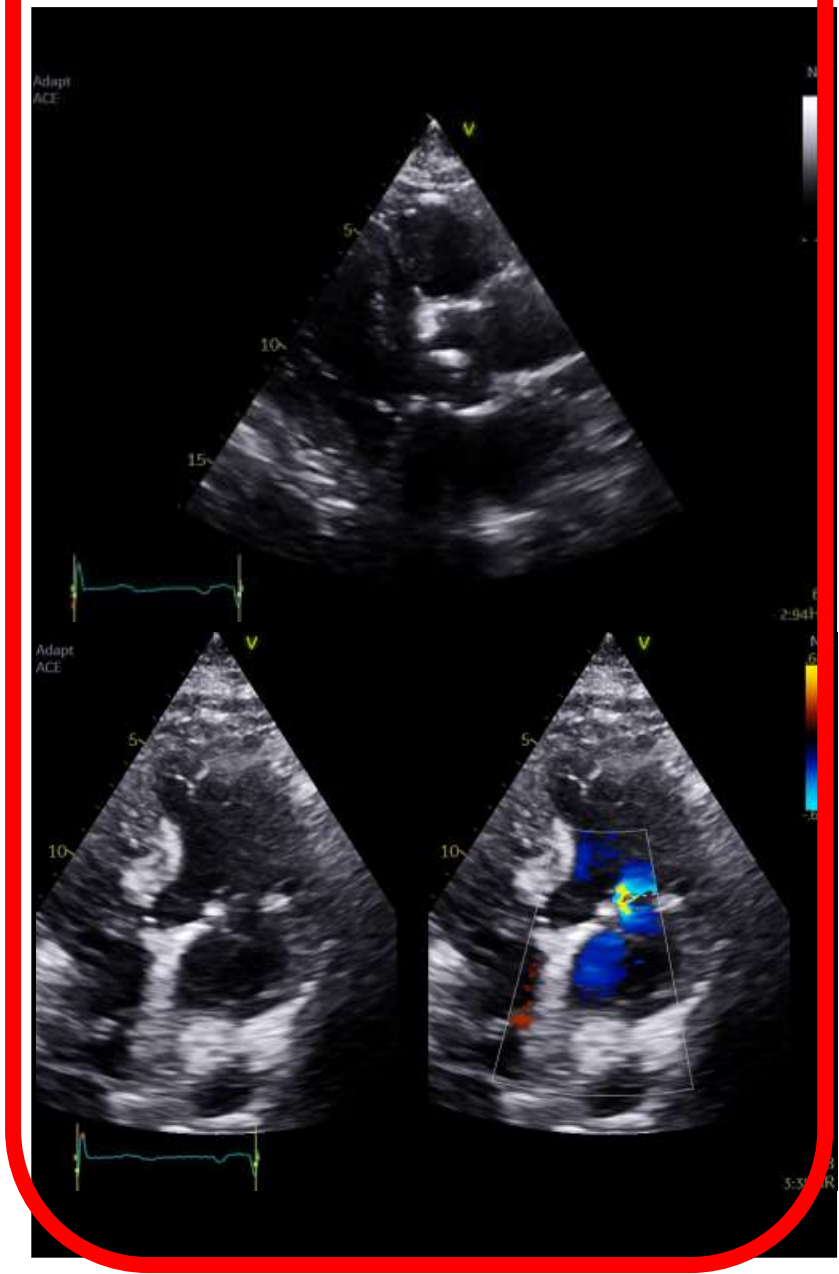
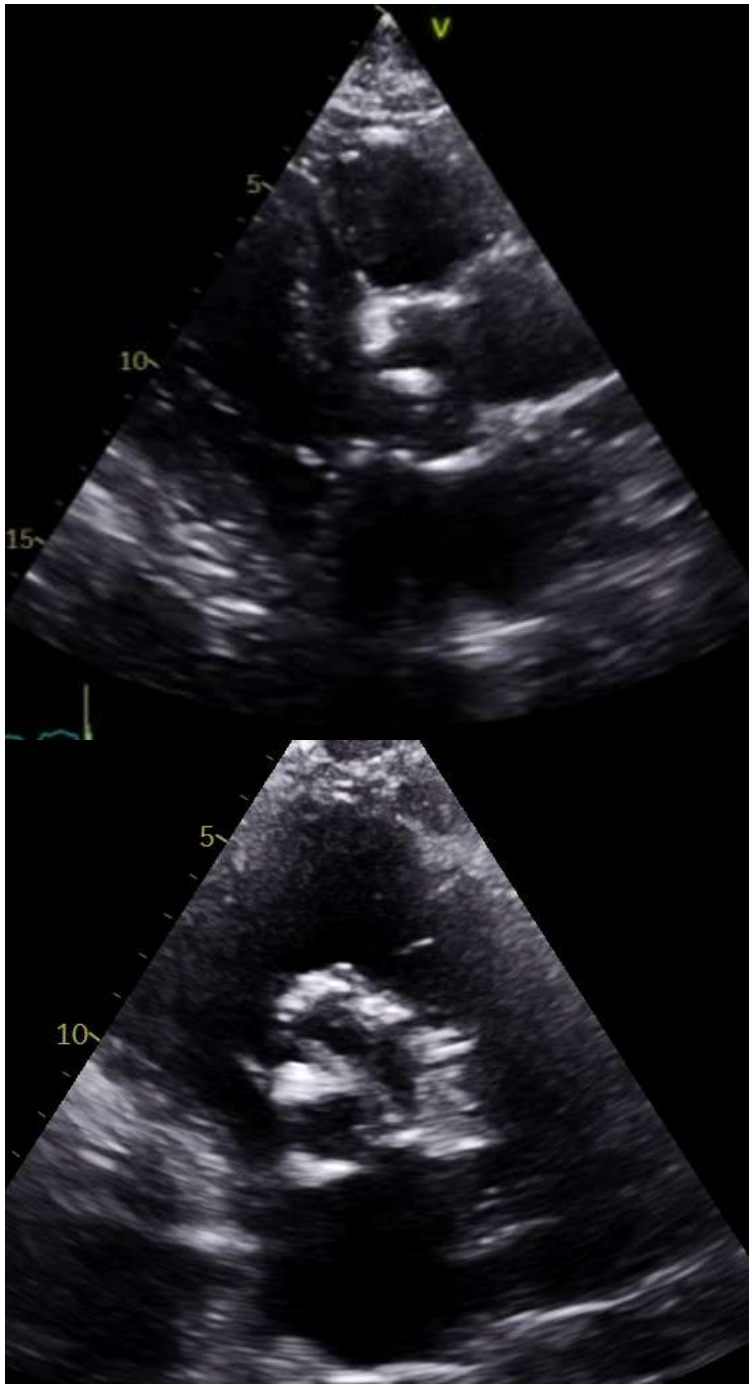
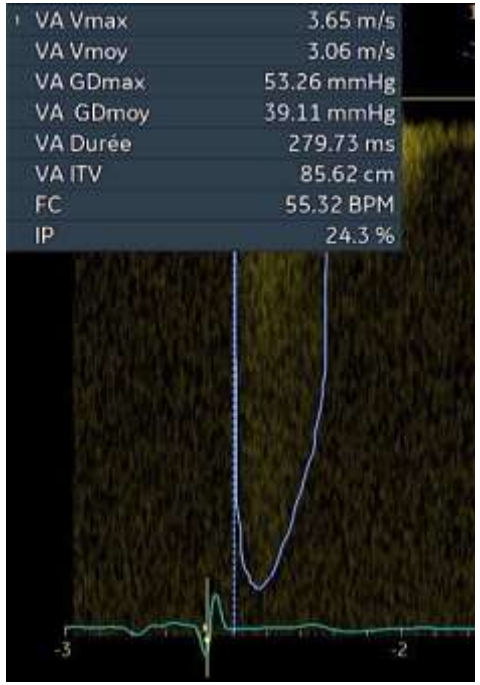


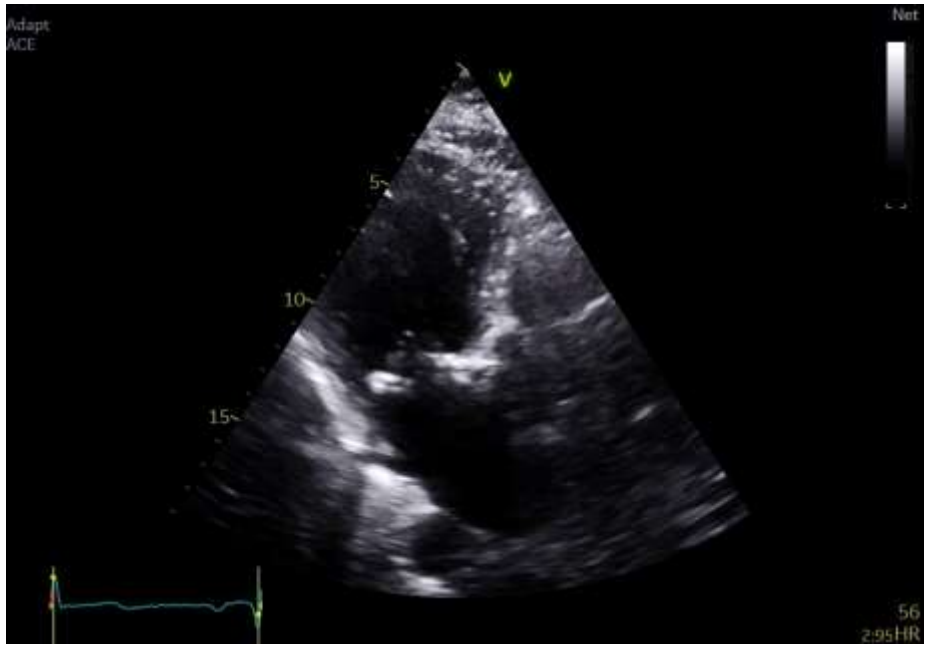
Cas clinique 3

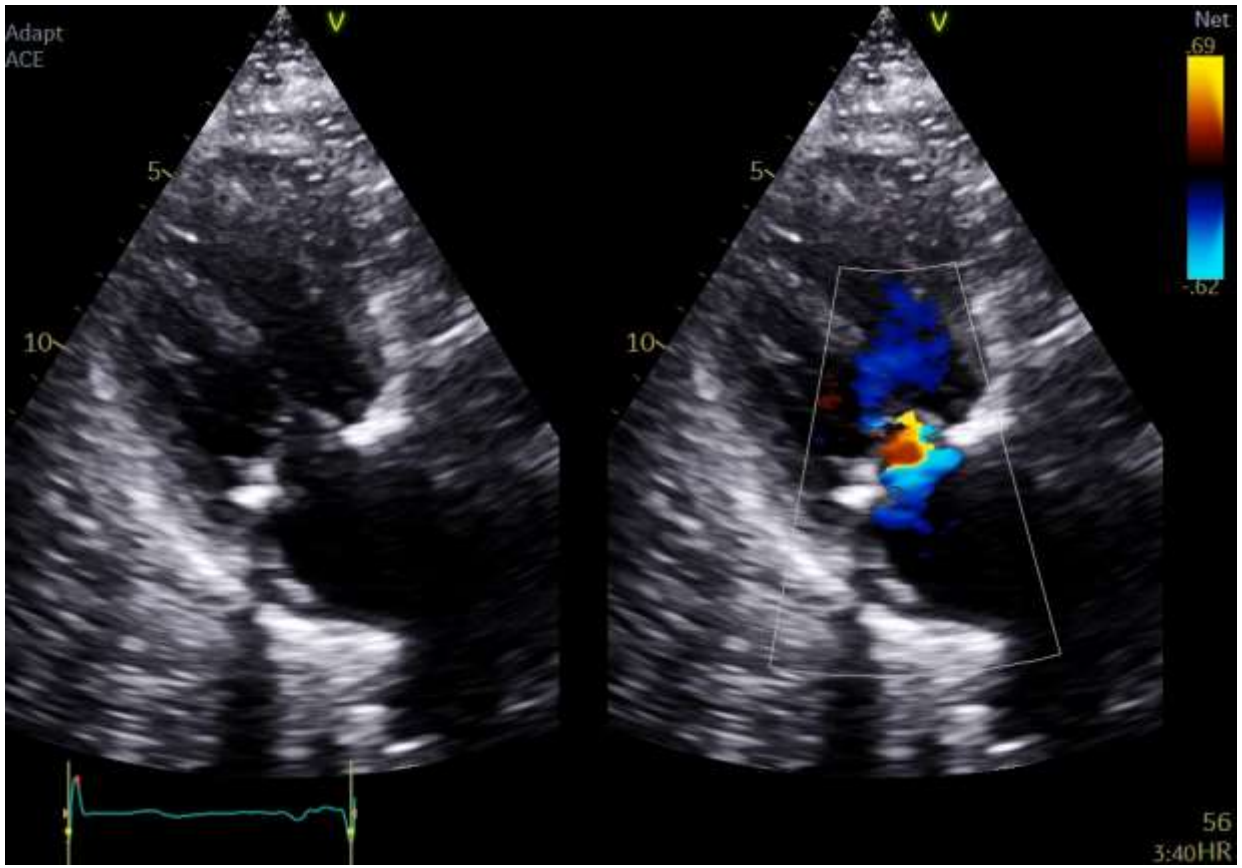
- Patiente de 78ans
- OAP récent
- Souffle systolique 3/6 b2 diminué
- Coronaropathie: serrée IVA
- Pas de comorbidité majeure

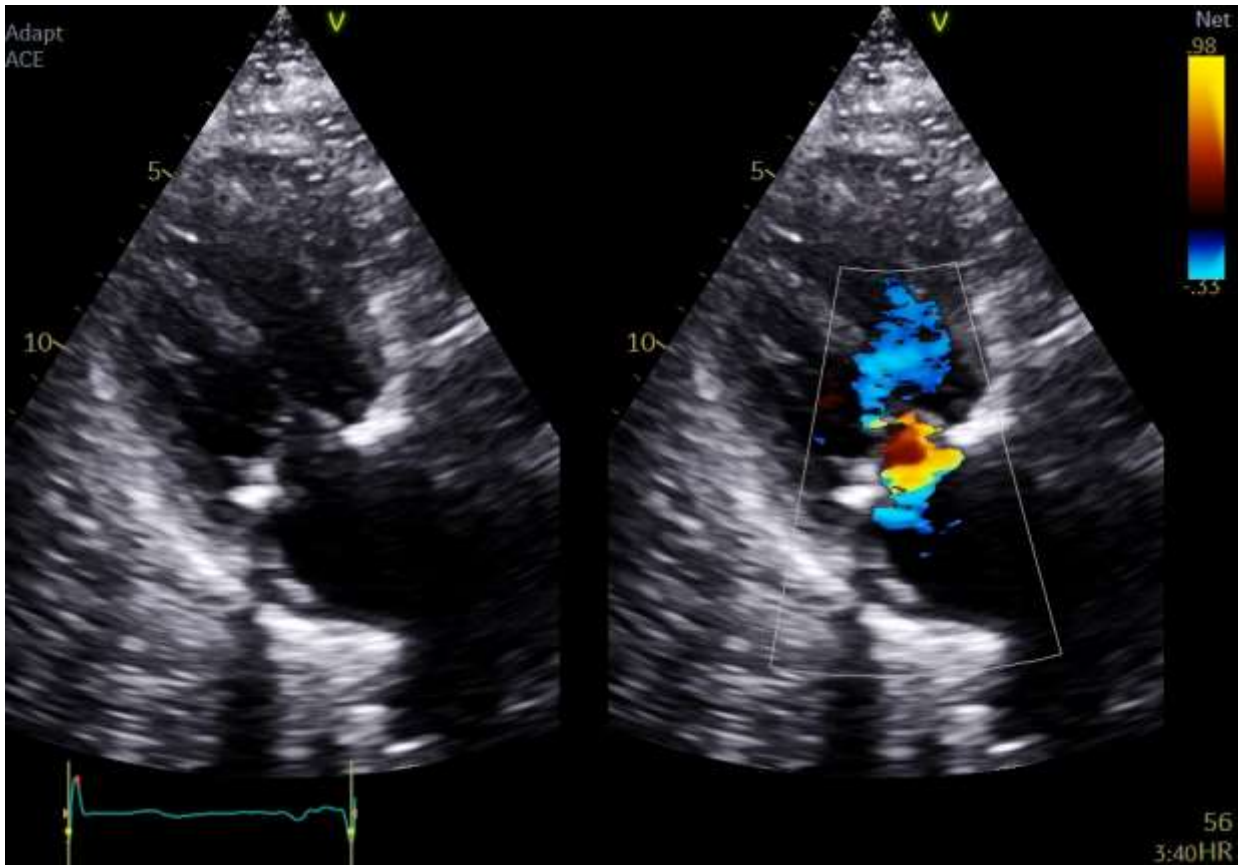


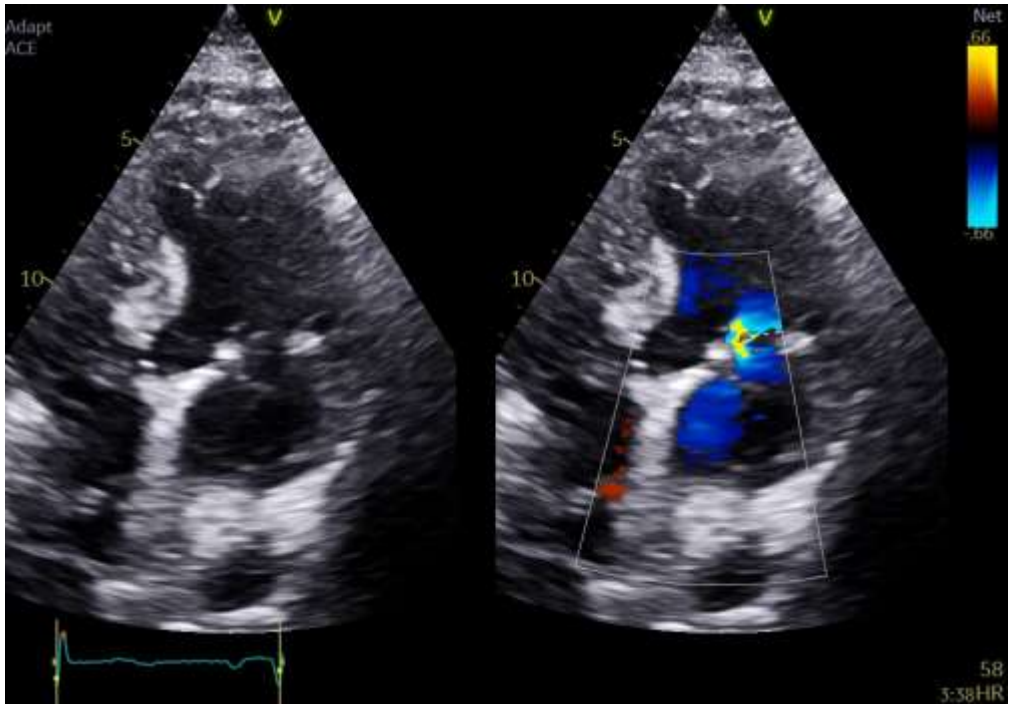


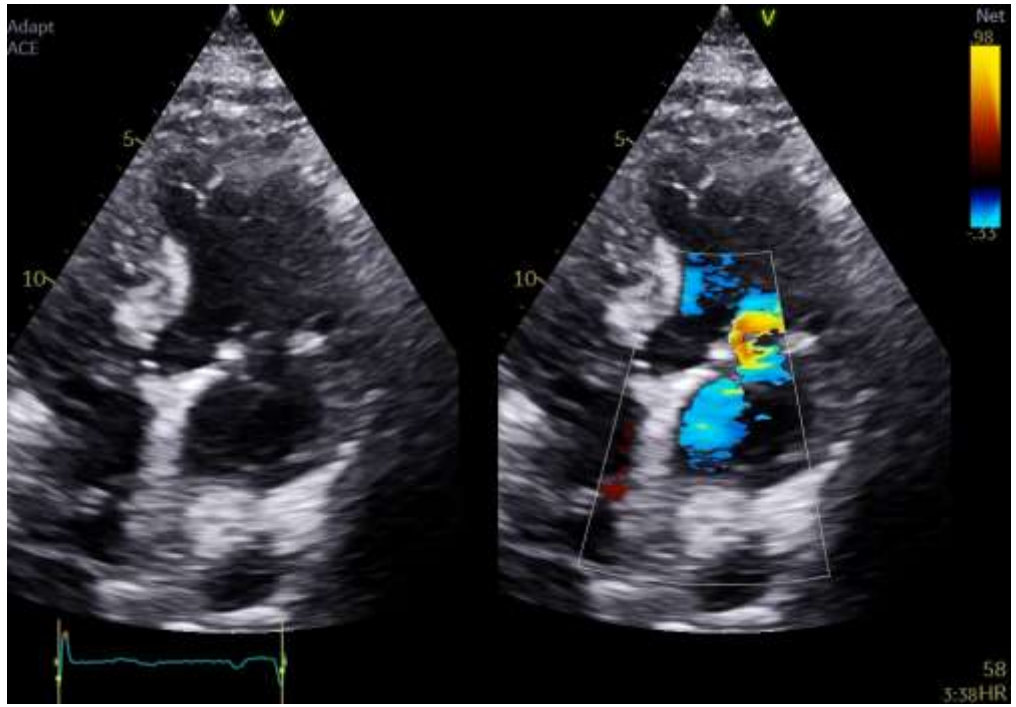
Et la mitrale?

