

# Dysfonction de prothèse valvulaire

Février 2026

Dr Manon Canevet

Anesthésiste Réanimateur – CTCV CHU Nantes



# Prothèses valvulaires ?

chirurgicales

percutanées

biologiques

Fémoral

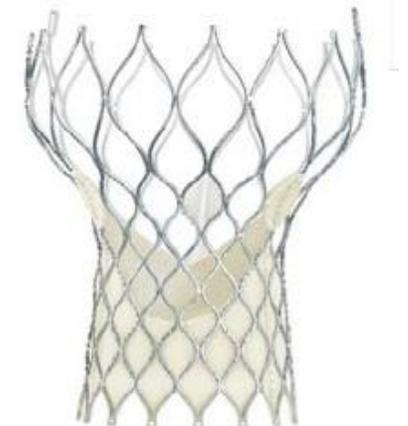
Carotidien

Apical



**SAPIEN 3**

*Edwards*



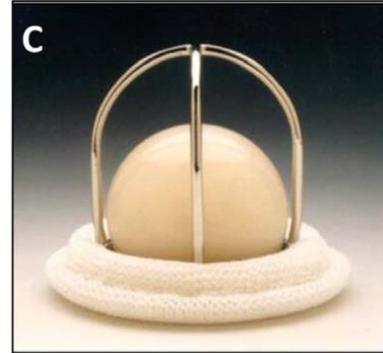
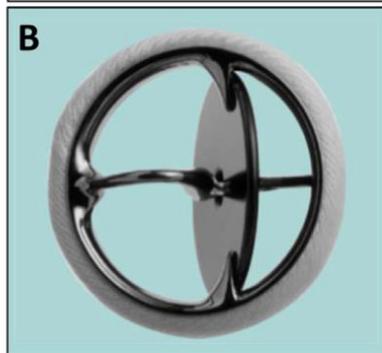
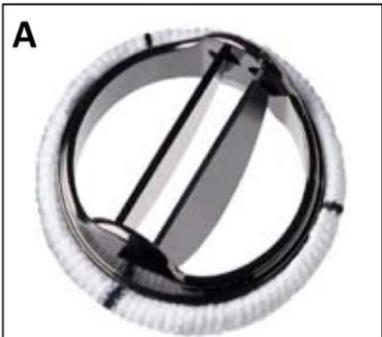
**CoreValve**

*Medtronic*

# Prothèses valvulaires ?

chirurgicales

mécaniques



Double ailette

Simple ailette

« cage ball »

*St Jude Medical, Carbomedics, On-X ...*

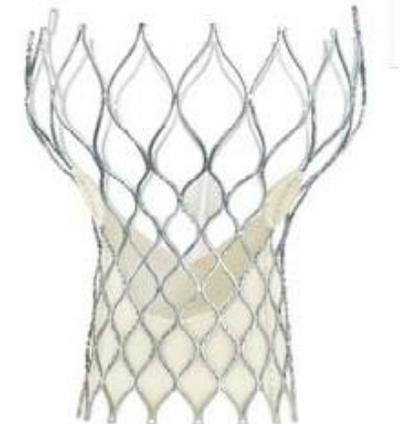
percutanées

biologiques



**SAPIEN 3**

*Edwards*



**CoreValve**

*Medtronic*

Fémoral

Carotidien

Apical

# Prothèses valvulaires ?

chirurgicales

Biologiques

percutanées

biologiques

Stentées

non stentées

Fémoral

Carotidien

Apical



Avalus

trifecta

F

Perceval

SAPIEN 3

CoreValve



Magna Ease

freestyle

Edwards

Medtronic

# Comment choisir ?