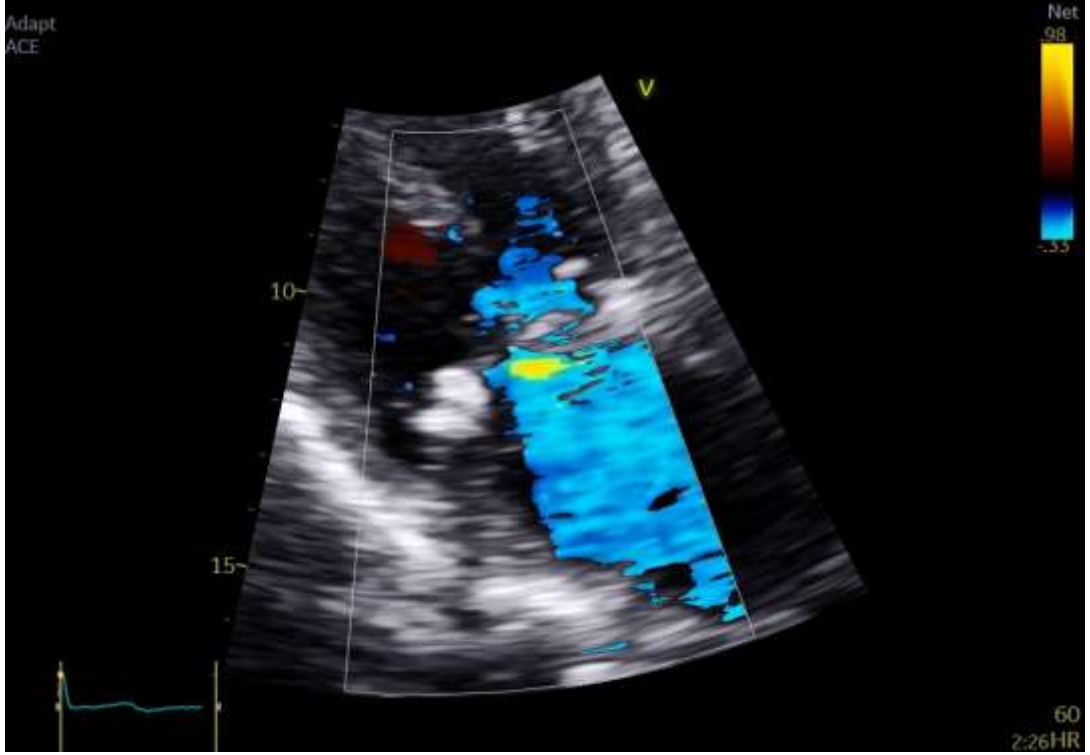


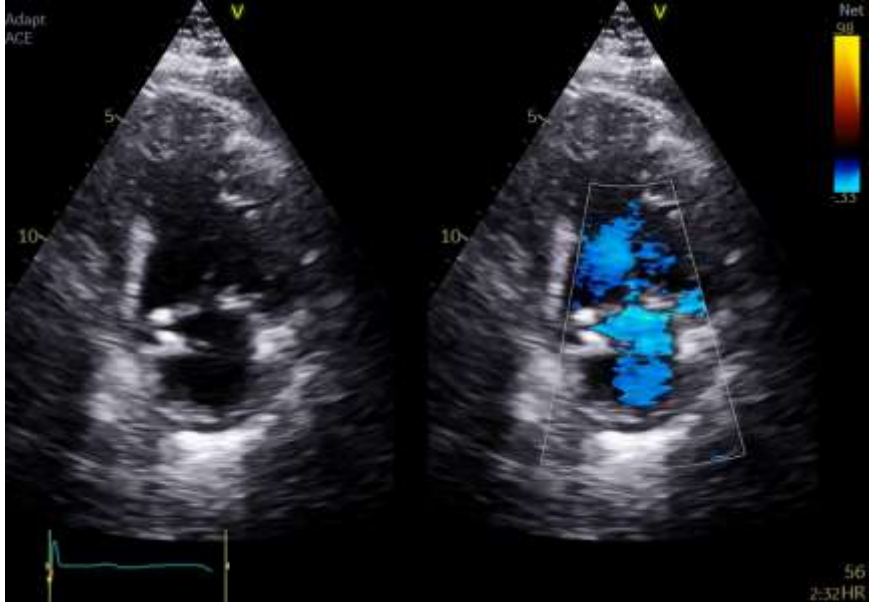

Adapt
ACE
Net
.69
-.62
5
10
56
3:40HR


Adapt
ACE
Net
.98
-.53
5
10
56
3:40HR

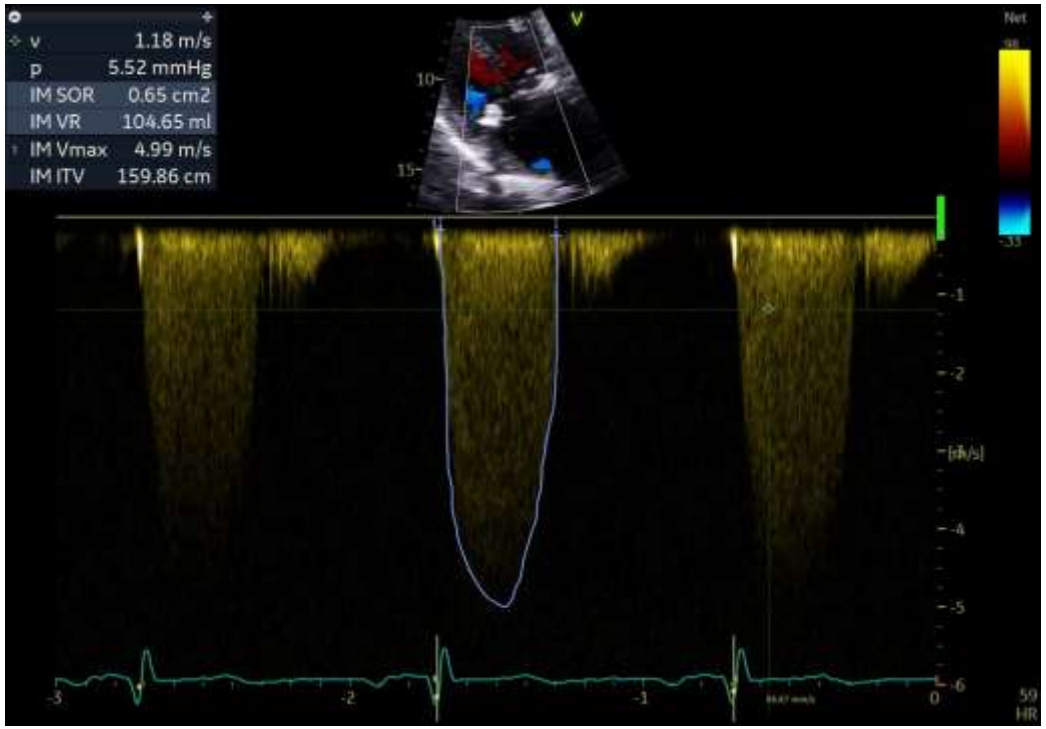

Adapt
ACE
Net
66
-66
58
5:38HR


Adapt
ACE
Net
98
-33
58
5:38HR


Adapt
ACE
Net
98
-33
V
10
15
60
2:26HR

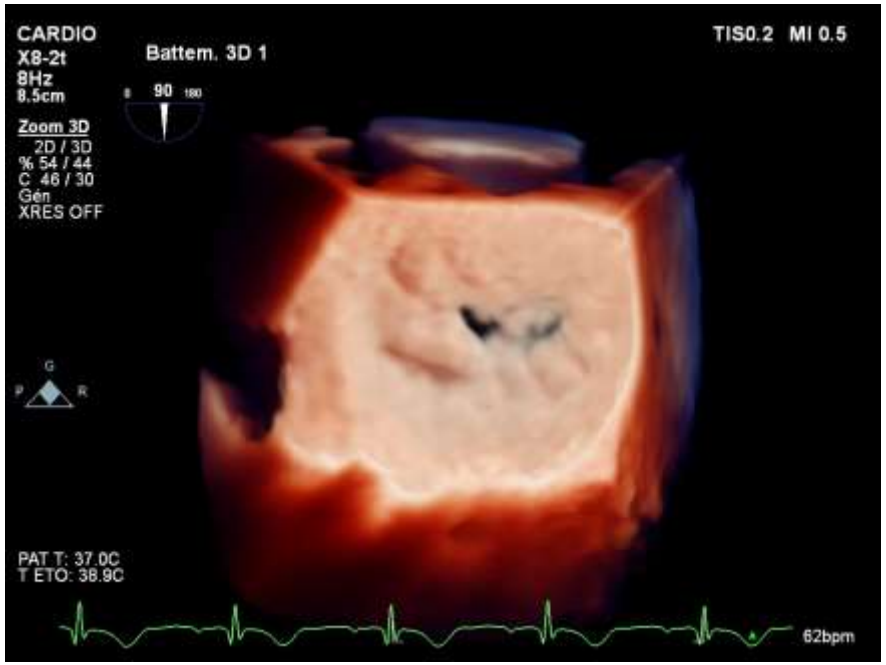

Adapt
ACE
V
V
Net
98
-33
5
10
56
2:32HR

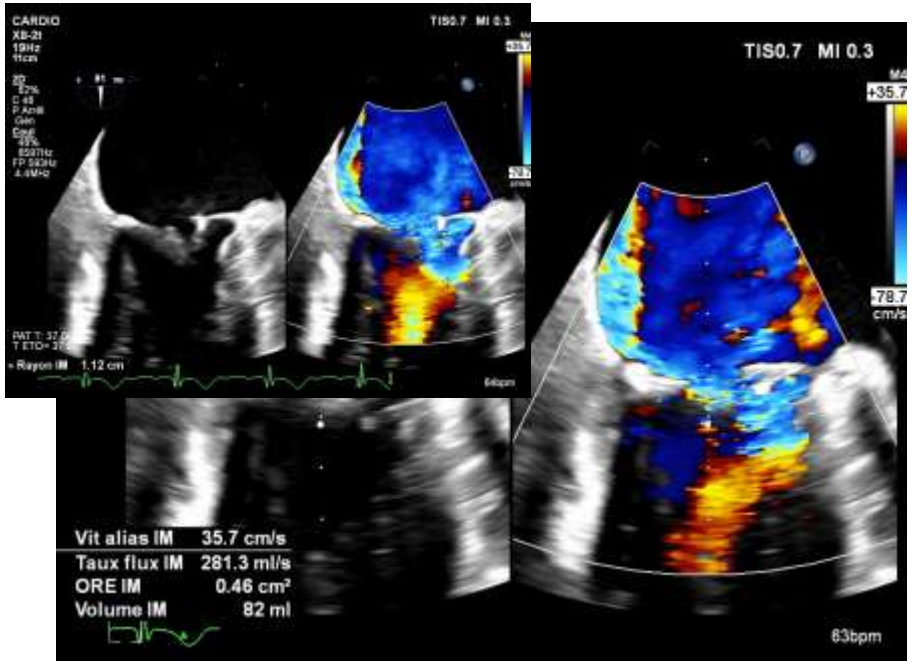

IM RAlias 1.26 cm
IM VAlias 0.33 m/s
IM Flux 326.66 ml/s
V
Net
10
15
61
HR

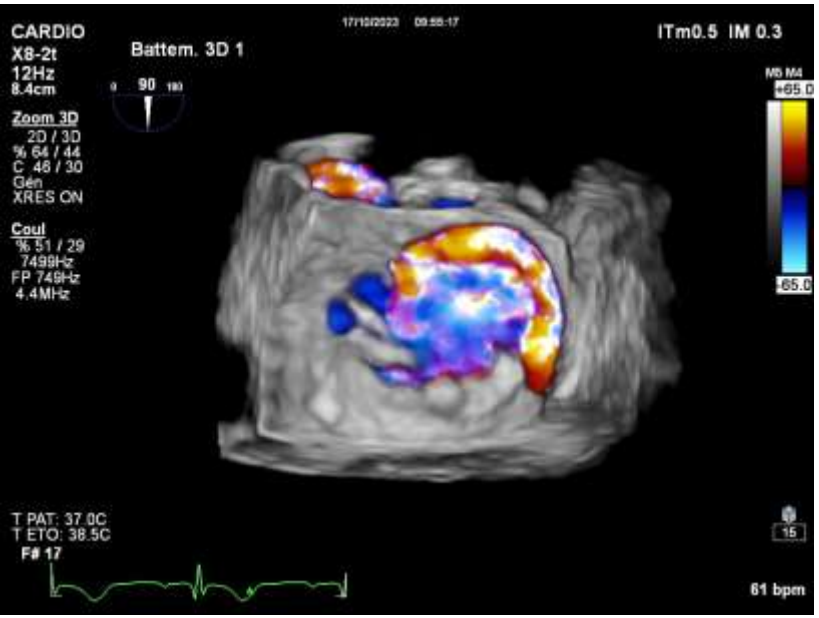

v 1.18 m/s
p 5.52 mmHg
IM SOR 0.65 cm2
IM VR 104.65 ml
IM Vmax 4.99 m/s
IM ITV 159.86 cm
V
Net
98
-33
10
15
-1
-2
-4
-5
-6
-3
-2
-1
0
59
HR

ETO

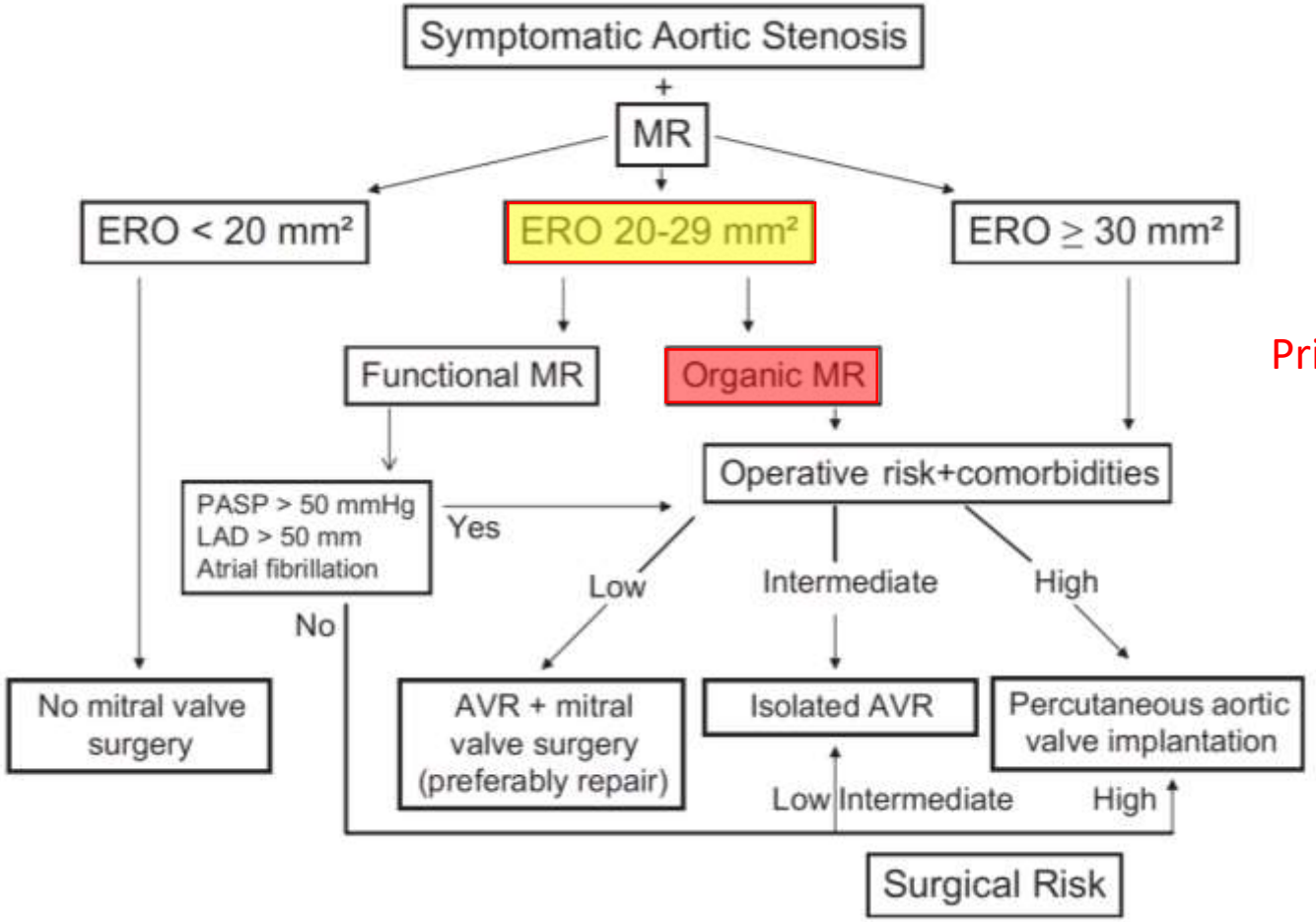
ETO


CARDIO
X8-2t
8Hz
8.5cm
Battem. 3D 1
TIS0.2 MI 0.5
Zoom 3D
2D / 3D
% 54 / 44
C 46 / 30
Gén
XRES OFF
PAT T: 37.0C
T ETO: 38.9C
62bpm


CARDIO
TIS0.7 MI 0.3
TIS0.7 MI 0.3
Vit alias IM 35.7 cm/s
Taux flux IM 281.3 ml/s
ORE IM 0.46 cm²
Volume IM 82 ml
63bpm


CARDIO
X8-2t
12Hz
8.4cm
Battem. 3D 1
ITm0.5 IM 0.3
90
Zoom 3D
2D / 3D
% 64 / 44
C 48 / 30
Gén
XRES ON
Coul
% 51 / 29
7499Hz
FP 749Hz
4.4MHz
M5 M4
+65.0
-65.0
T PAT: 37.0C
T ETO: 38.5C
F# 17
61 bpm

RAC +IM



SOR ?

Primaire ou secondaire?

Unger et al

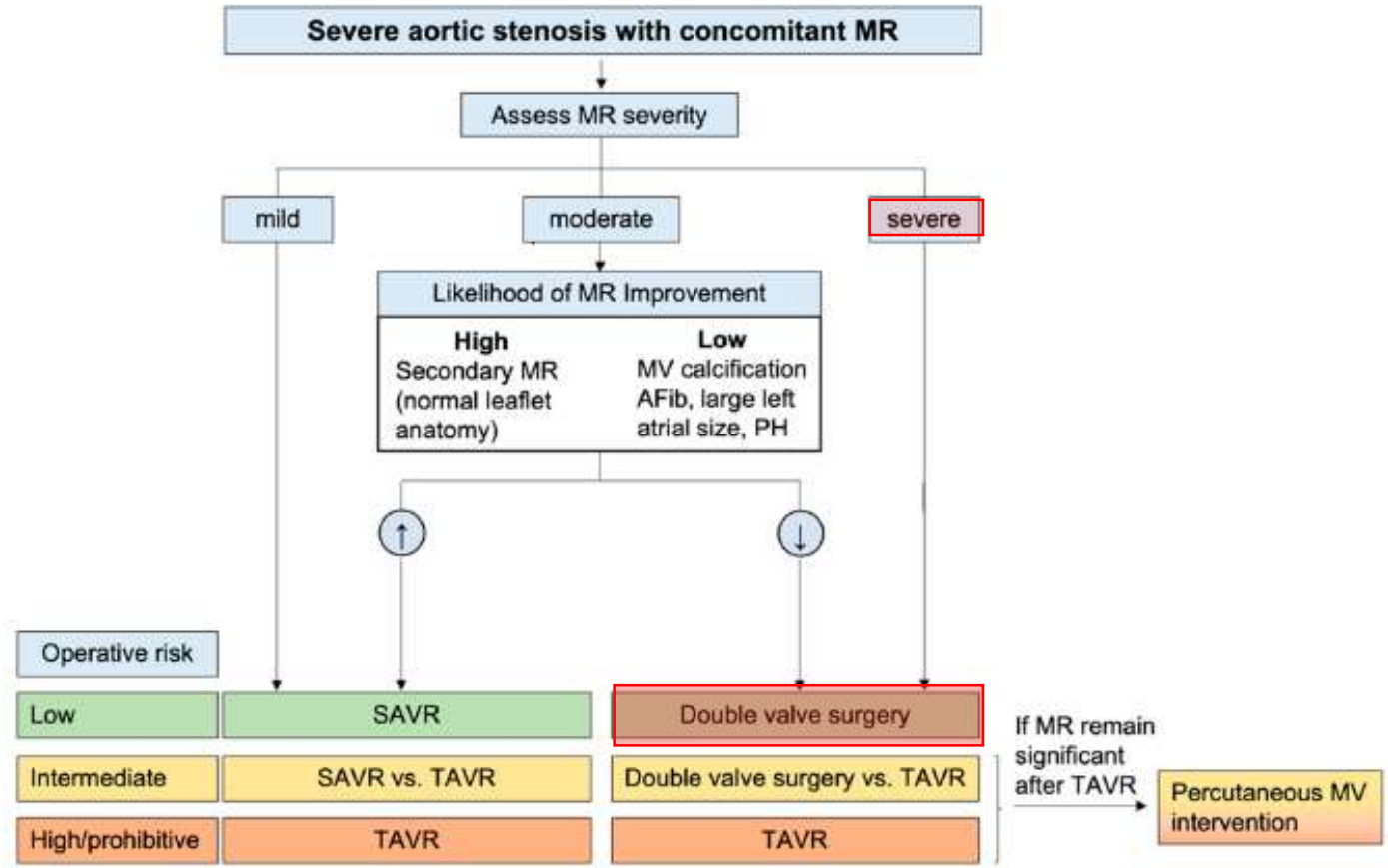
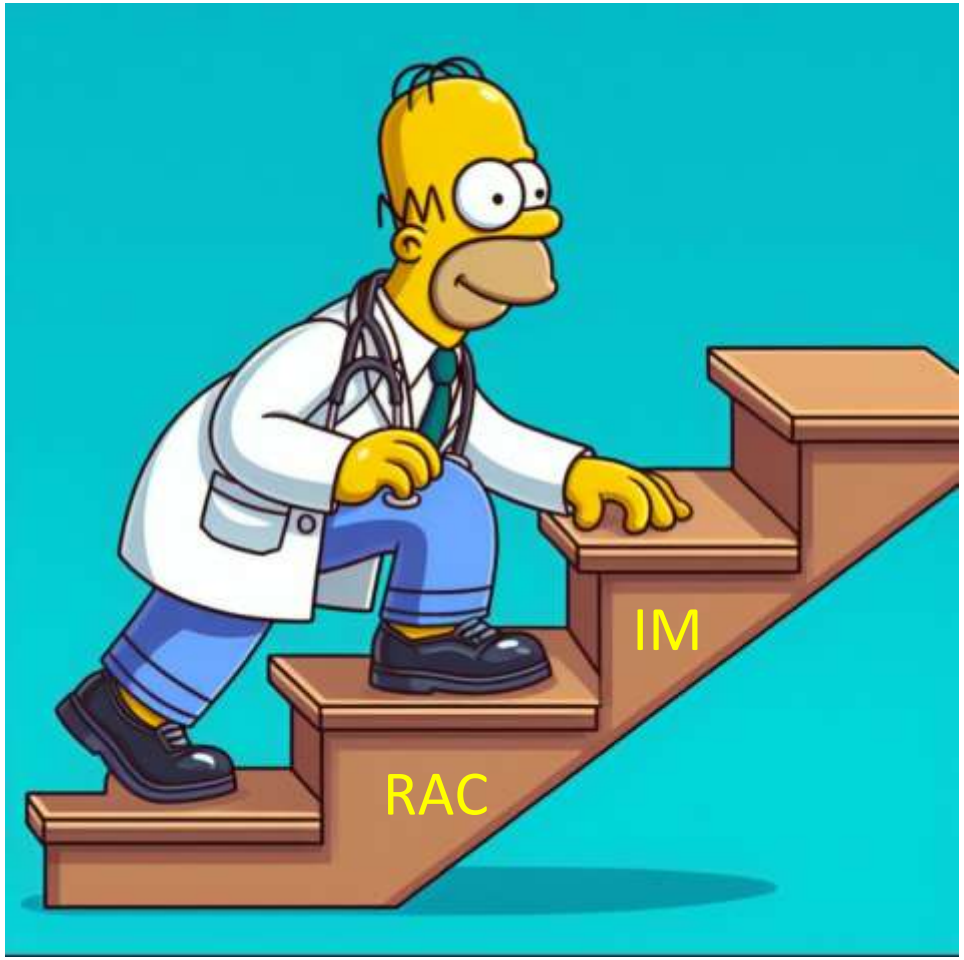


Figure 3. Proposed algorithm for the management of severe aortic stenosis with concomitant mitral regurgitation. MR—mitral regurgitation; MV: mitral valve; AF: atrial fibrillation; PH: pulmonary hypertension; SAVR: surgical aortic valve replacement; TAVR: transcatheter aortic valve replacement. Adapted from Unger 2016 and Kiriyama 2022 [85,86].

Chez les patients à haut risque



Low or intermediate surgical risk

SAVR candidate

- Severe primary MR
  - Highly repairable → *SAVR + surgical MV repair*
  - Not repairable → *SAVR + surgical MV replacement*
- Severe secondary MR → *SAVR + surgical MV repair/replacement*

High or prohibitive surgical risk

TAVR candidate

- Severe primary MR
- Severe secondary MR

→ *TAVR* → **Follow-up with clinical re-assessment of MR:** if symptoms and severe MR persist after AS treatment despite OMT → *Consider mitral transcatheter edge-to-edge repair* *if suitable**

Staged strategy

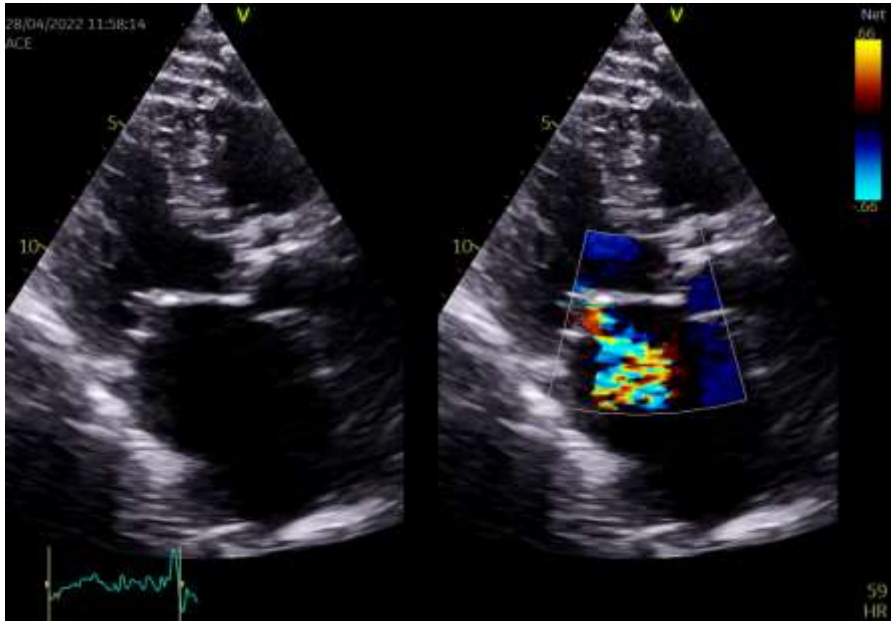
Patiente de 85 ans

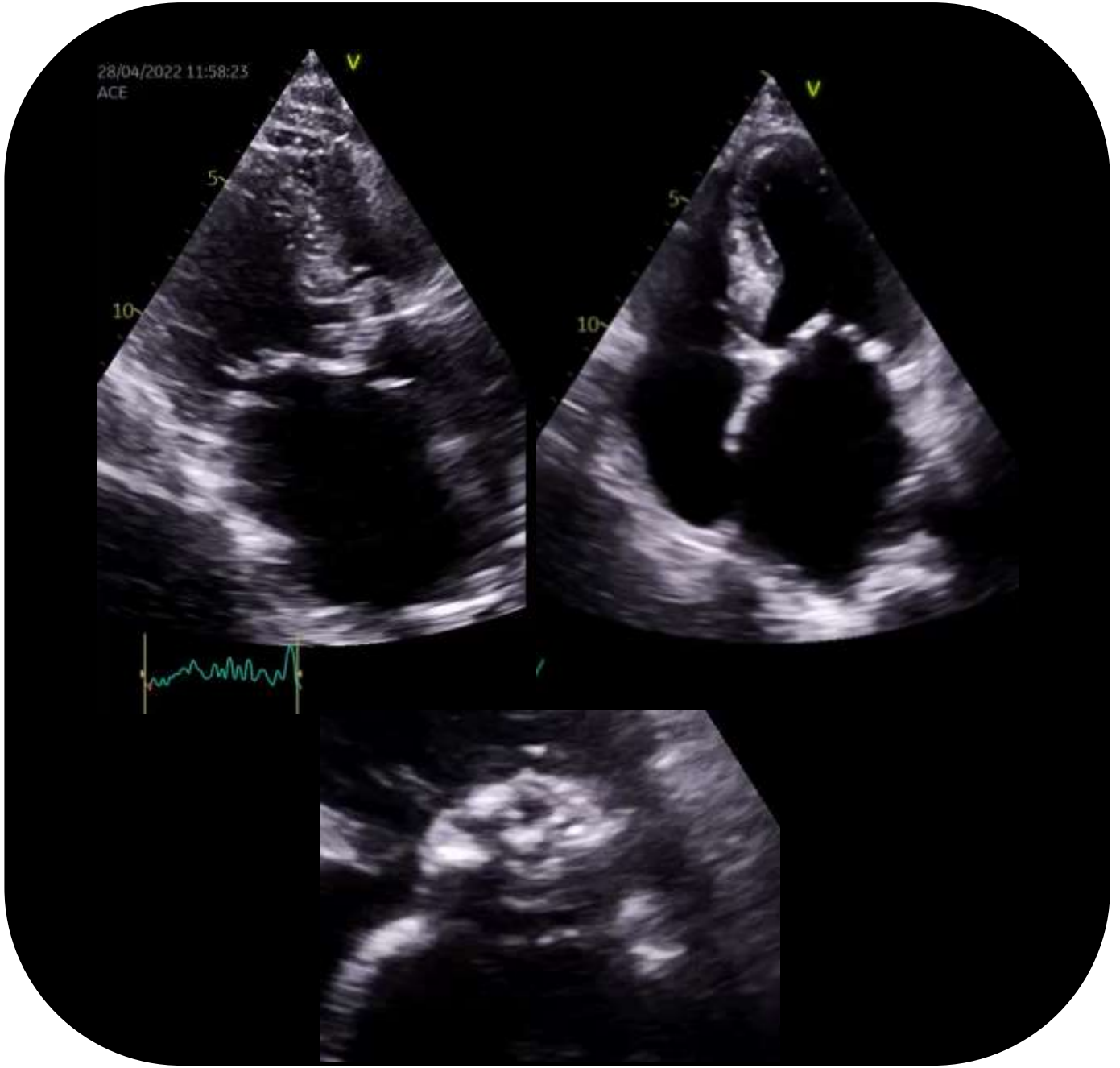
1m55 61Kg

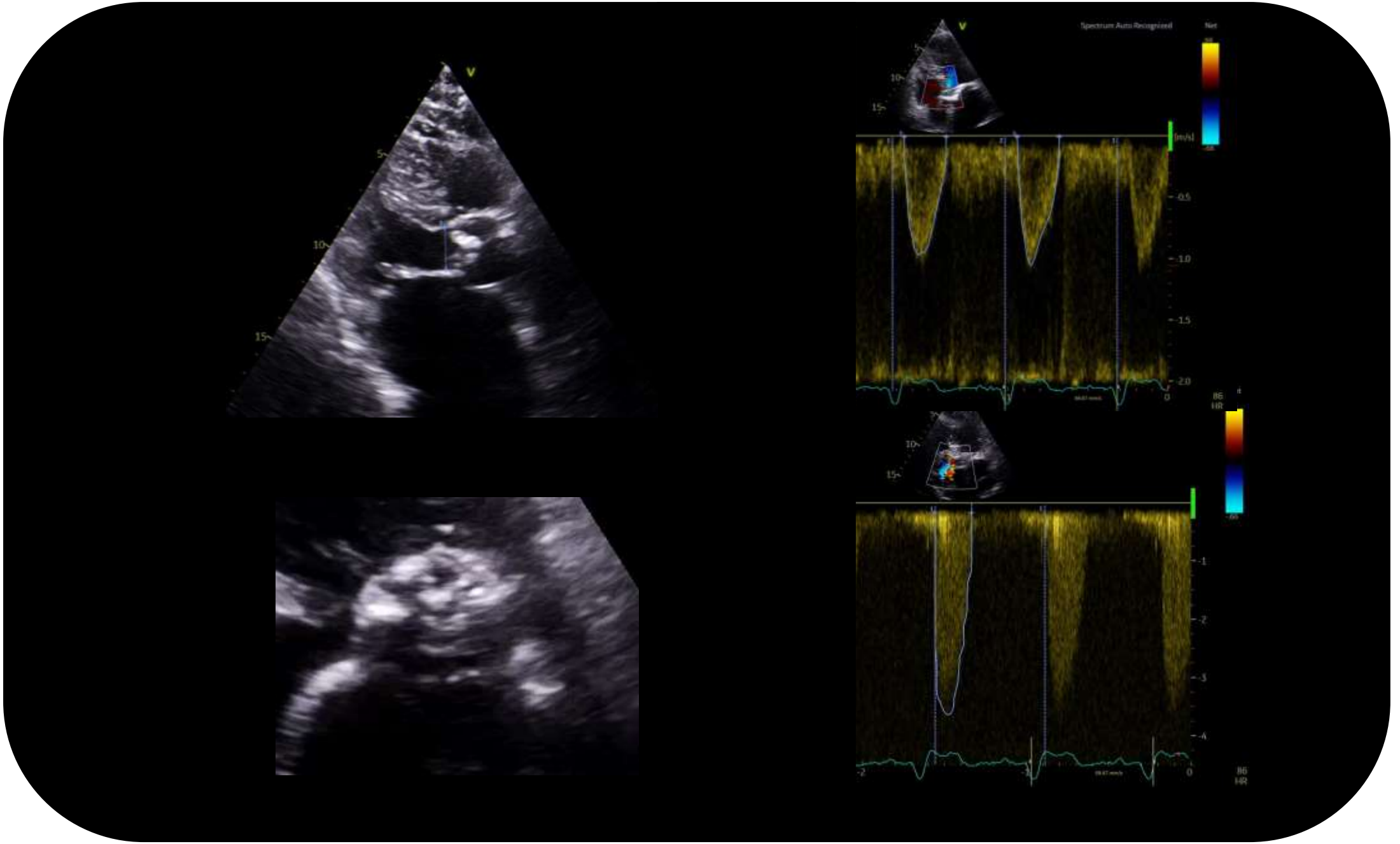
Dyspnée stade III

SS 4/6 b2 aboli

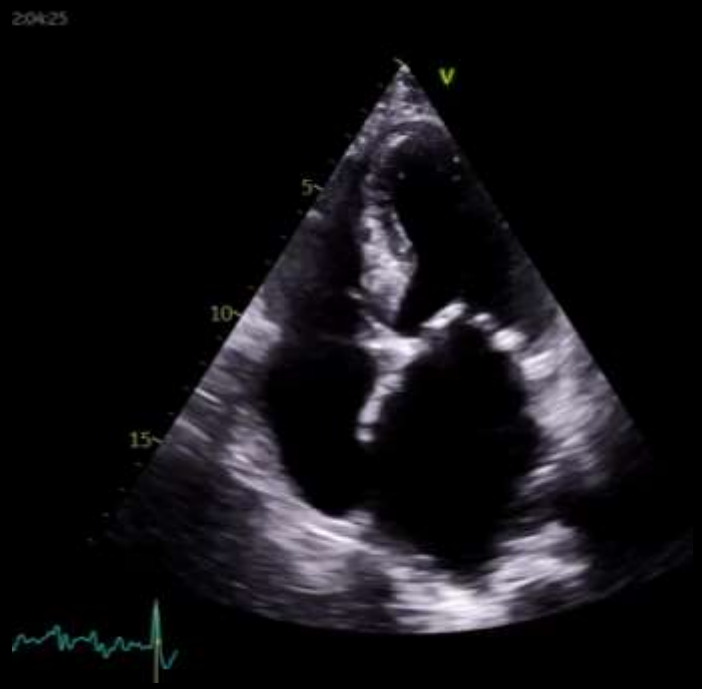
En ACFA permanente anticoagulée

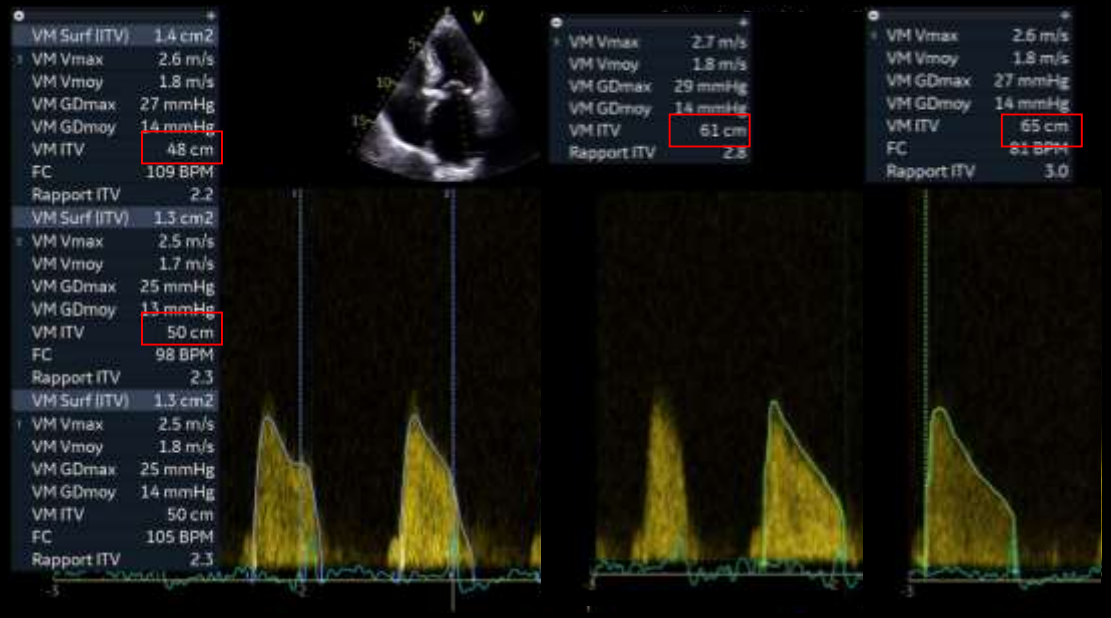


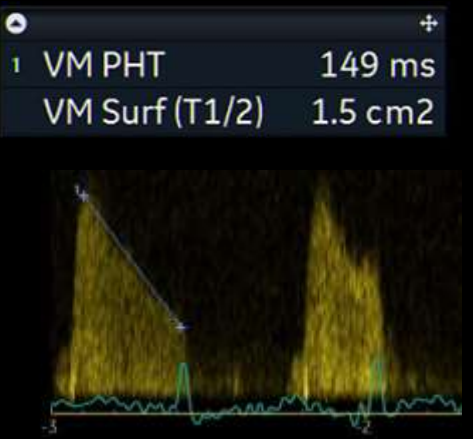


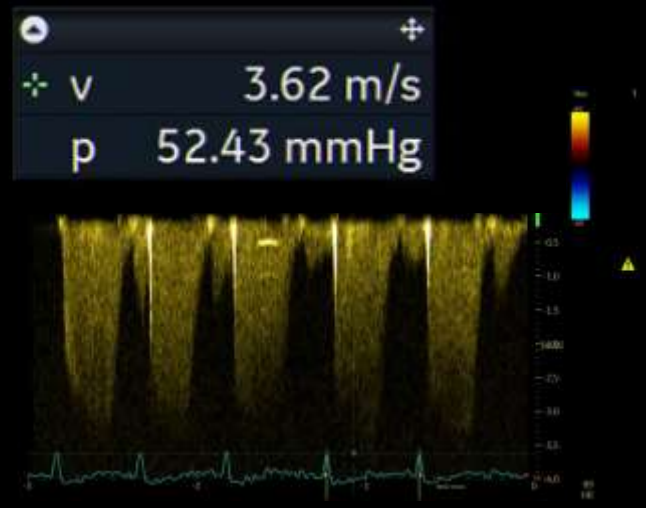

V
5
10
15
V
Spectrum Auto Recognized
Net
10
15
[m/s]
-0.5
-1.0
-1.5
-2.0
0
86
HR
10
15
-1
-2
-3
-4
-2
0
86
HR

Gdt moyen 14mmhg, moyenné









- Concernant l’association sténose aortique et calcification annulaire mitrale (MAC) :

A. Le MAC est rarement associé à la sténose aortique dégénérative

B. Le MAC ne donne jamais de sténose mitrale significative

C. Un RM serré peut être associé avec un RAC bas débit / bas gradient paradoxal

D. L’équation de continuité n’est pas fiable pour le calcul de la surface mitrale

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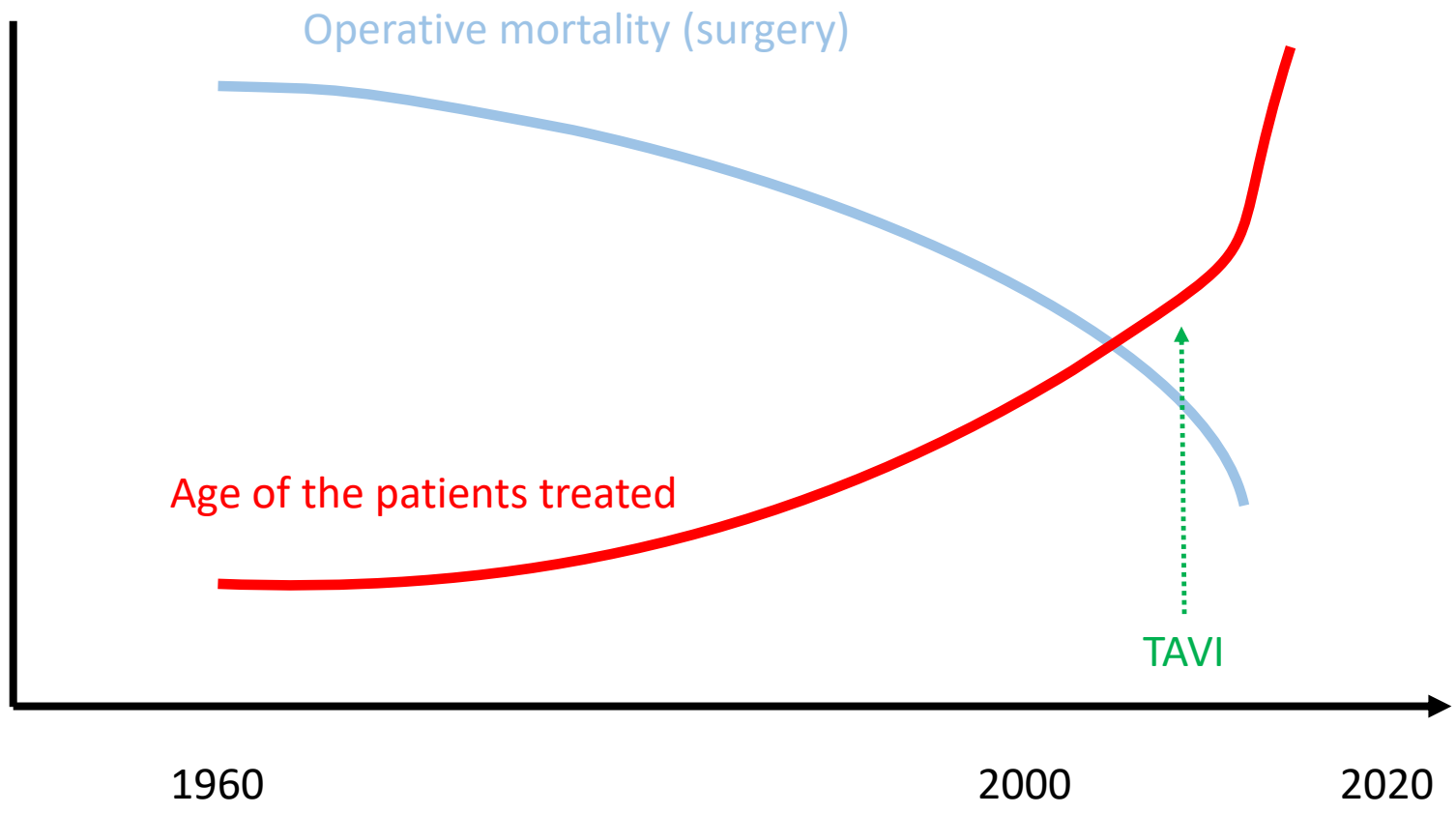
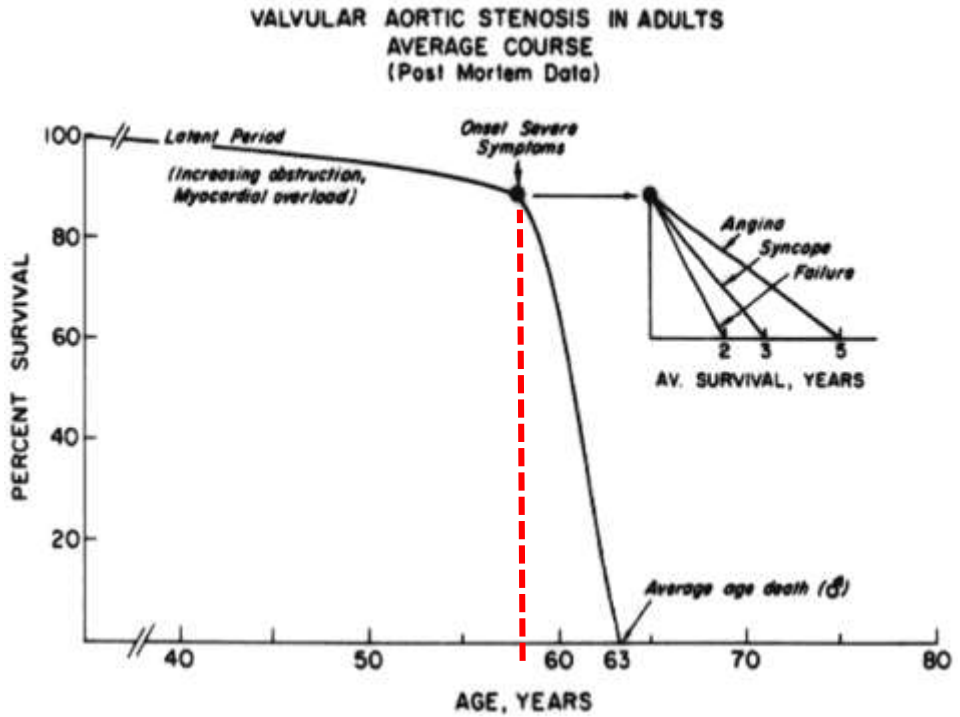
Patients with AS have changed…



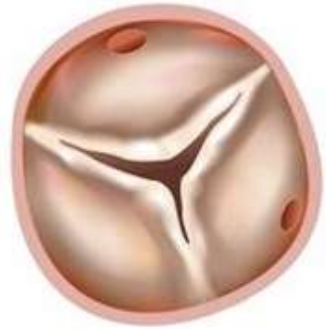
Things have changed since 1968….

1968

Ross



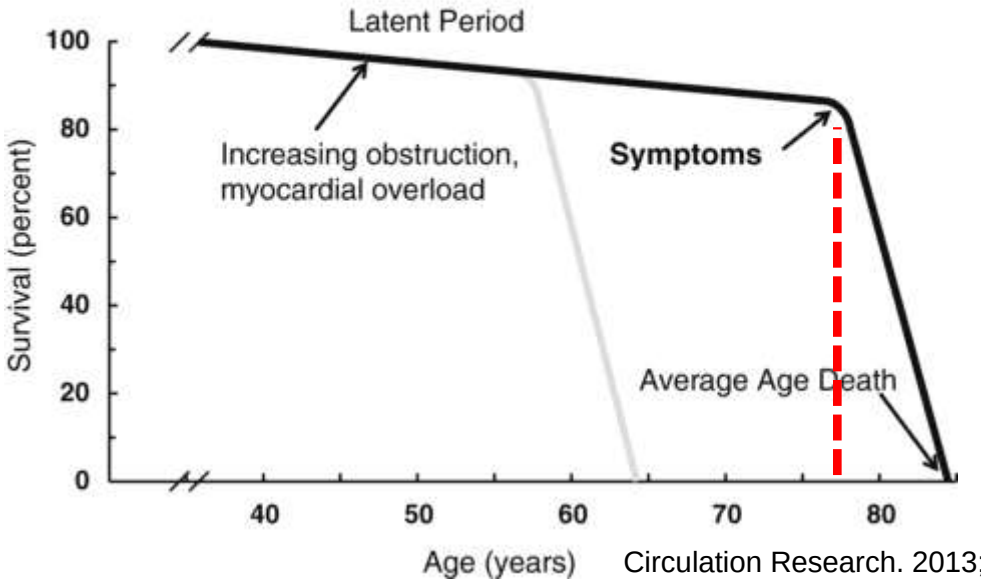
Bicuspid

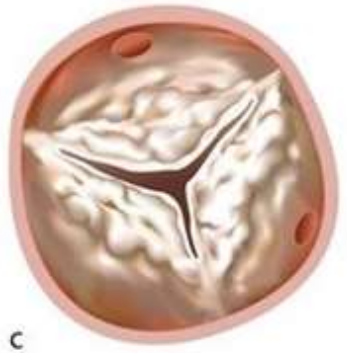


Rheumatic

2020

Ross modifié

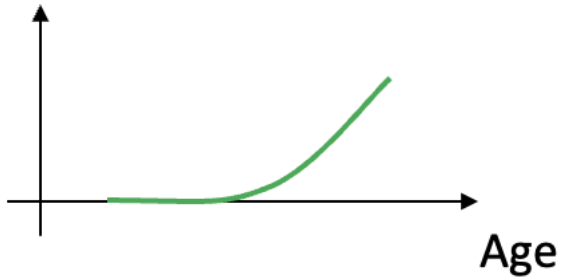




Degenerative Calcified

Bicuspid

Circulation Research. 2013;113:179–185



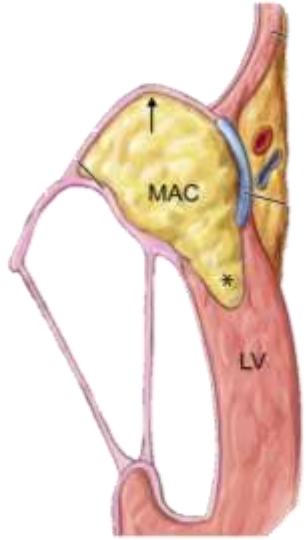
AS and MAC: prévalence

- MAC coexists in **50%** of the patients with severe AS (TAVI)

Yong et al. *Catheter Cardiovasc Interv.*2009;74:957–964.

Abramowitz et al. *Eur Heart J.* 2017;38:1194–1203.

Ancona et al. Am J Cardiol. 2017;120:2233–2240.



- Calcified Mitral Stenosis is present in up to **15%** of the patient with AS
  - In a recent french registry : 7% Mesnier et al. Am J Cardiol 2021; 155:103-112 (Bichat)

Calcified MS = (MG≥ 5mmhg)

Physiopathologie du MAC

Proche du RAC…

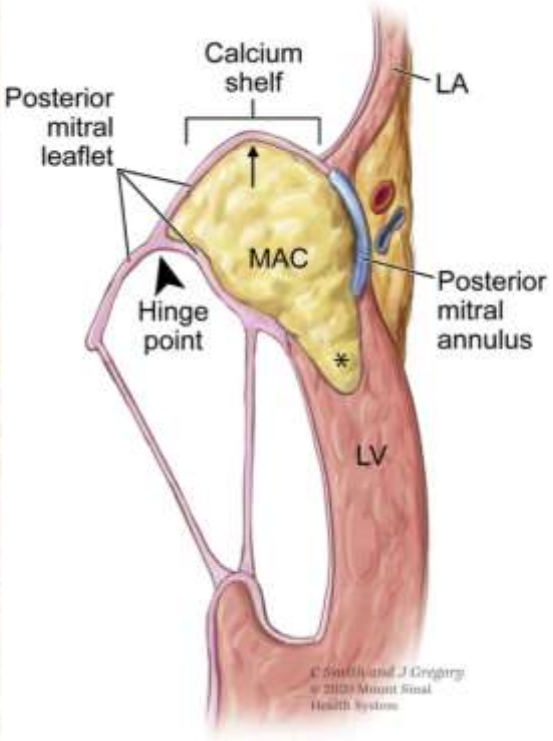
Le MAC est caractérisé par un processus fibreux, dégénératif aboutissant à une calcification située le long et sous l'anneau mitral.

Processus actif et pas uniquement lié au vieillissement:

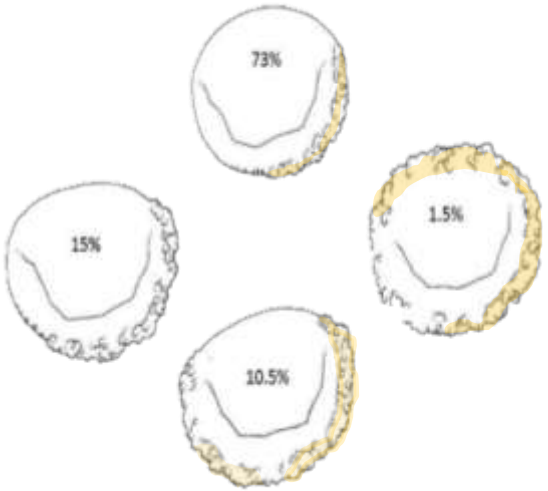
- situé dans les zones de stress hémodynamique
- lésion endothéliale guidant le processus inflammatoire
- ostéogénése, dépôt de calcium

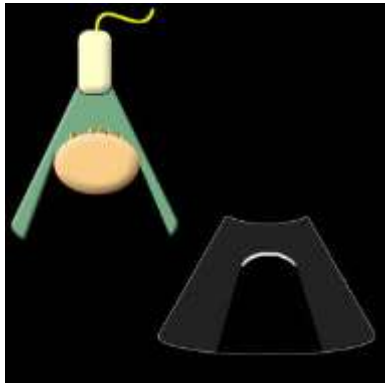
Conditionné et influencé par les conditions générales:

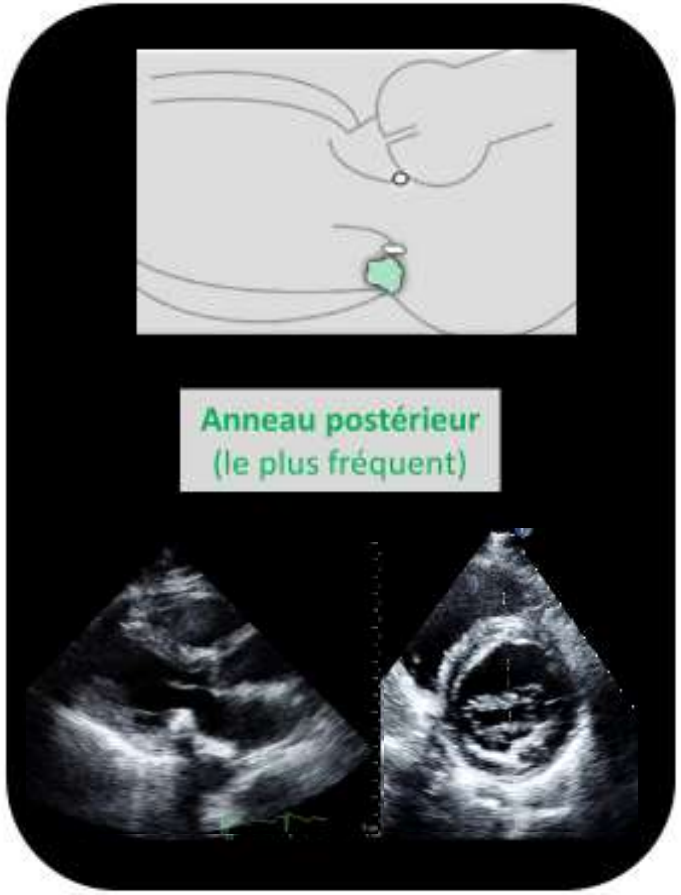
- athérosclerose, hypertension, diabète, tabac
- surpoids
- insuffisance rénale +++ (métabolisme P calcique)

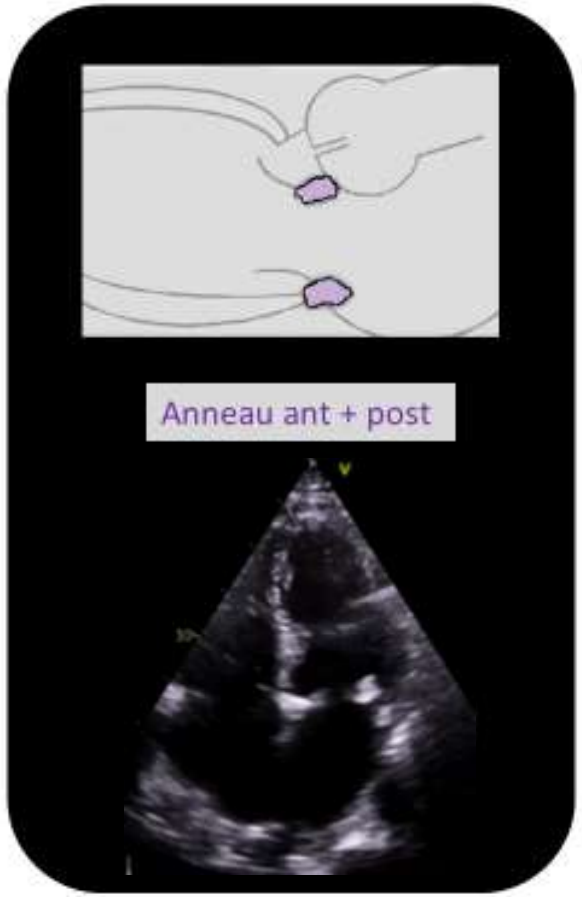


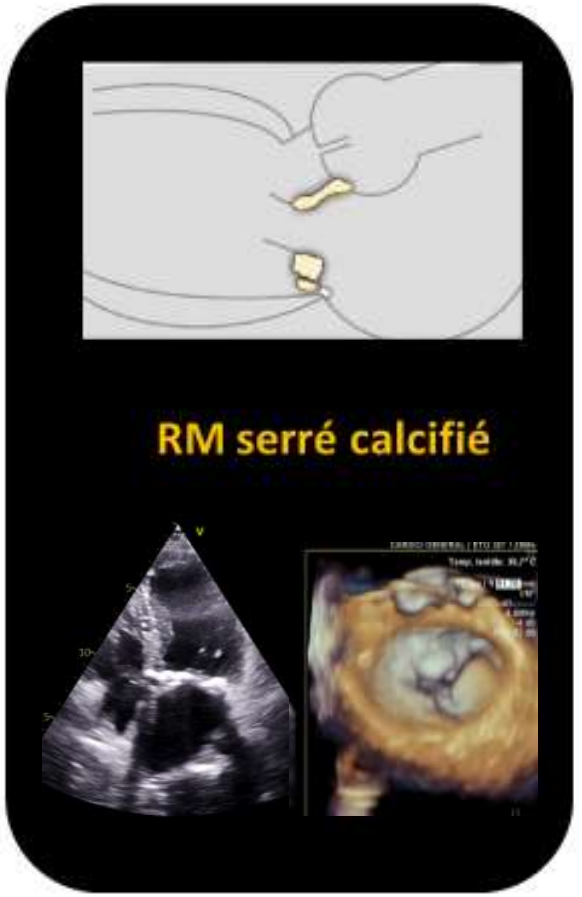
Localisation du MAC











J Am Soc Echocardiogr 2013;26:1135-42

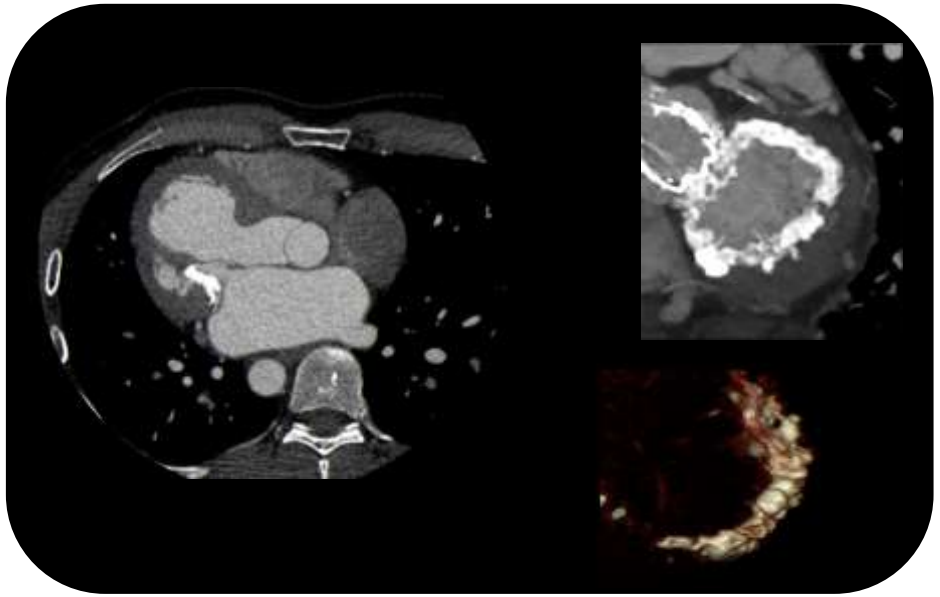
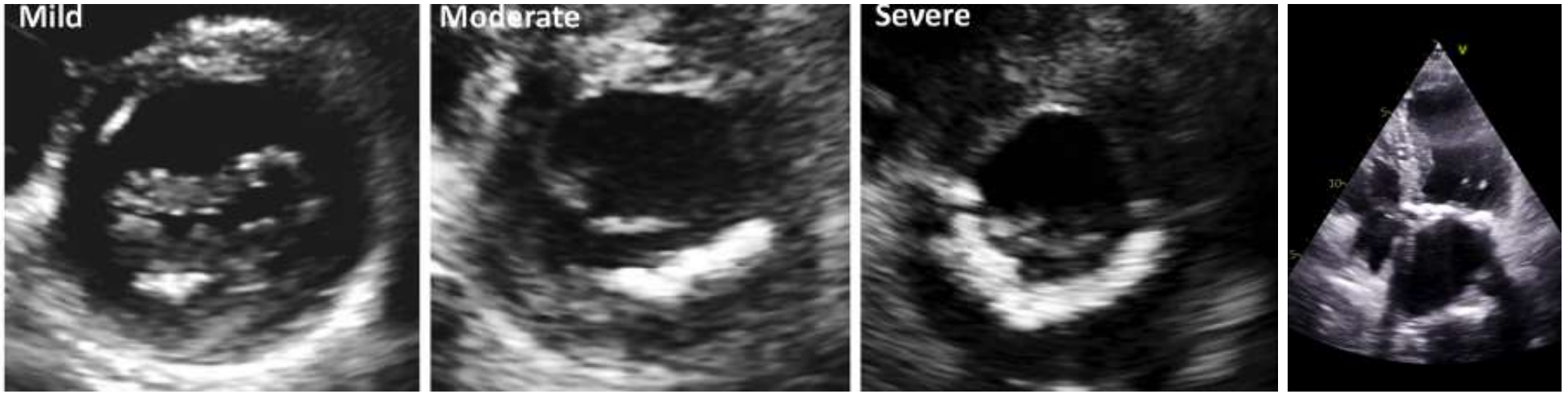


Table 2 Proposed multi-parametric grading system for MAC, based on echocardiographic and cardiac CT quantification, and evaluation of associated special MAC features

Overall MAC grade	Qualitative echocardiographic grading (based on parasternal short-axis imaging at mitral annulus level)	Quantitative CT grading (based on quantification of calcium score of mitral annulus using gated non-contrast CT)	Special features grade
Grade 1	<90° and non-contiguous	<1000 Agatston units	None
Grade 2	90°–<180°	1000–<3000 Agatston units	Calcification of subvalvular structures and leaflets by CT Involvement of one trigone
Grade 3	180°–<270°	3000–5000 Agatston units	Extension into LVOT Mobile MAC Involvement of both trigones
Grade 4	270° to circumferential	>5000 Agatston units	Heavy extension into LVOT Infiltration into myocardium

CT, computed tomography; LVOT, left ventricular outflow tract; MAC, mitral annular calcification.
For instance, a prominent chunk of posterior MAC may have <90% extent on short-axis echocardiographic imaging (echocardiographic Grade 1); however, due to the bulkiness of MAC, the elevated Agatston score (4500 Agatston units) will cause it to be classified as Grade 3.

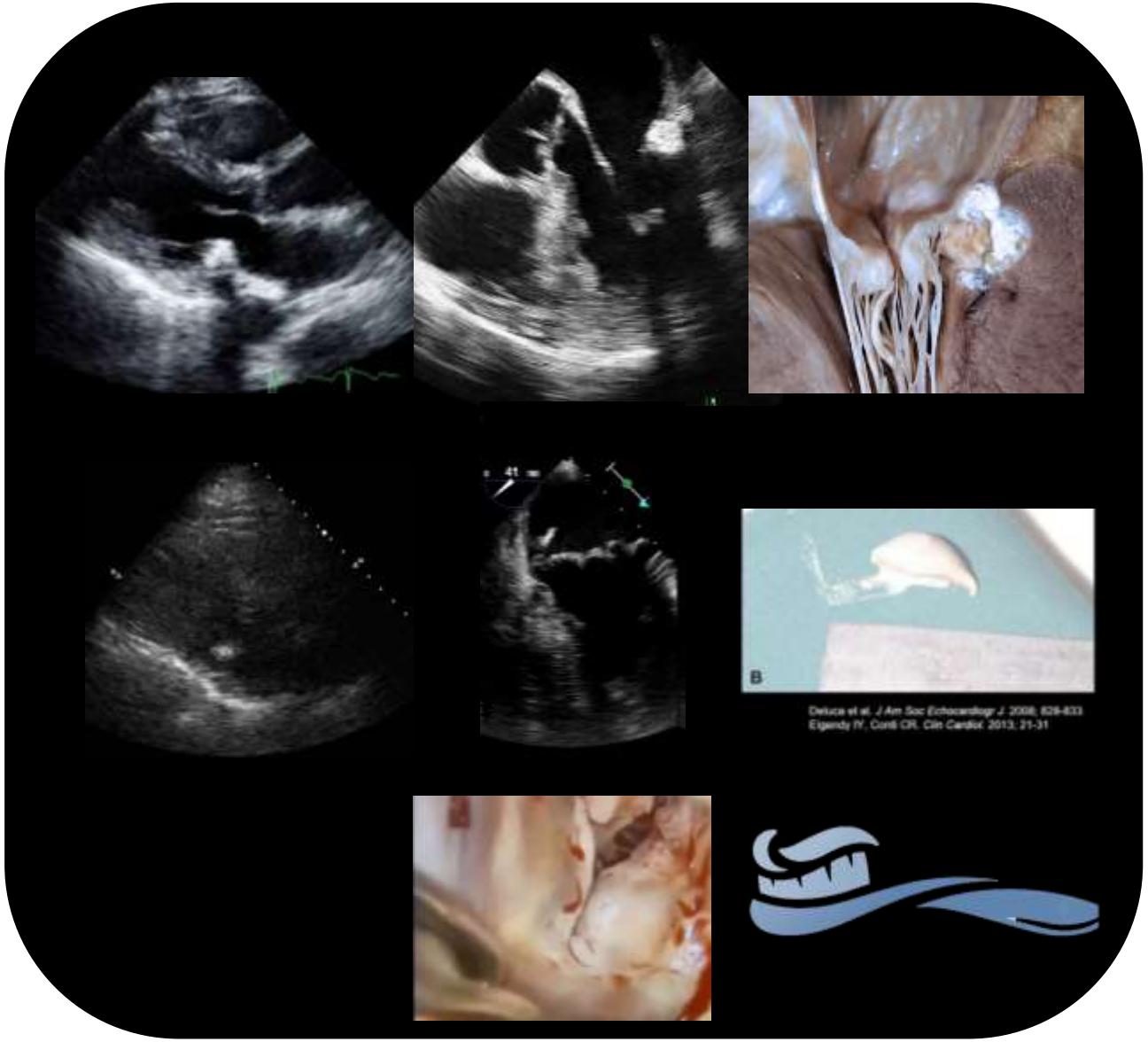
European Heart Journal - Cardiovascular Imaging (2022) 23, e111–e122

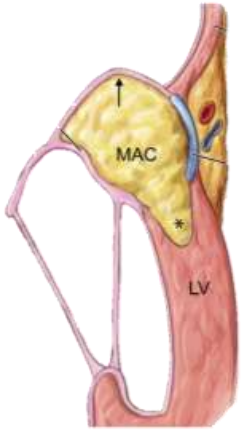


1000 3000 5000

Agaston units

Caseous MAC Stroke





MAC

Endocarditis

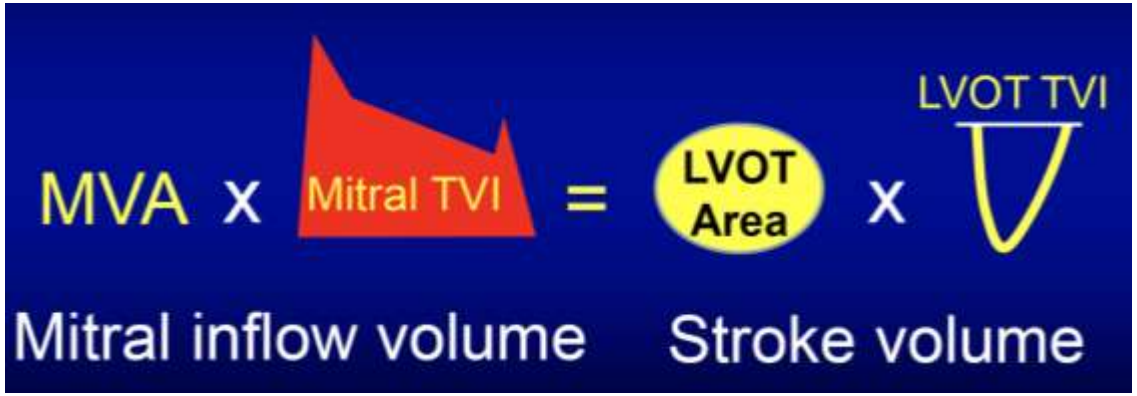
Comment évaluer la sévérité du RM sur MAC?

Mitral Stenosis Severity

	Progressive	Severe	Very severe
MVA (cm^2)	>1.5	1.0-1.5	<1.0
MG (mmHg)	<5	5-10	>10
PHT (ms)		>150	>220
PASP (mmHg)	-	>30 (50)	>30 (70)

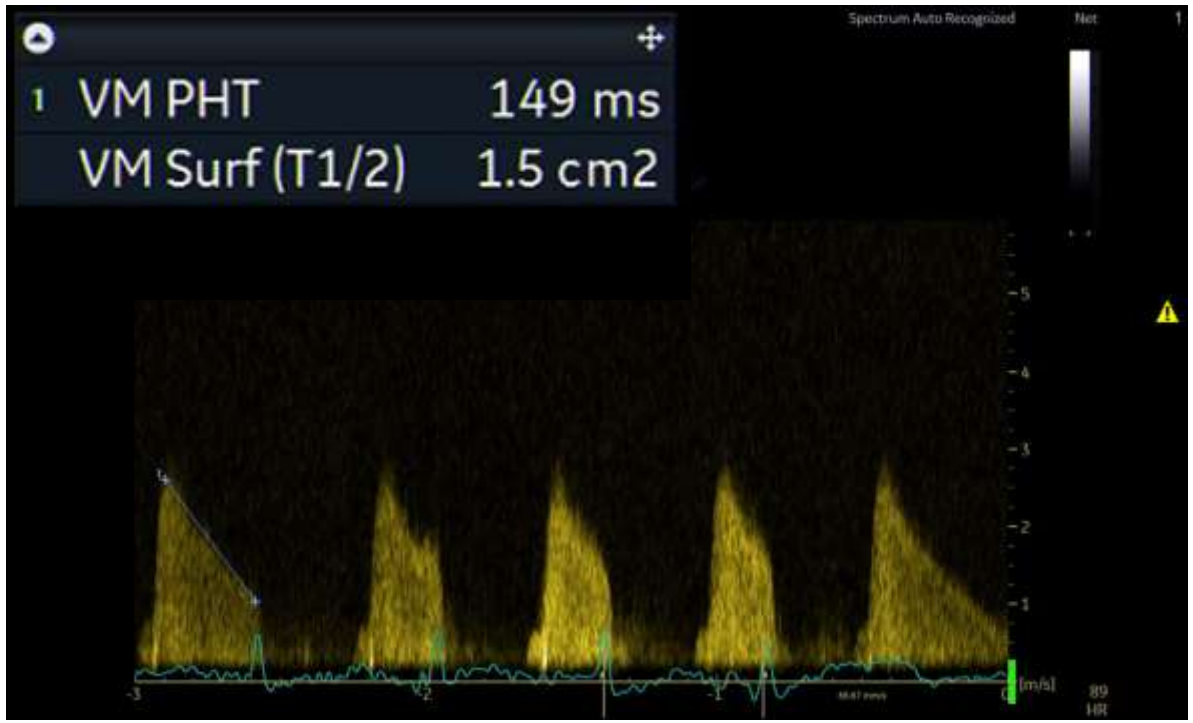
Young (rheumatic) : 3D > PHT > continuity

Old (calcific): continuity > planimetry ~~PHT~~



Ne pas utiliser le PHT dans le MAC

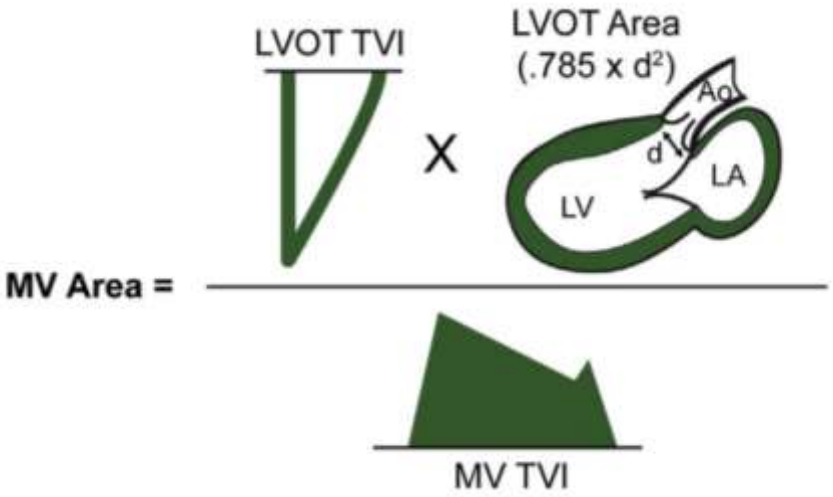
- reduced LV compliance, common among older individuals, may decrease mitral valve pressure half-time (P½t), resulting in overestimation of mitral valve area (MVA) when the Hatle formula (MVA = 220/P½t) is used

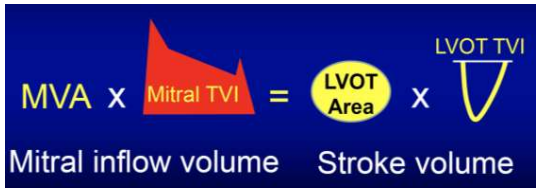


Evaluation de la sévérité du RM sur MAC

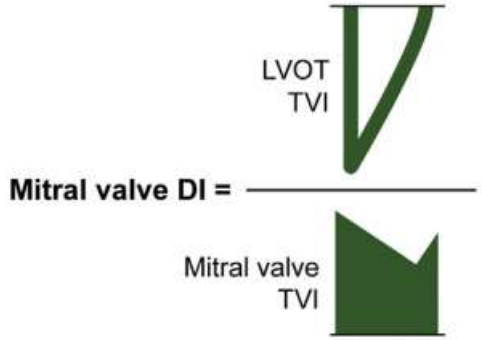
Equation de continuité

pas fiable si FA, IM ou IAo





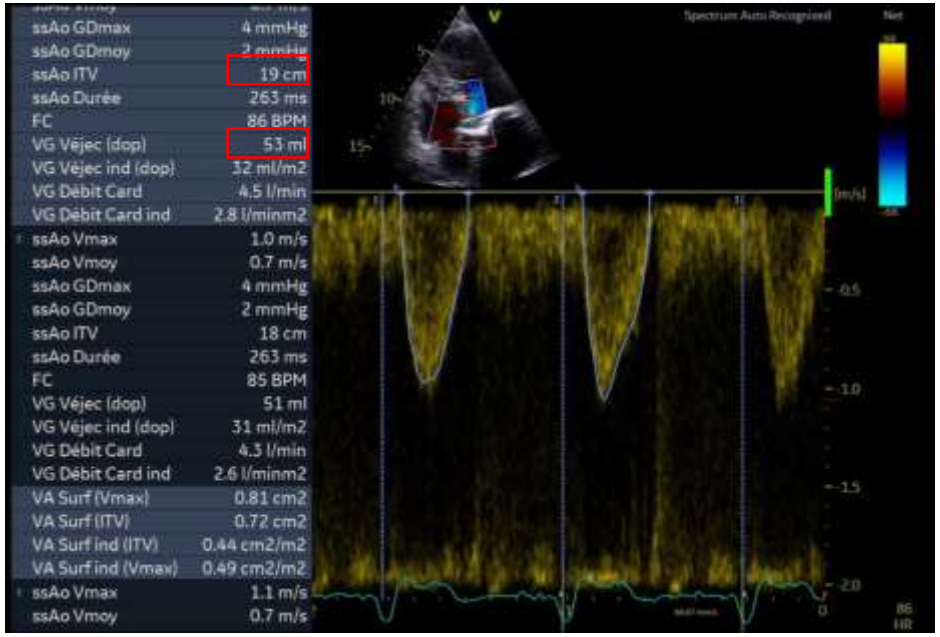
Indice de perméabilité

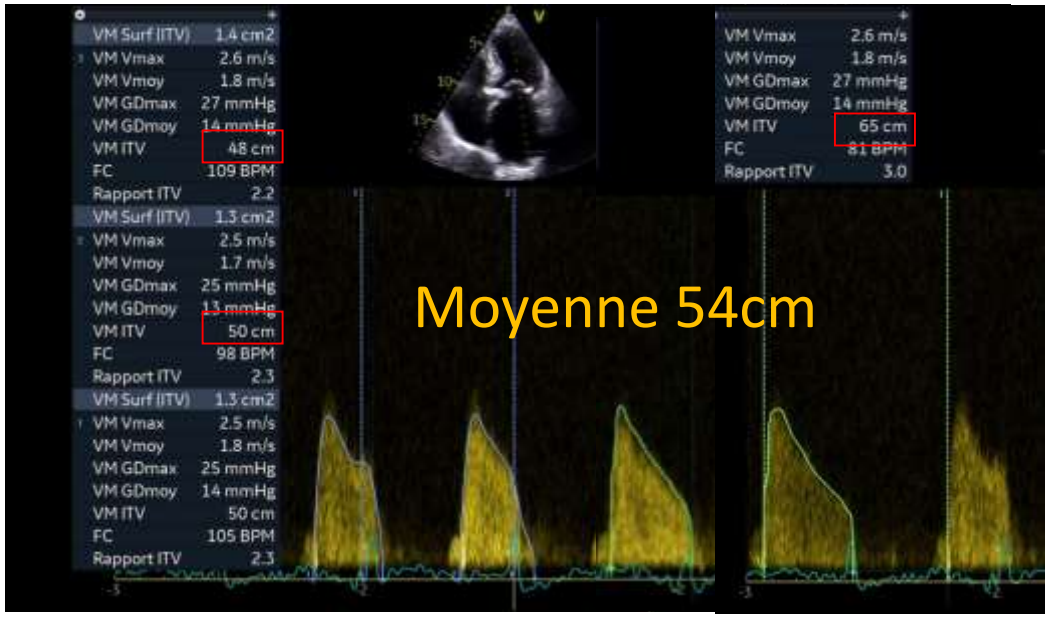


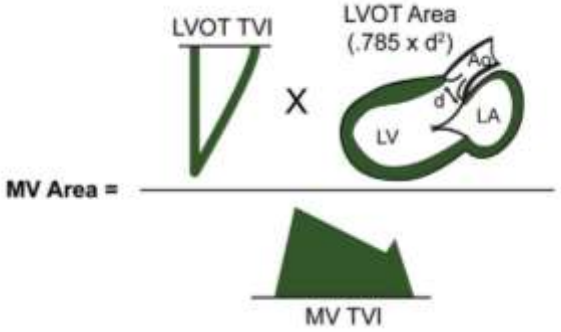
a DI of 0.35 to 0.50 is consistent with severe calcific MS (MVA # 1.5 cm2)
a DI < 0.35 suggests very severe calcific MS (MVA # 1.0 cm2)

Silbiger et al. JASE 2021

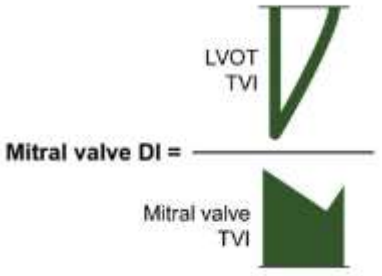
Notre patiente







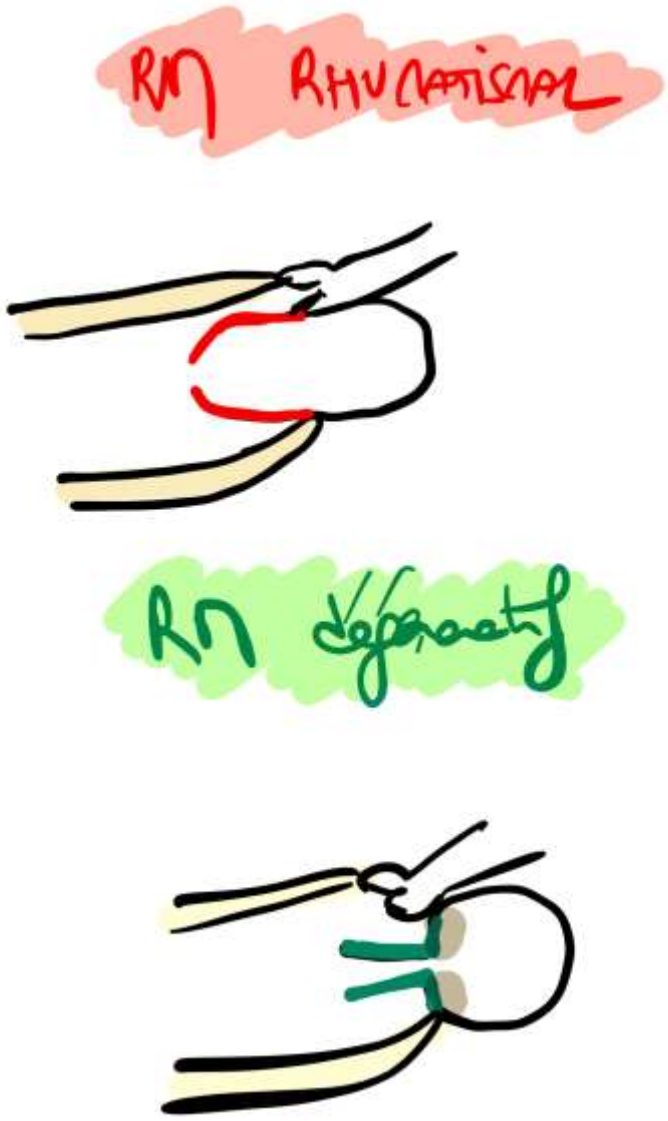
Moyenne sur multiples mesures

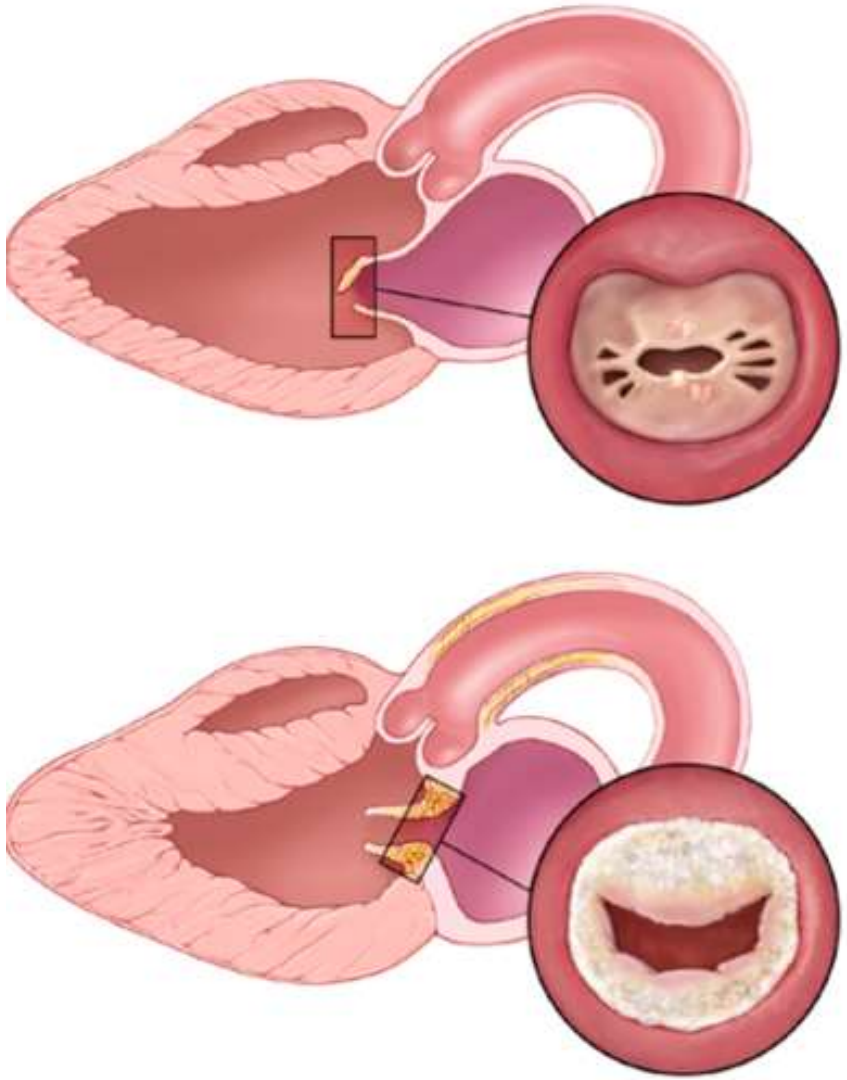


SM eq de continuité = 52/54= 1cm²

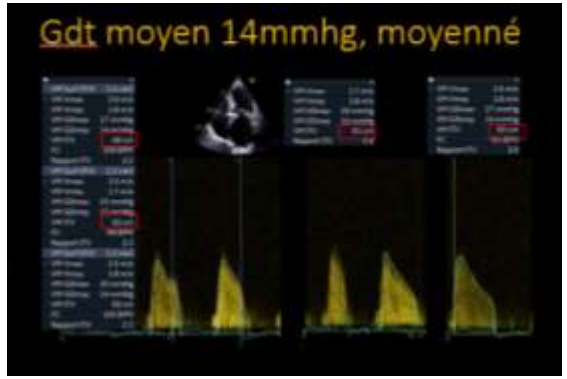
DI 19/54 = 0,35

Ne pas utiliser la planimétrie dans le MAC





Gradient moyen transmitral

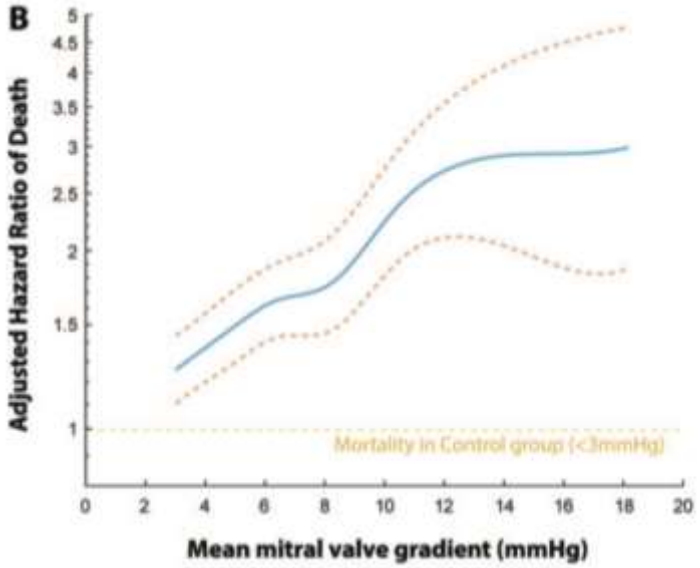


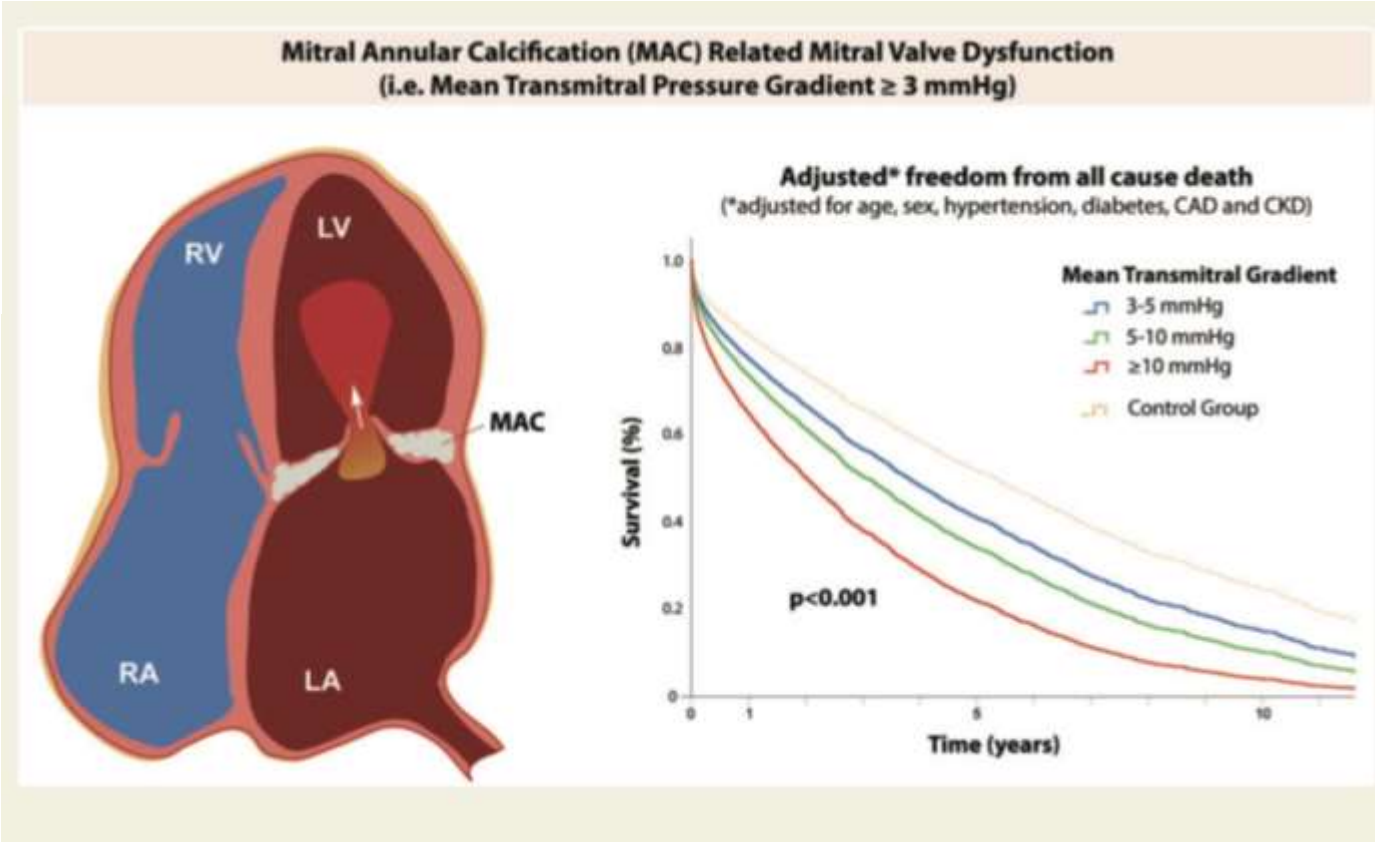
ESC European Society of Cardiology
European Heart Journal (2020) 41, 4321–4328
doi:10.1093/eurheartj/ehaa819

CLINICAL RESEARCH
Valvular heart disease

Prognostic importance of the transmitral pressure gradient in mitral annular calcification with associated mitral valve dysfunction

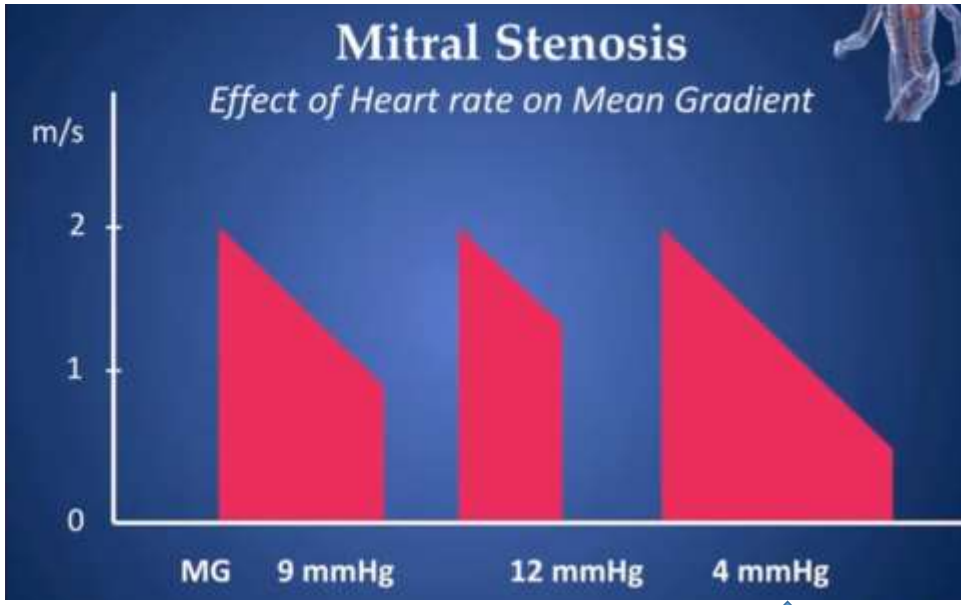
Philippe B. Bertrand †, Timothy W. Churchill †, Evin Yucel, Mayooran Namasivayam, Samuel Bernard, Yasufumi Nagata, Wei He, Carl T. Andrews, Michael H. Picard, Arthur E. Weyman, Robert A. Levin

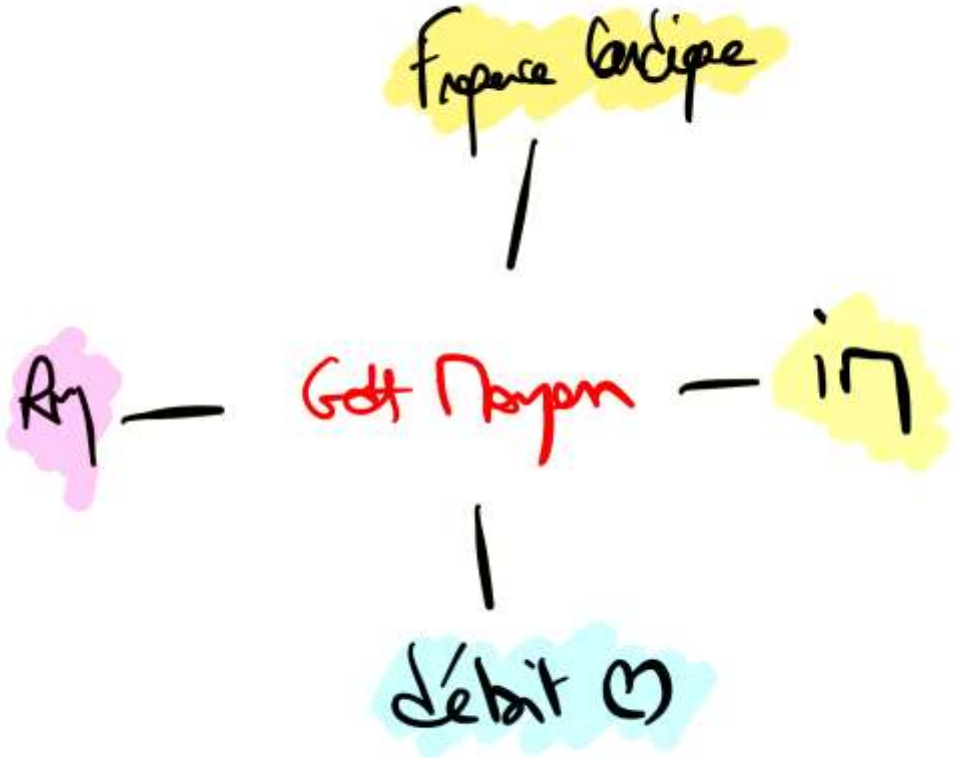




European Heart Journal (2020) 41, 4321–4328

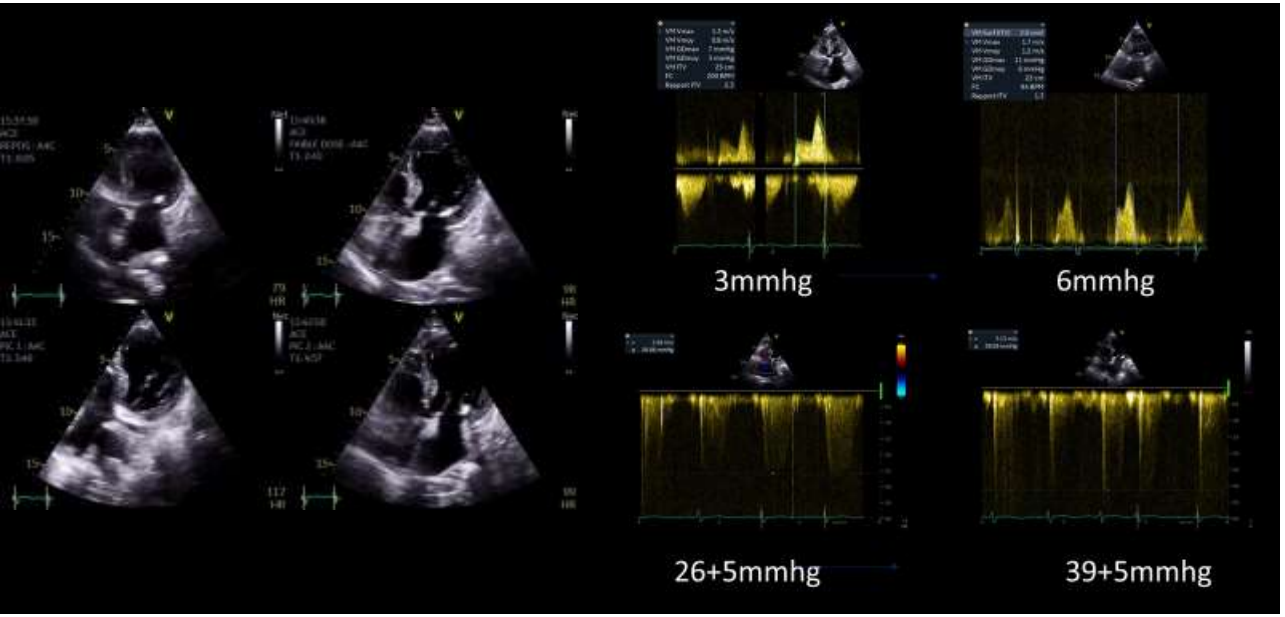
influence de la fréquence cardiaque



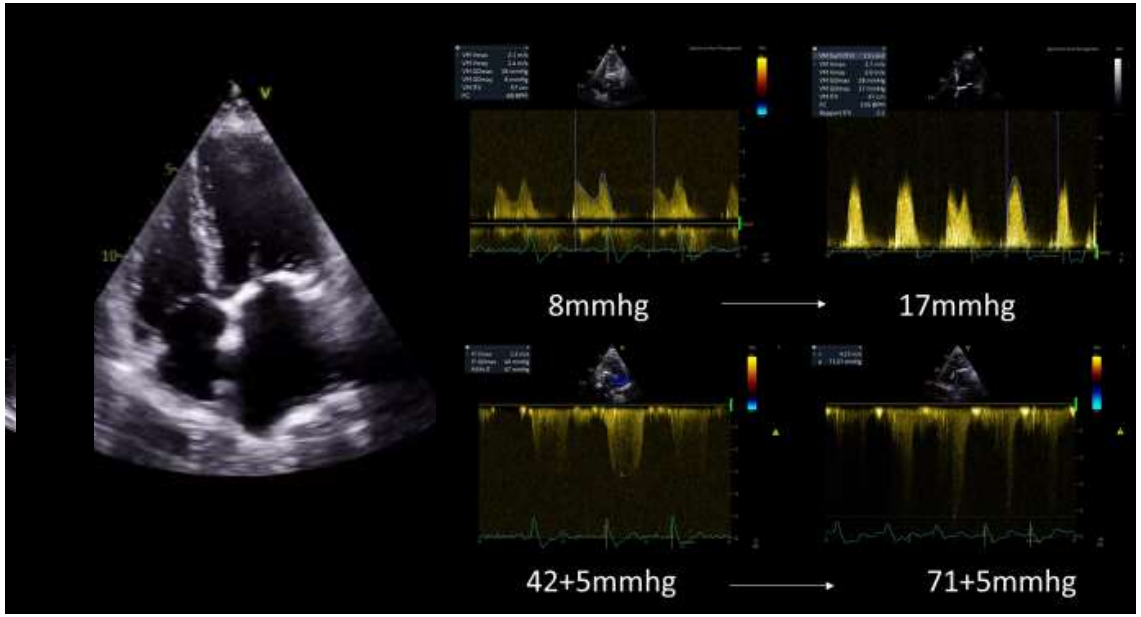


Apport de l'écho d'effort

Sténose mitrale lâche

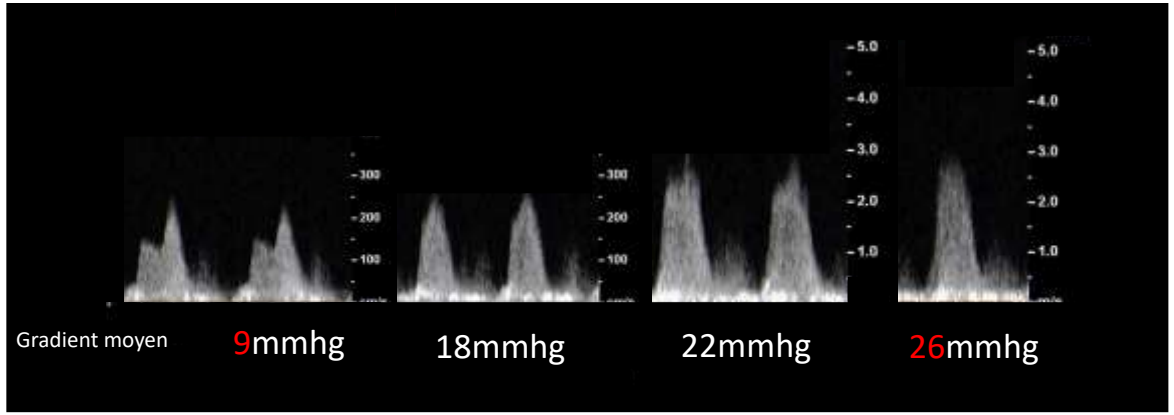


Sténose mitrale serrée

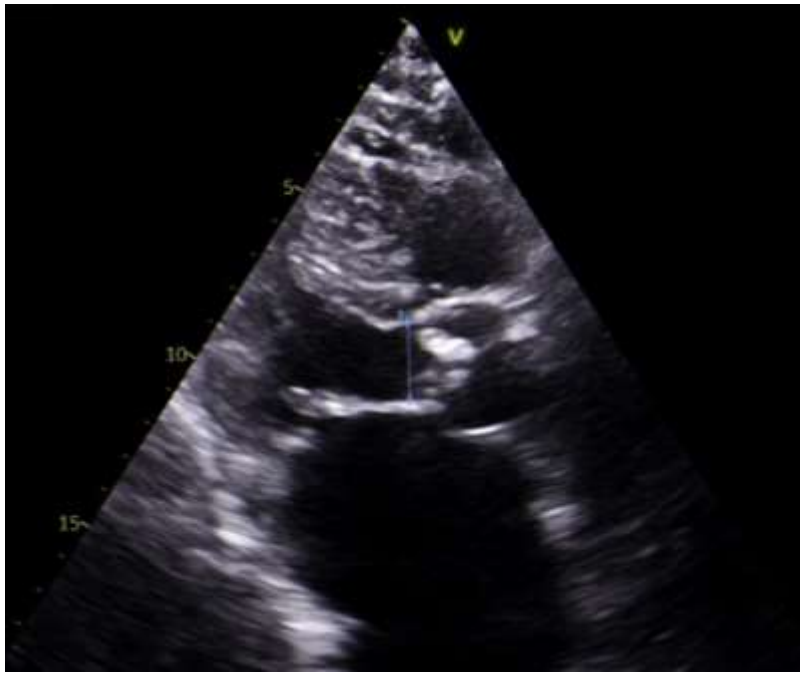


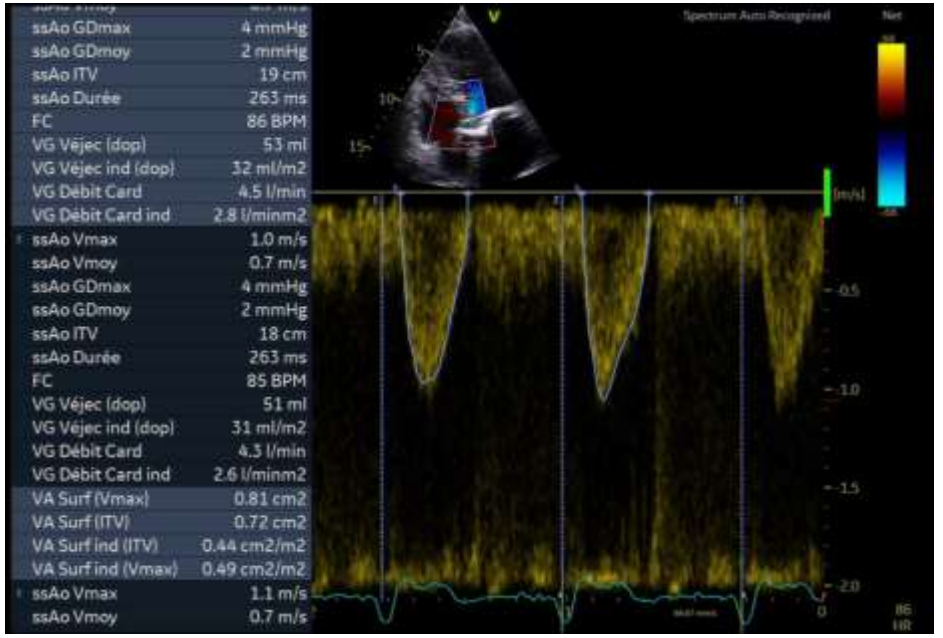
A l'effort
gdt moyen > 15mmhg
paps > 64mmhg

Review of Cardiovascular Therapy, 17:7, 473-477

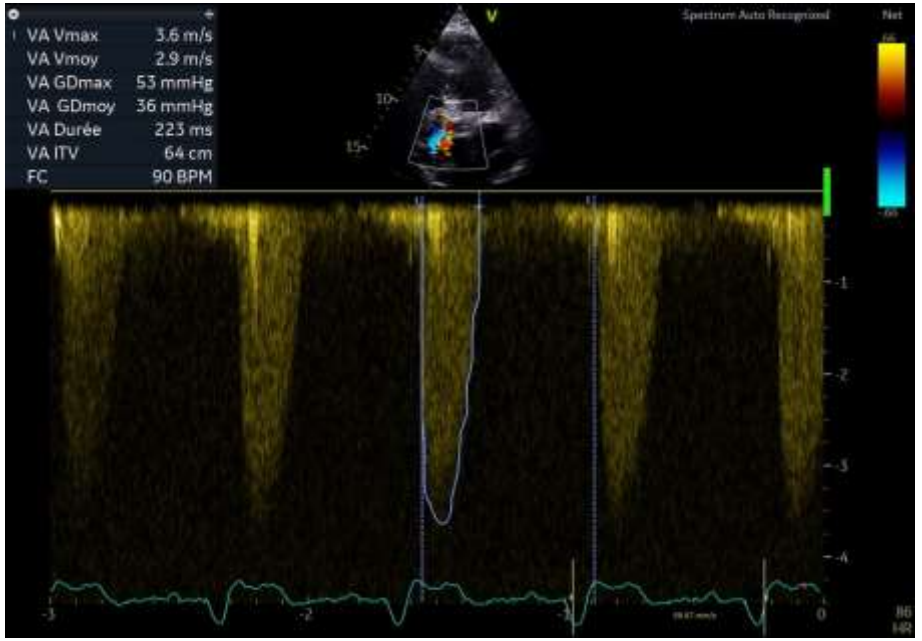


Anneau aortique 19mm





VES i 32ml/m²



Vmax 3.6m/s
Gdt moyen 36mmhg
Sao 0.8cm²
Sao I 0.4cm²/m²

ESC European Society of Cardiology
European Heart Journal (2022) 43, 561–632
https://doi.org/10.1093/eurheartj/ehab395

2021 ESC/EACTS Guidelines for the management of valvular heart disease

Developed by 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)

High gradient AS

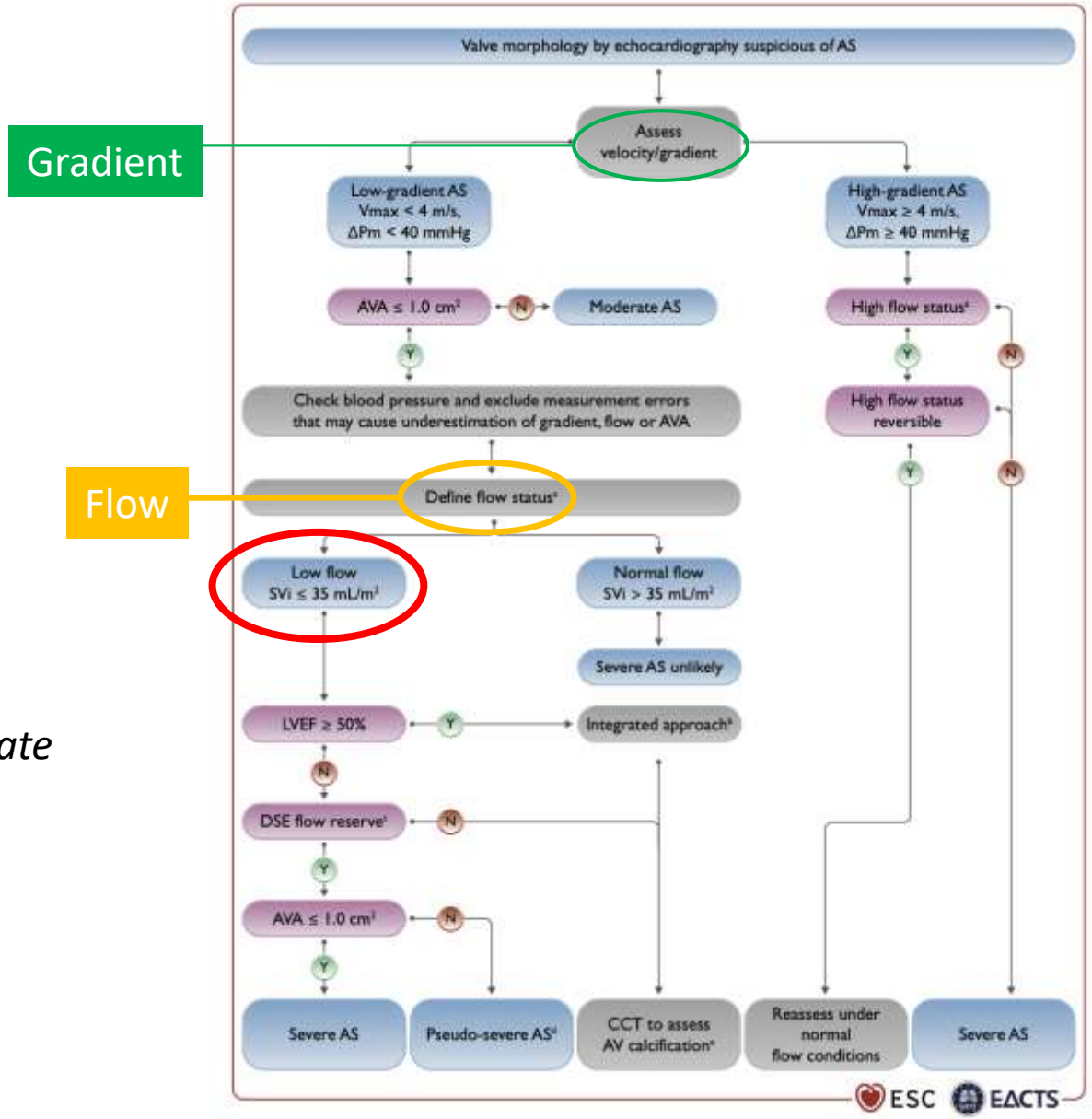
Low gradient AS (MG < 40 mmHg, AVA < 1.0 cm2)

- **LF/LG AS with reduced LVEF**
  LVEF < 50%, SVI < 35 ml/m²
- **LF/LG AS with preserved LVEF**
  LVEF ≥ 50%, SVI < 35 ml/m²

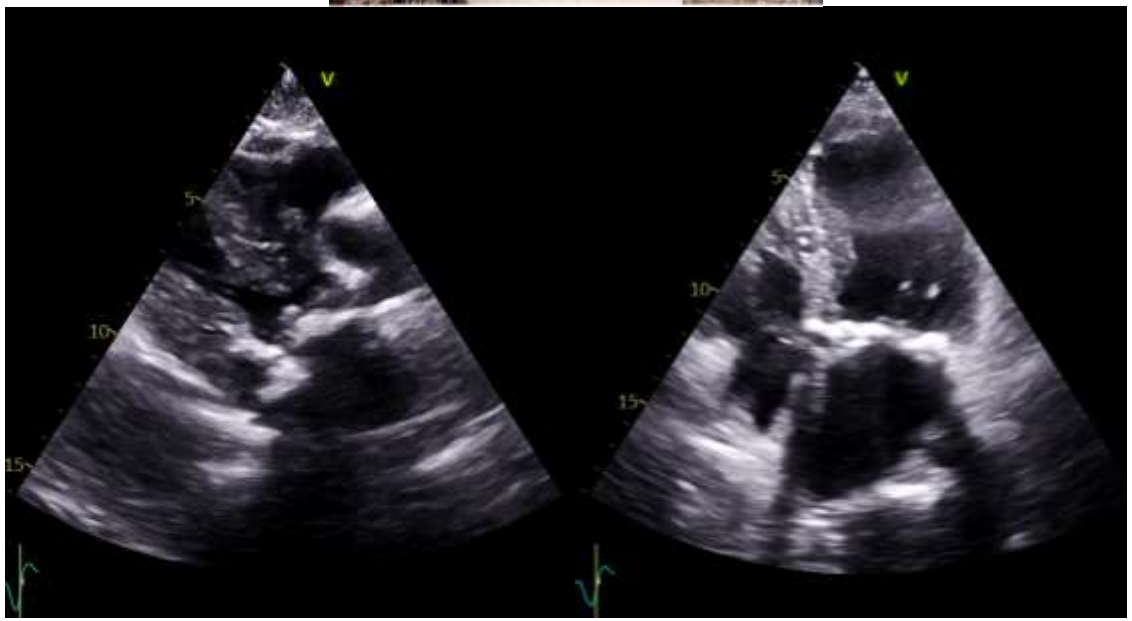
Low flow

- **NF/LG AS**
  LVEF ≥ 50%, SVI ≥ 35 ml/m²

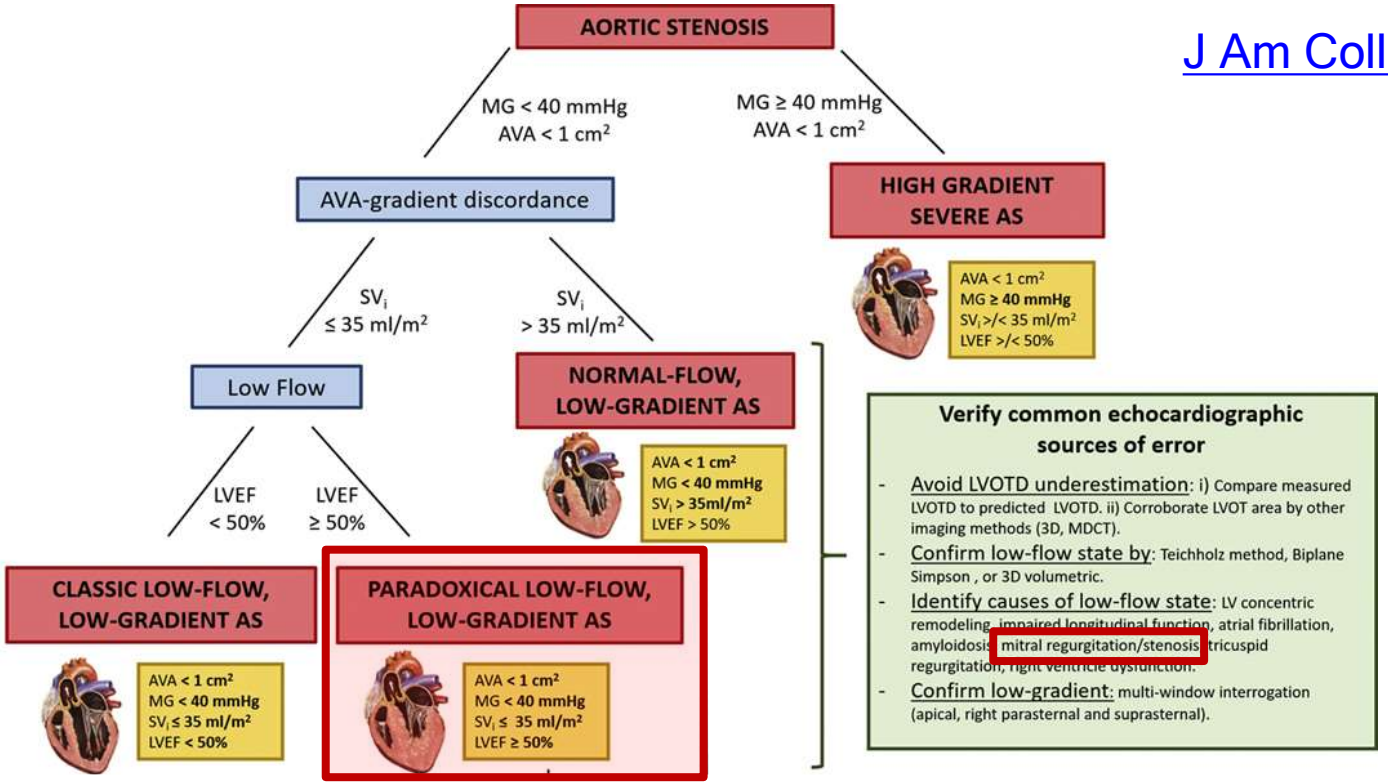
→ *Usually moderate*



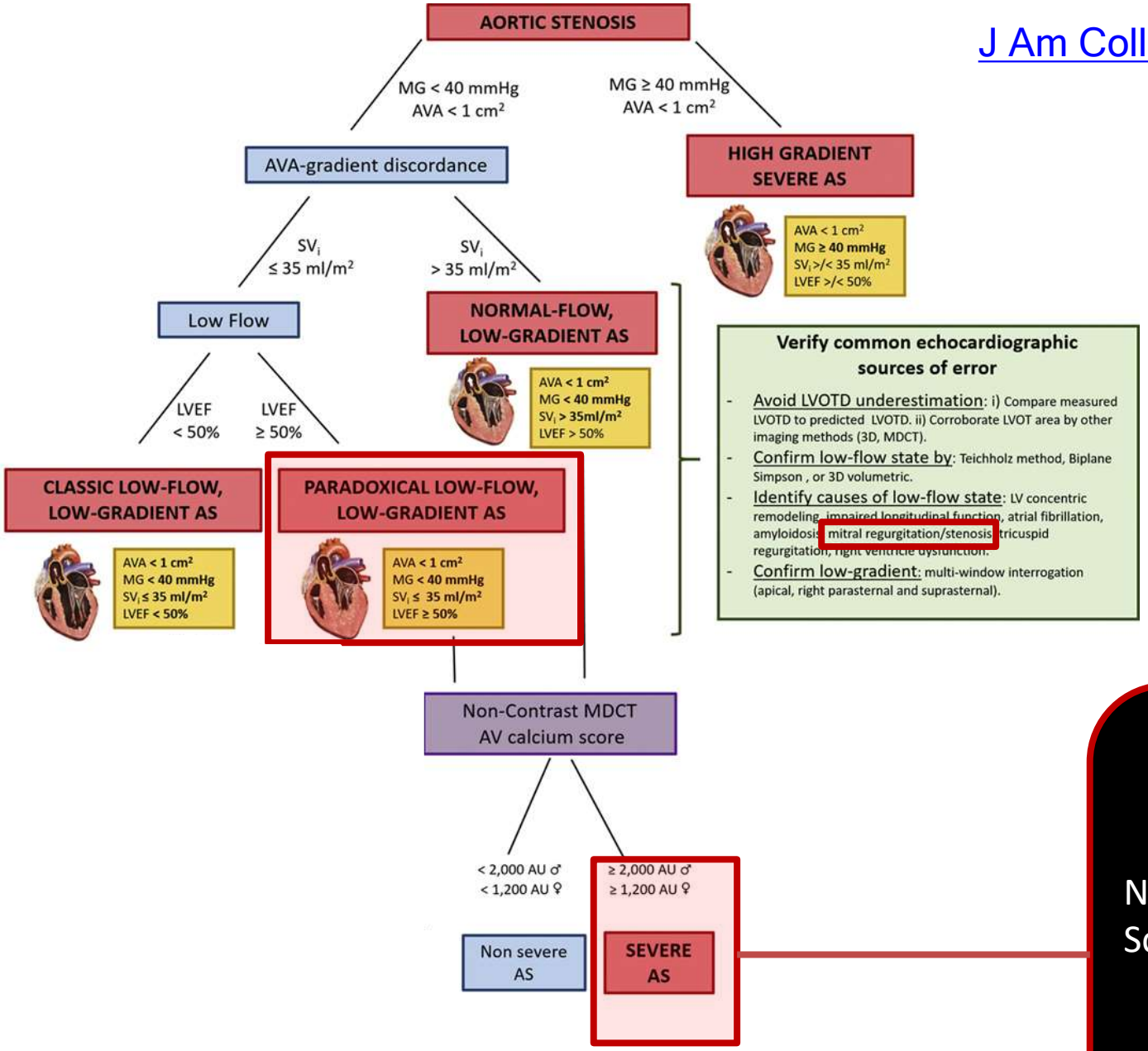
Decreased cardiac output



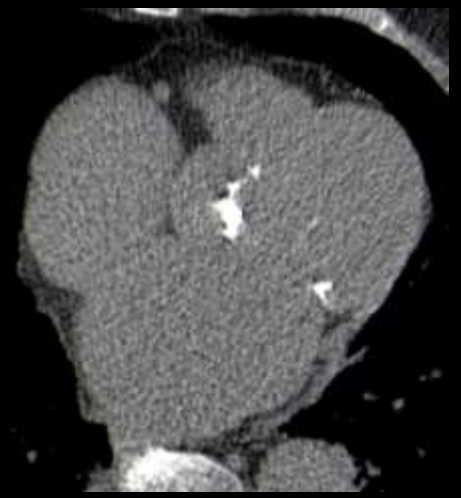
J Am Coll Cardiol Case Rep. 2022 Feb, 4 (3) 170-177



J Am Coll Cardiol Case Rep. 2022 Feb, 4 (3) 170-177

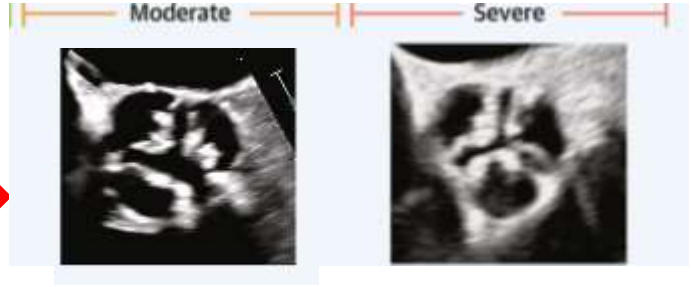


Notre patiente
Score calcique : 1769



800 1200 1600

Agaston units



1600 2000 3000

Agaston units

1000 3000 5000

Agaston units

question

- Concernant la prise en charge thérapeutique en cas d'association RAC + RM serrés sur MAC:

A. Le TAVI est contre indiqué en cas de MAC

B. Le gradient moyen transmitral n'a pas de valeur pronostique après TAVI

C. Après TAVI, il existe parfois une amélioration des paramètres de sévérité du RM

D. Le remplacement valvulaire mitral percutané n'est pas faisable

question

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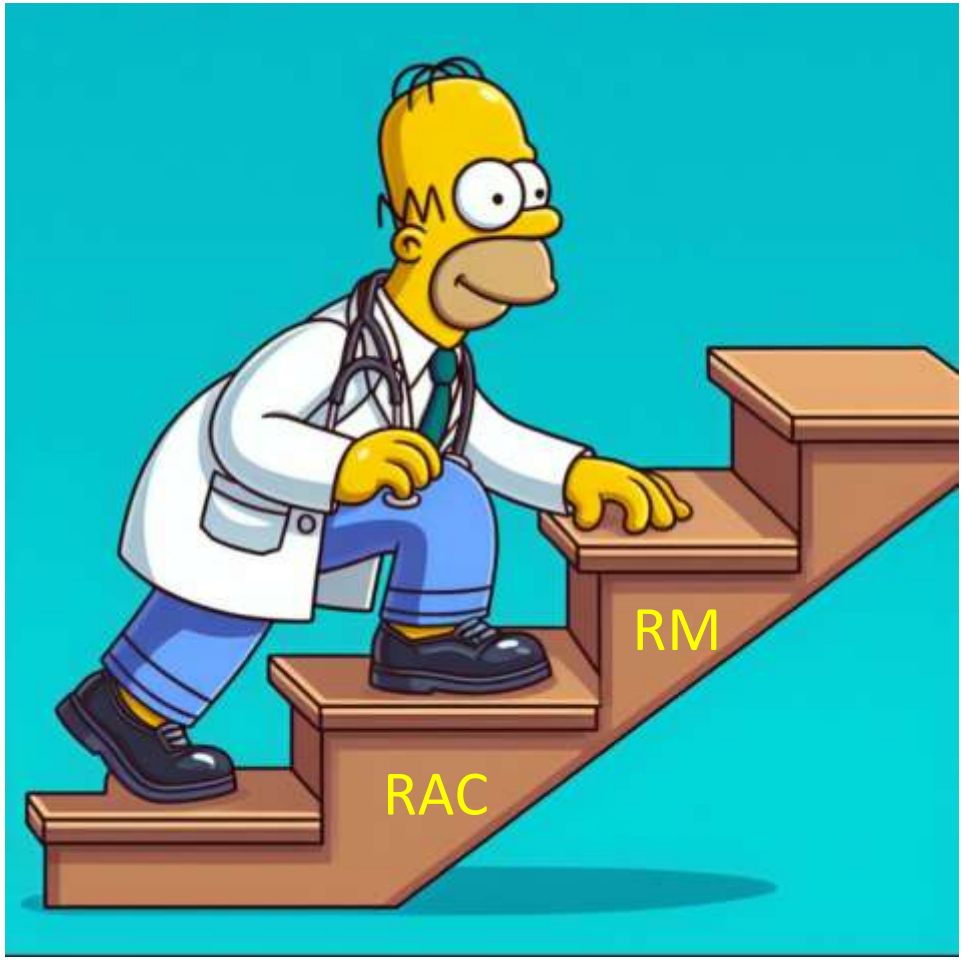
D. Le remplacement valvulaire mitral percutané n'est pas faisable

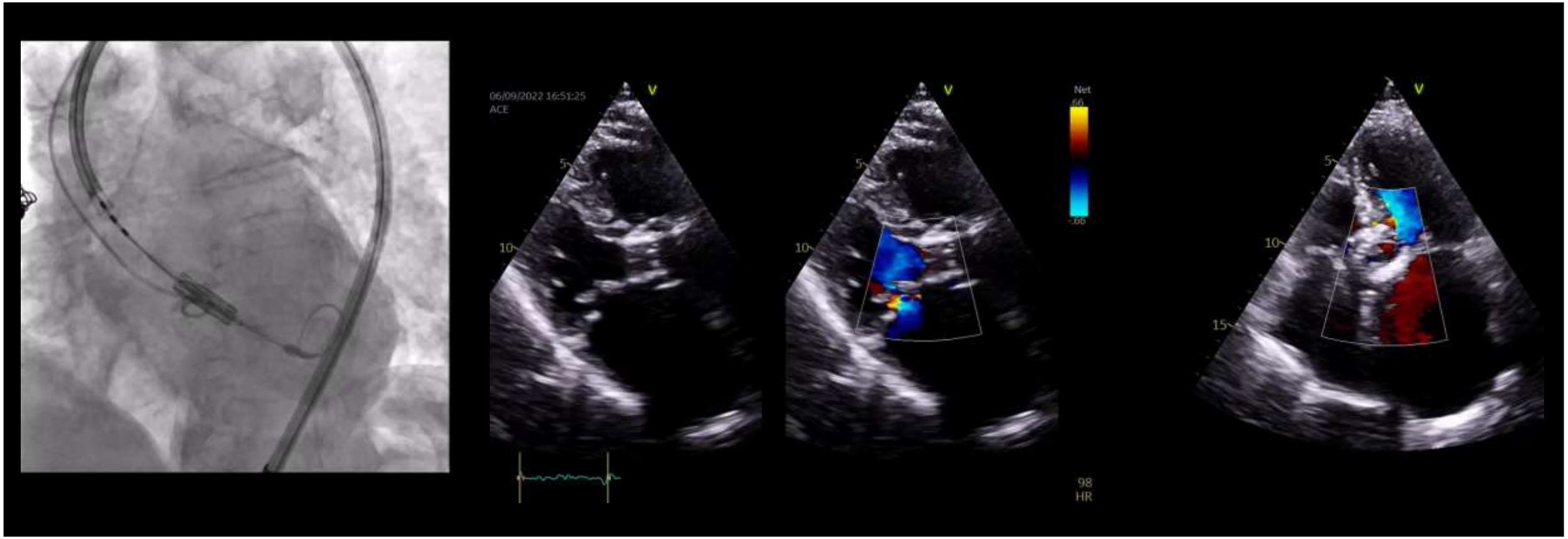
RAC + RM sur MAC: staged strategy ?

- TAVR and then we will see…



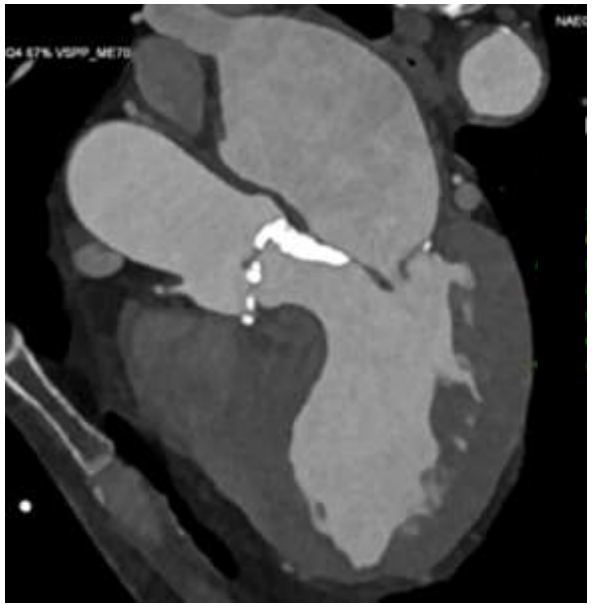
Suivi à 4 mois: asymptomatique pour son âge…

NYHA 2
BNP 256
Lasilix 60mg/j aldactone 25mg/j



TAVR in concomitant MAC

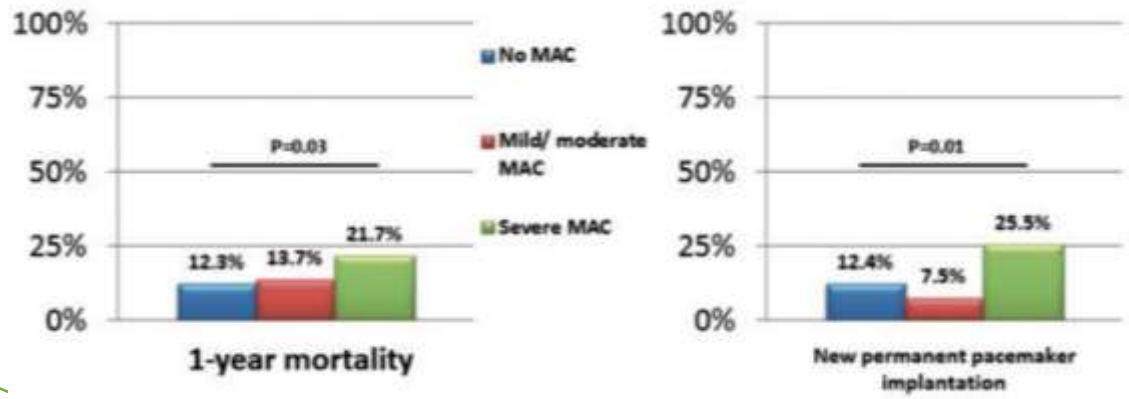
Higher risk of pace maker implantation
Lower survival
Higher risk of paravalvular leak?



European Heart Journal (2017) 38, 1194–1203
doi:10.1093/eurheartj/ehw594

CLINICAL RESEARCH
Valvular heart disease

Concomitant mitral annular calcification and severe aortic stenosis: prevalence, characteristics and outcome following transcatheter aortic valve replacement



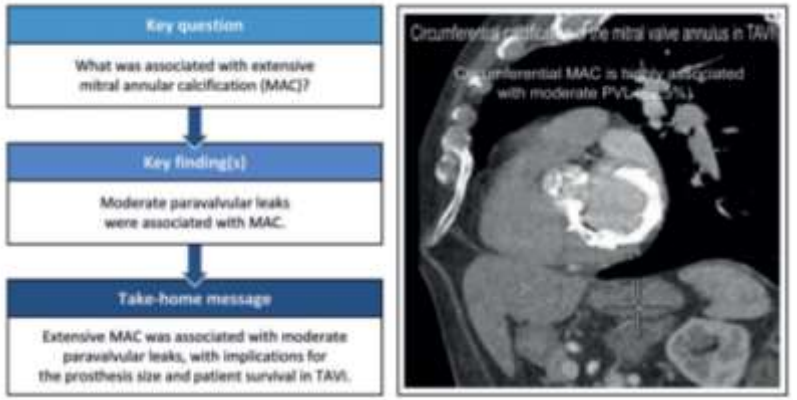
Interactive CardioVascular and Thoracic Surgery 34 (2022) 167–175
doi:10.1093/icvts/ivab235 Advance Access publication 3 October 2021

ORIGINAL ARTICLE

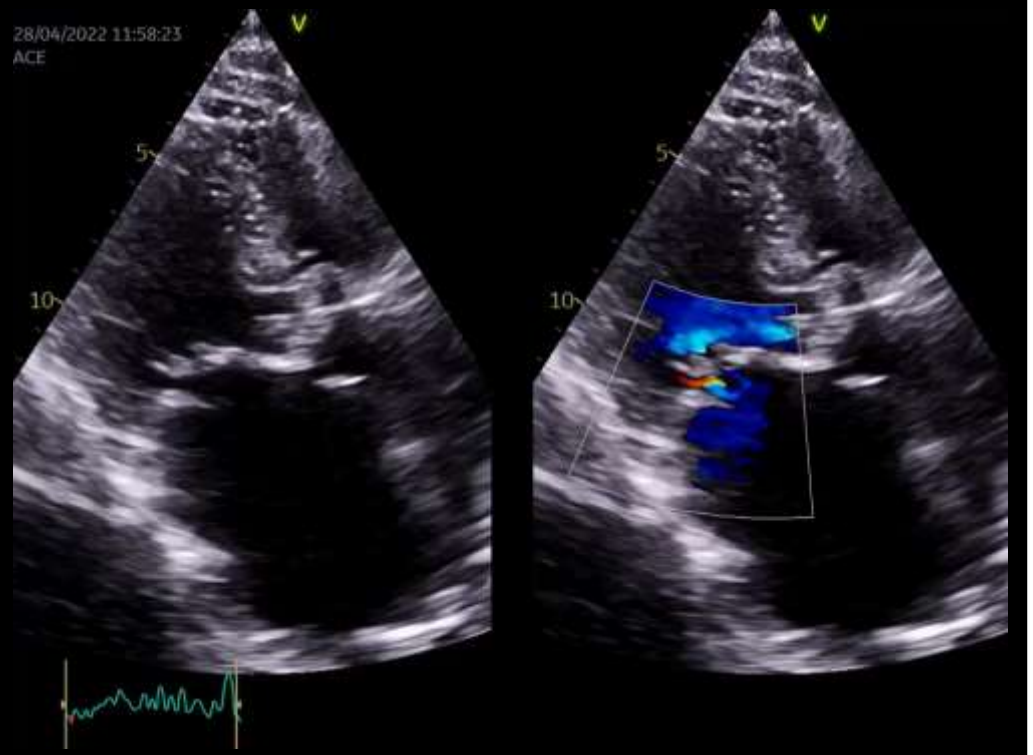
Cite this article as: Haensig M, Kuntze T, Gonzalez DL, Lapp H, Lauten P, Owais T. Extensive calcification of the mitral valve annulus in transcatheter aortic valve implants. Interact CardioVasc Thorac Surg 2022;34:167–75.

Extensive calcification of the mitral valve annulus in transcatheter aortic valve implants

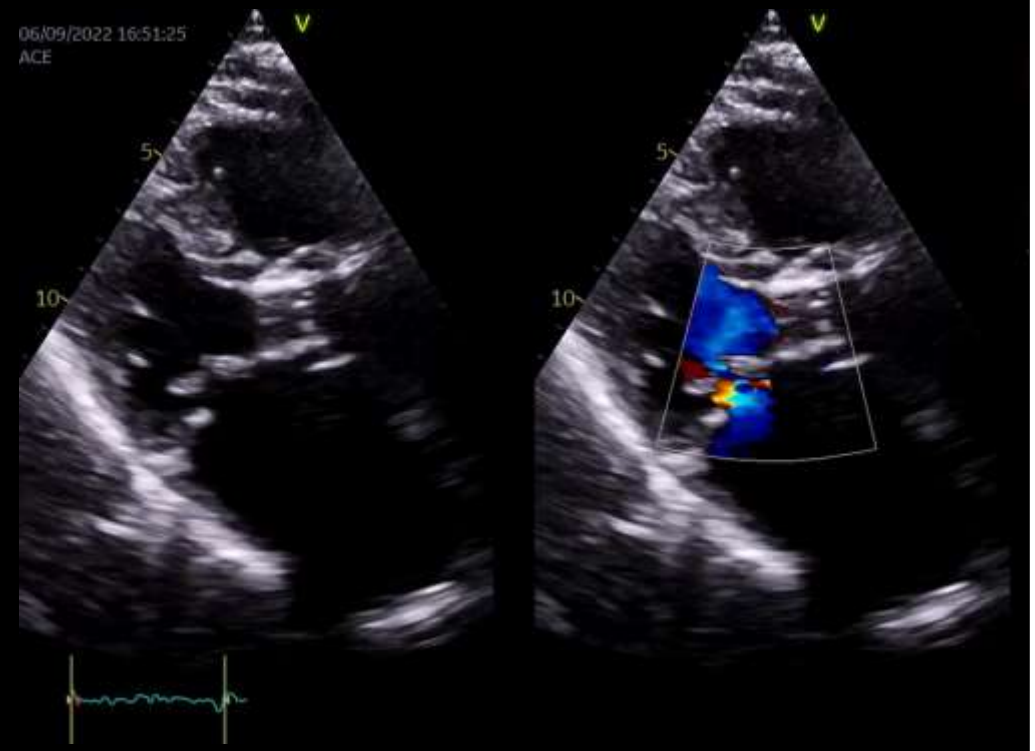
Martin Haensig [a,*], Thomas Kuntze[a], David Lopez Gonzalez[a], Harald Lapp[b], Philipp Lauten[b] and



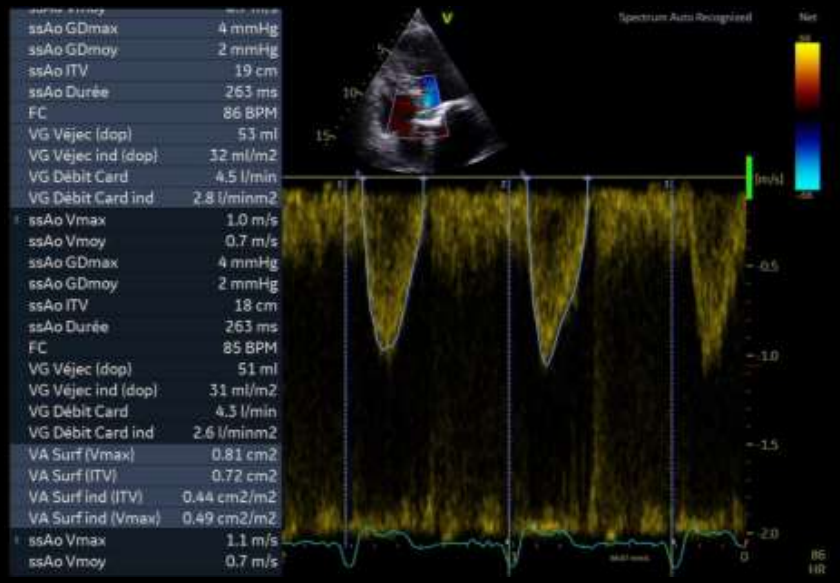
Pre tavi

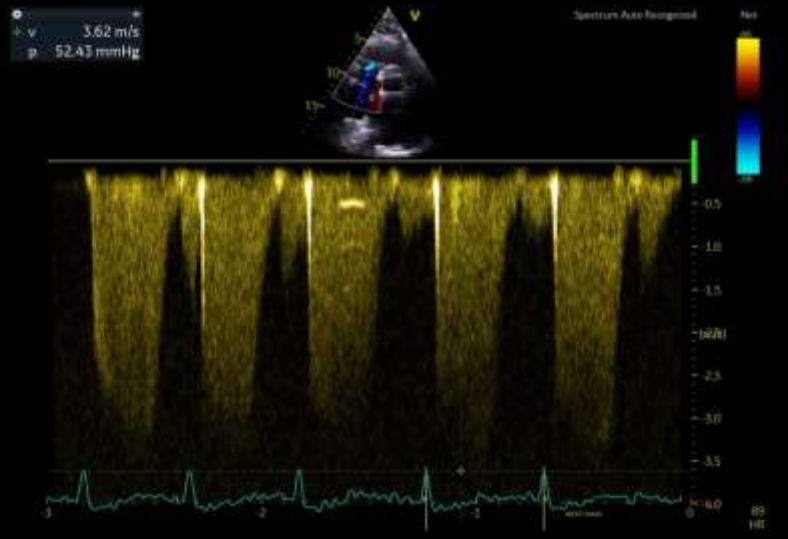


Post tavi

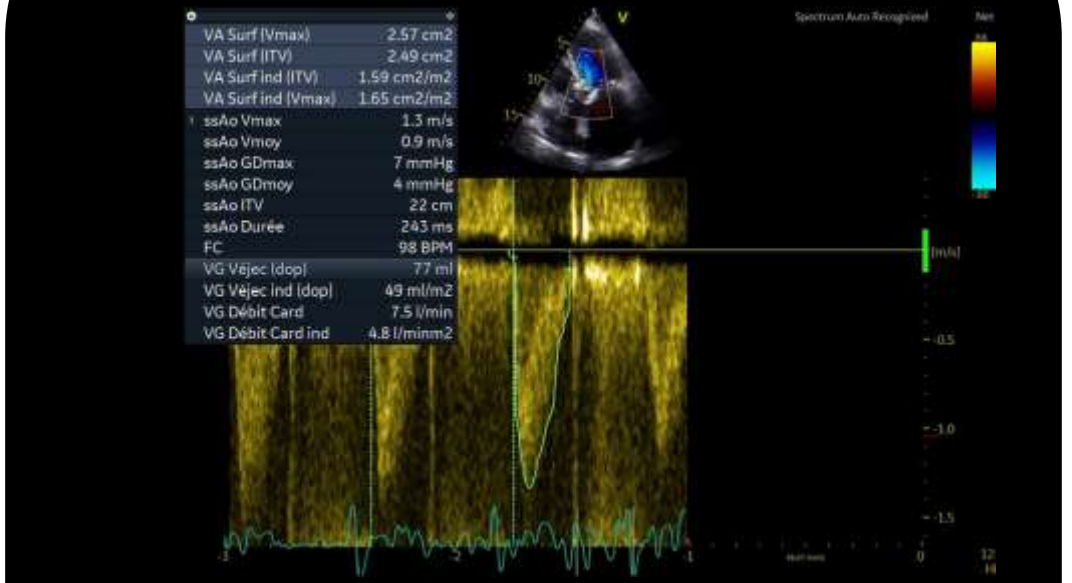


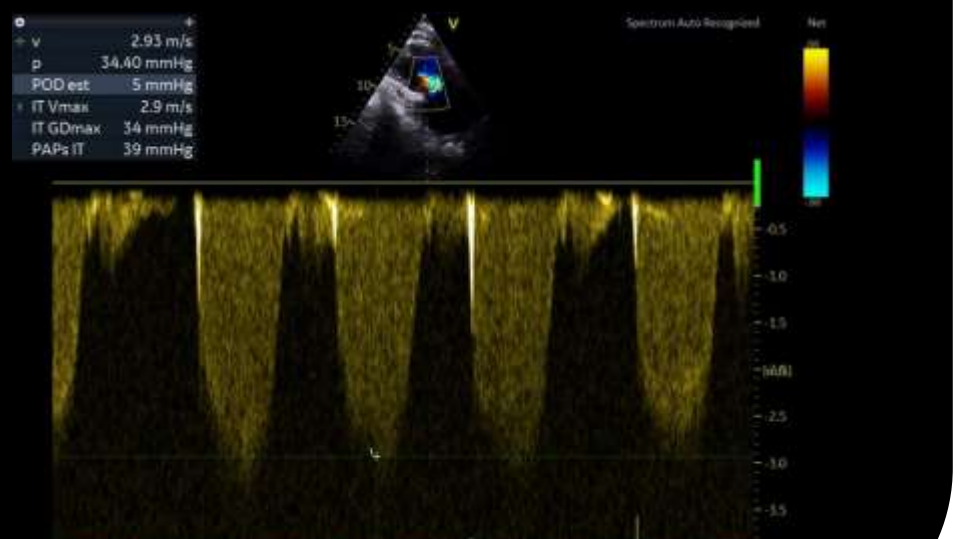
Pre tavi



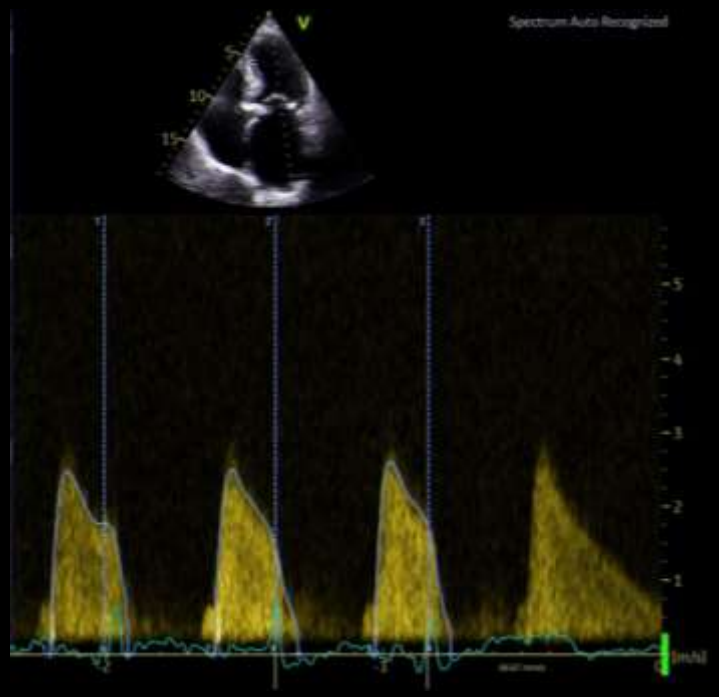


Post tavi



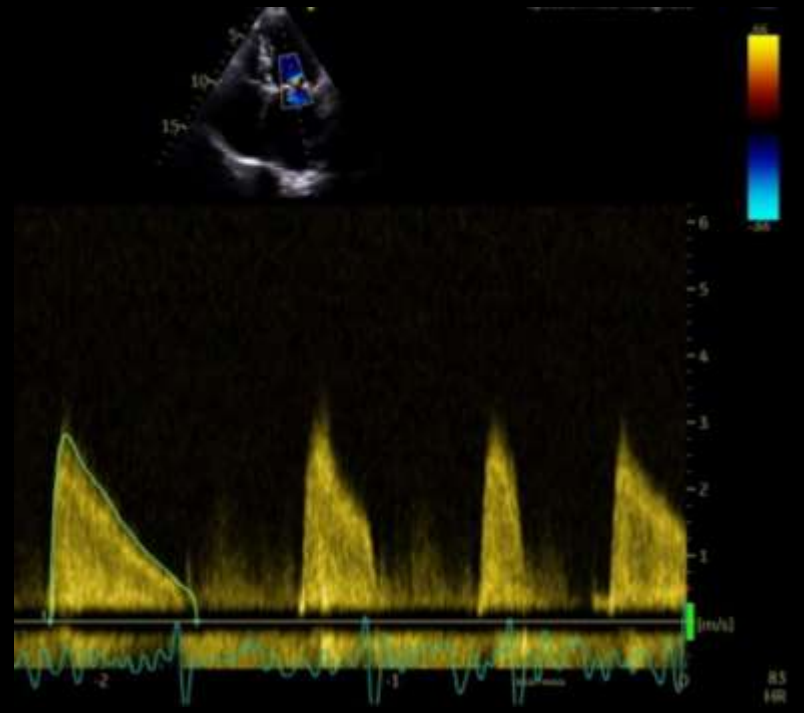


Pre tavi



SM = 1cm²

Post tavi

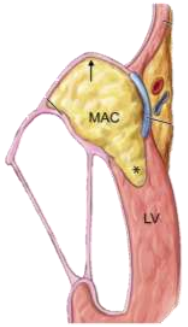


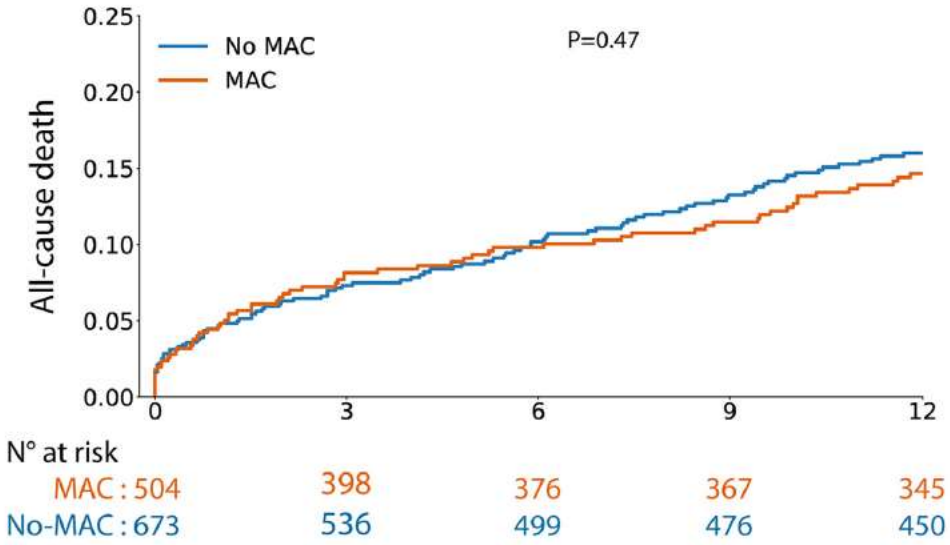
GDt moyen 11mmhg
SM =77/75 = 1cm²

True severe MS

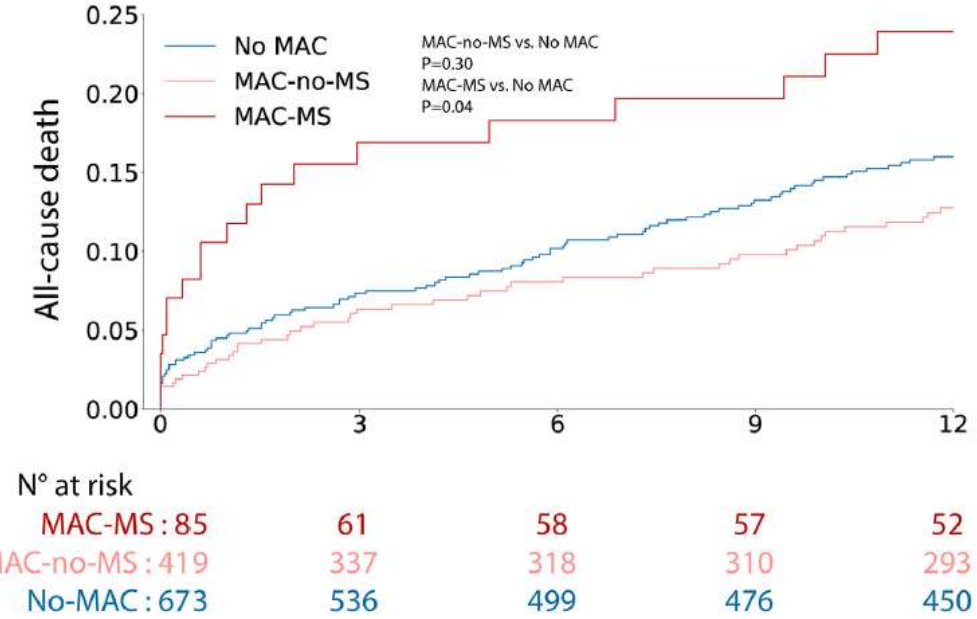
AS and MAC: MG and prognosis after TAVR

MAC



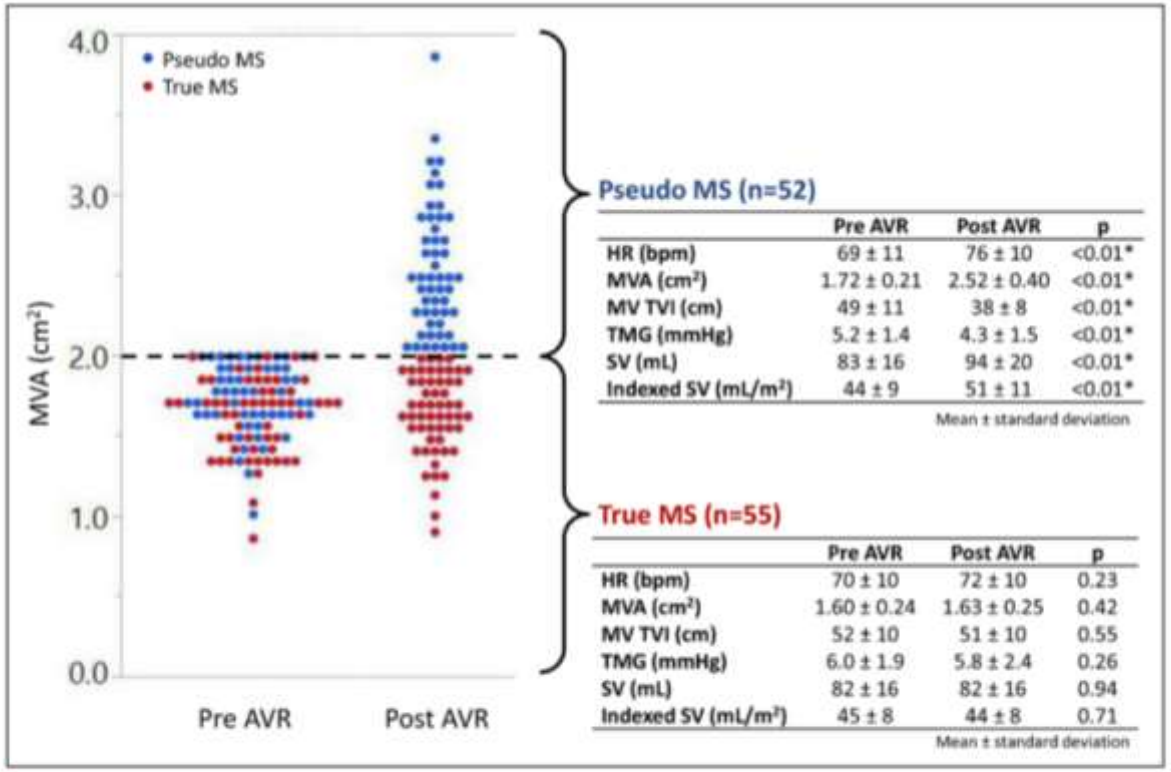


Calcified MS
(MG≥ 5mmhg)



Mesnier et al. Am J Cardiol 2021; 155:103-112

MS severity is overestimated in 50% of the pts before TAVR improved SV after TAVR : pseudo severe MS



Pseudo MS (n=52)

	Pre AVR	Post AVR	p
HR (bpm)	69 ± 11	76 ± 10	<0.01*
MVA (cm²)	1.72 ± 0.21	2.52 ± 0.40	<0.01*
MV TVI (cm)	49 ± 11	38 ± 8	<0.01*
TMG (mmHg)	5.2 ± 1.4	4.3 ± 1.5	<0.01*
SV (mL)	83 ± 16	94 ± 20	<0.01*
Indexed SV (mL/m²)	44 ± 9	51 ± 11	<0.01*

Mean ± standard deviation

True MS (n=55)

	Pre AVR	Post AVR	p
HR (bpm)	70 ± 10	72 ± 10	0.23
MVA (cm²)	1.60 ± 0.24	1.63 ± 0.25	0.42
MV TVI (cm)	52 ± 10	51 ± 10	0.55
TMG (mmHg)	6.0 ± 1.9	5.8 ± 2.4	0.26
SV (mL)	82 ± 16	82 ± 16	0.94
Indexed SV (mL/m²)	45 ± 8	44 ± 8	0.71

Mean ± standard deviation

Figure 1. Hemodynamics of true mitral stenosis (MS) and pseudo MS.
In 107 patients with mitral valve area (MVA) ≤2.0 cm² at baseline, MVA increased to >2.0 cm² after aortic valve replacement (AVR) in 52 patients (pseudo MS), whereas it remained ≤2.0 cm² in 55 patients (true MS). *P<0.05 before AVR vs after AVR. HR indicates heart rate; MV TVI, mitral valve time-velocity integral; SV, stroke volume; and TMG, transmitral gradient.

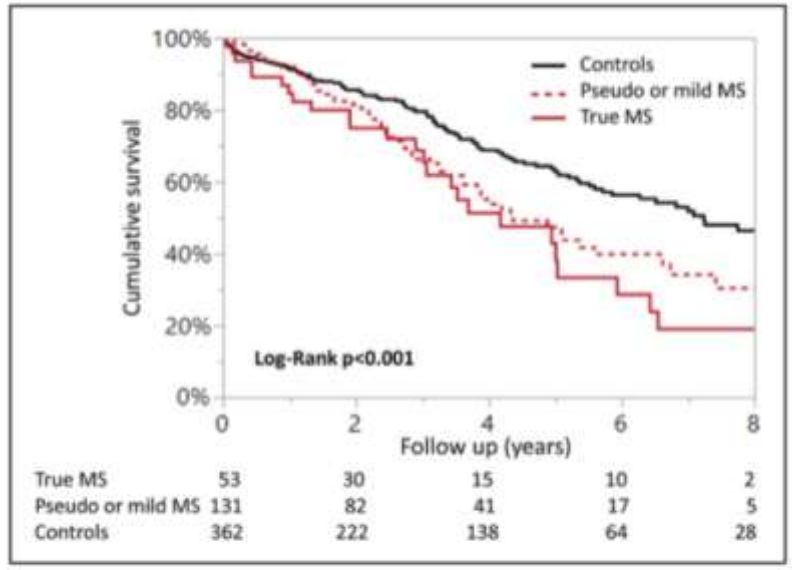
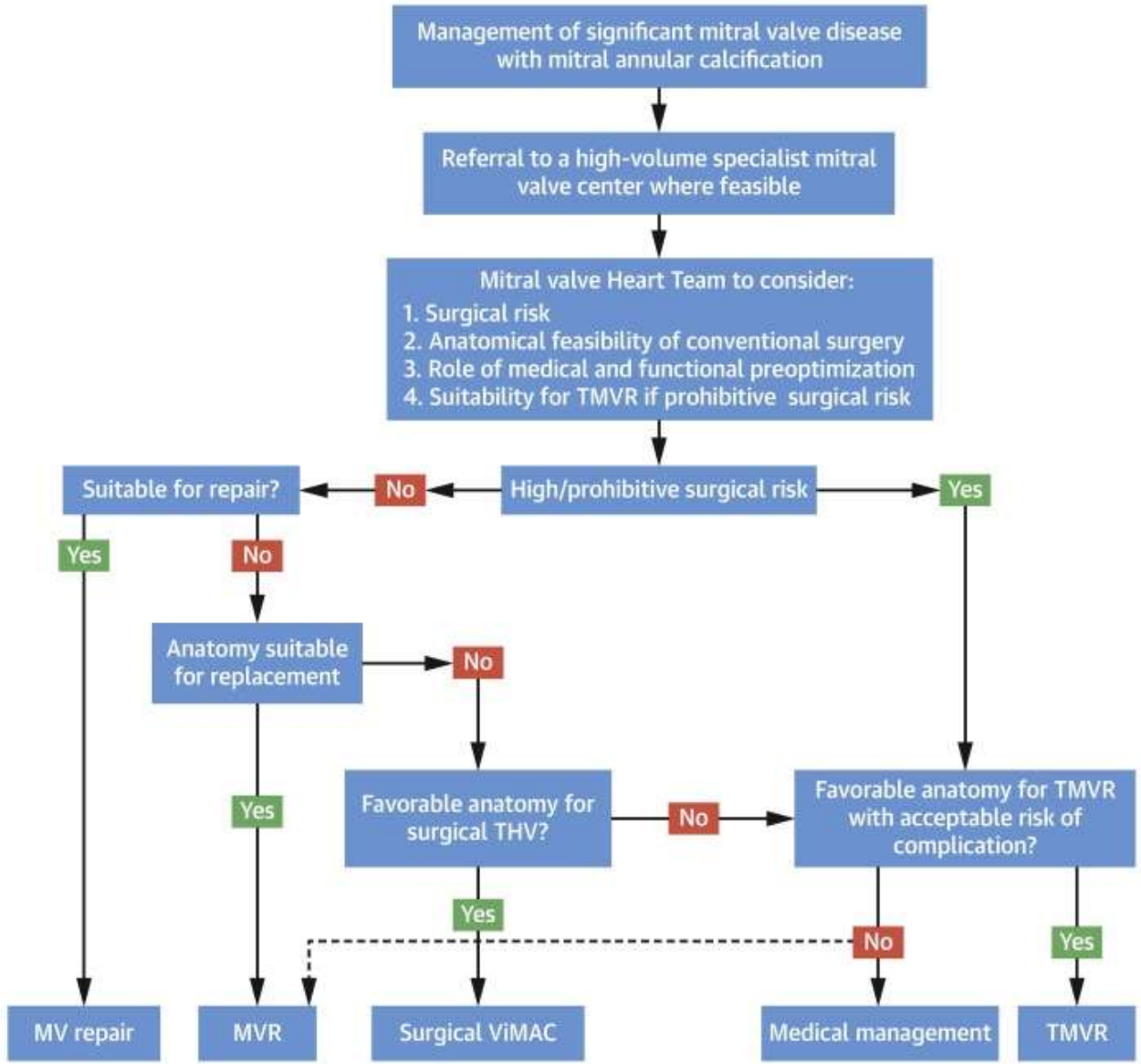


Figure 3. Kaplan–Meier curves for all-cause mortality in patients with severe aortic stenosis with and without mitral stenosis (MS).
True MS and pseudo or mild MS were associated with higher overall mortality compared with the absence of MS.

Circulation. 2019;140:1251–1260.

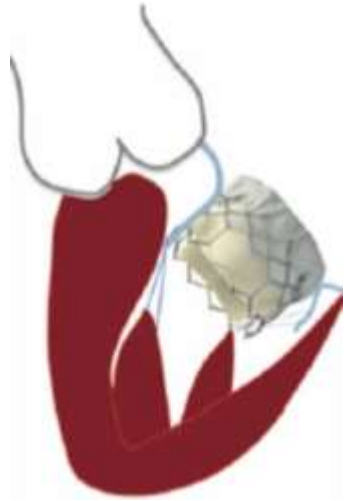
CENTRAL ILLUSTRATION: Proposed Treatment Algorithm for Patients With Mitral Annular Calcification Requiring Valve Intervention

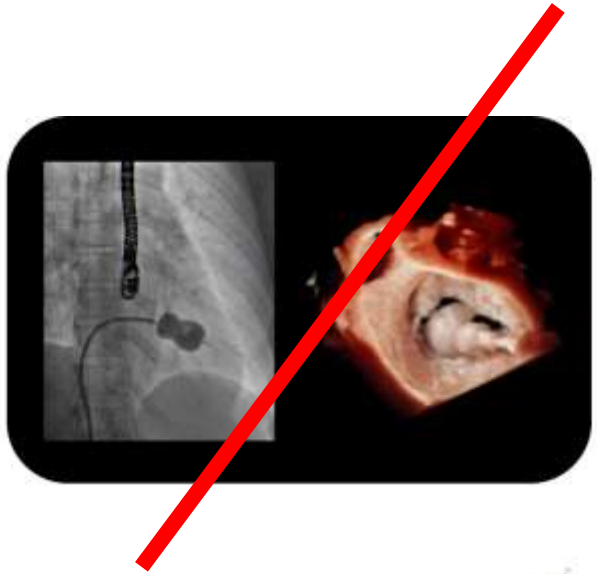


Chehab O, et al. J Am Coll Cardiol. 2022;80(7):e008425.

MAC: quelles options thérapeutiques ?

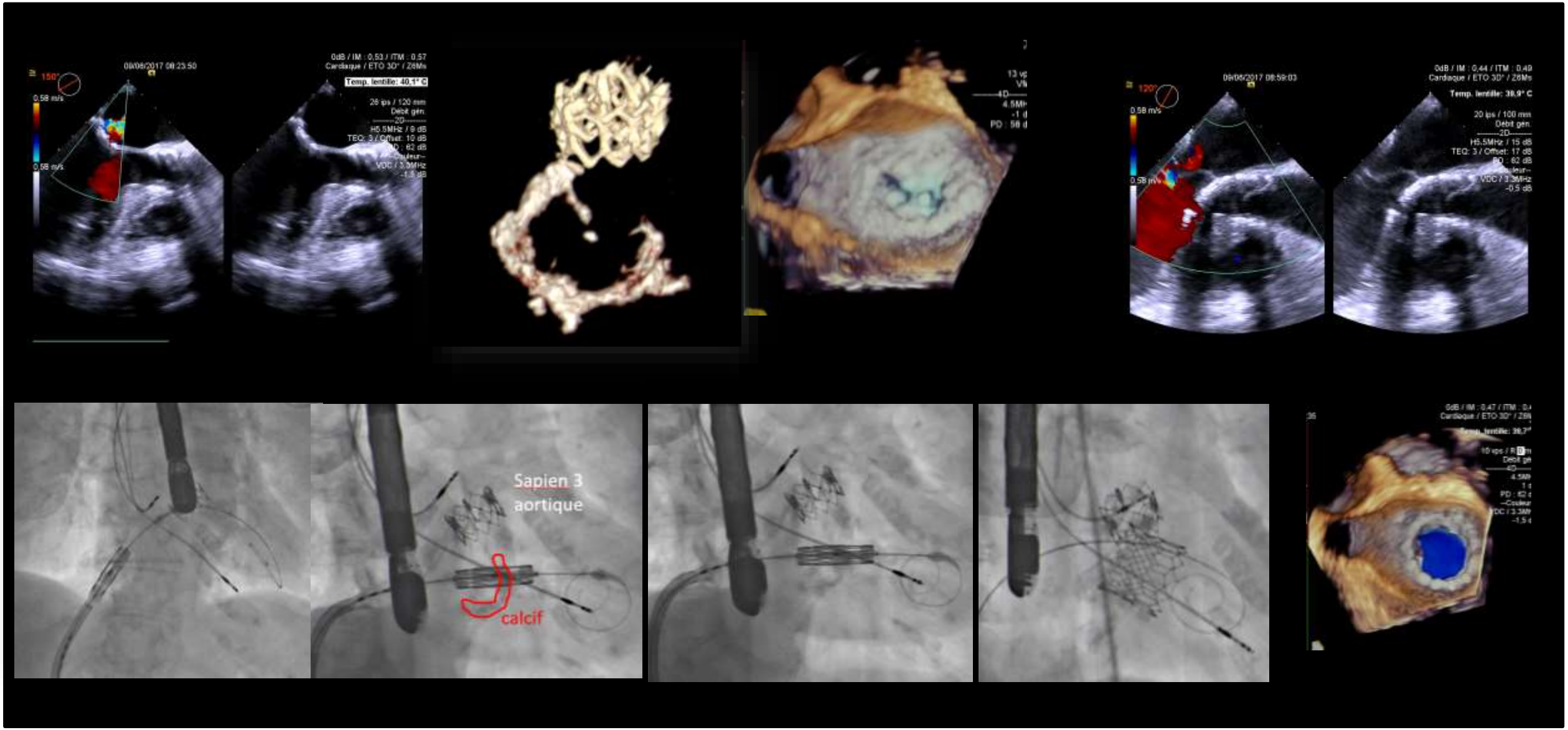
Rupture d'anneau
Fuite paraprothétique
Risque opératoire double valve



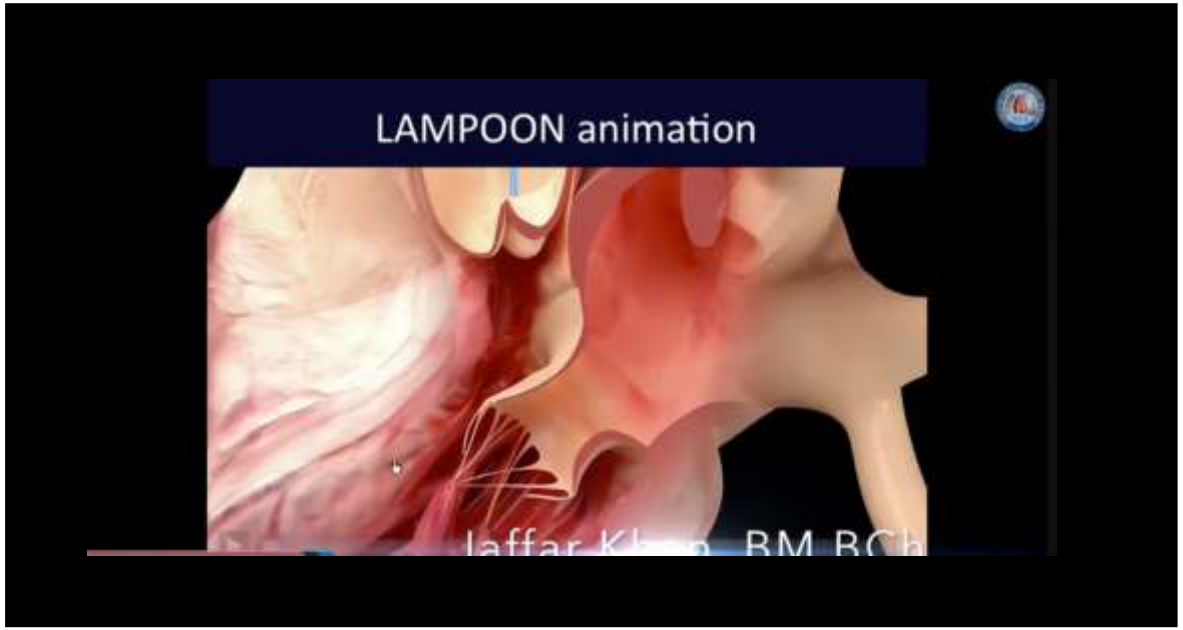


Décès
Embolisation
AVC
LVOT obstruction
Fuite paraprothétique

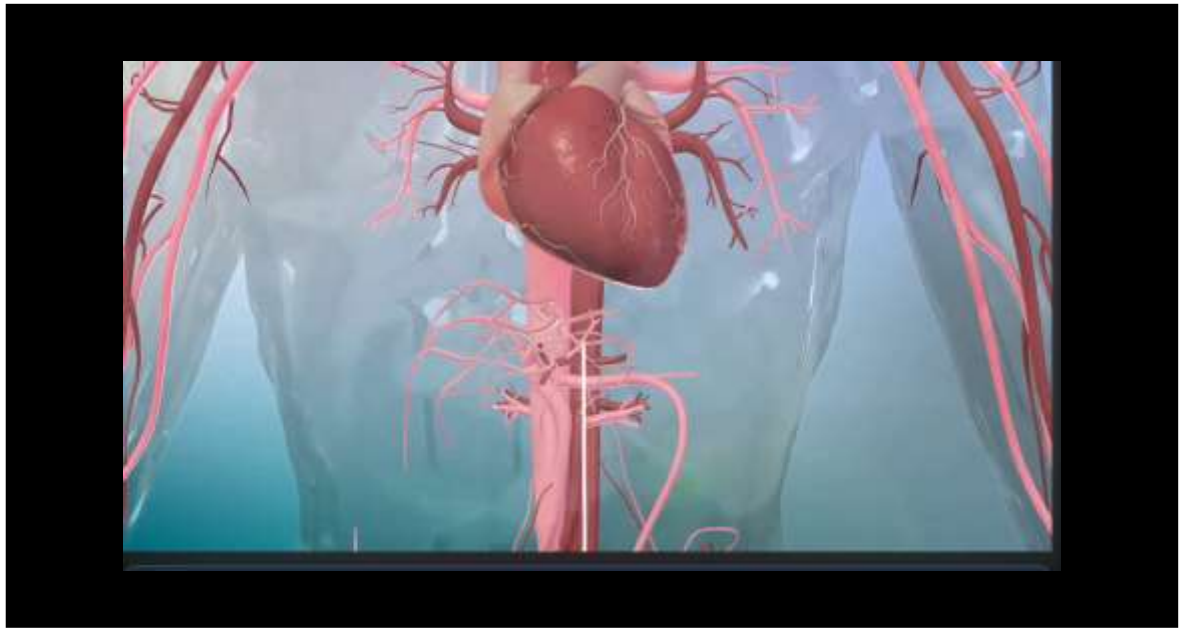
83 ans , atcd de TAVI / RM calcifié serré . Dyspnée stade III



Gestes associés?

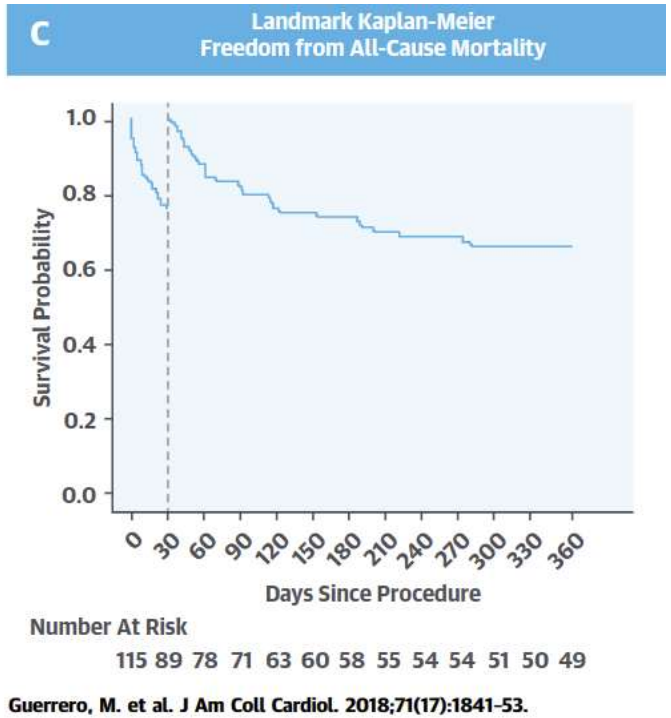


Lacération valve antérieure



Alcoolisation septale

Results of TMVR in MAC



Guerrero, M. et al. J Am Coll Cardiol. 2018;71(17):1841-53.

N=116
30 day mortality: 25% !
1 year mortality: 53% !

Futility?

L'évaluation de….peut être modifiée					
En présence de ….		RAC	Iao	RM	IM
	RAC		PHT	PHT Sous estimation de la sévérité du RM par le pht Planimétrie Eq de cont	Majoration du jet couleur PISA ++
	Iao	Bernoulli (gradient) AVA V max +++		PHT Eq de continuité	Méthode volumetrique
	RM	RAC Bas débit bas gradient+++ (attention avec valvuloplastie au ballon de ne pas sous estimer le RAC+++)	Le RM masque l'hyperdebit de l'IAO		-
	IM	RAC Bas débit bas gradient Ne pas confondre flux RAC / IM	PHT	PHT Eq de continuité	

Objectifs pédagogiques 9 janvier 2024

- Connaitre la problématique des associations de valvulopathies
- Evaluation du RAC en situation hémodynamique complexe
- Mieux connaitre la problématique des calcifications mitrales
- Connaitre les stratégies de prise en charge

  (chir vs percutané, par étape ou complète…)
- Connaitre le déroulement d'une procédure de TAVI en 2023

A.C.C.A.

MERCI !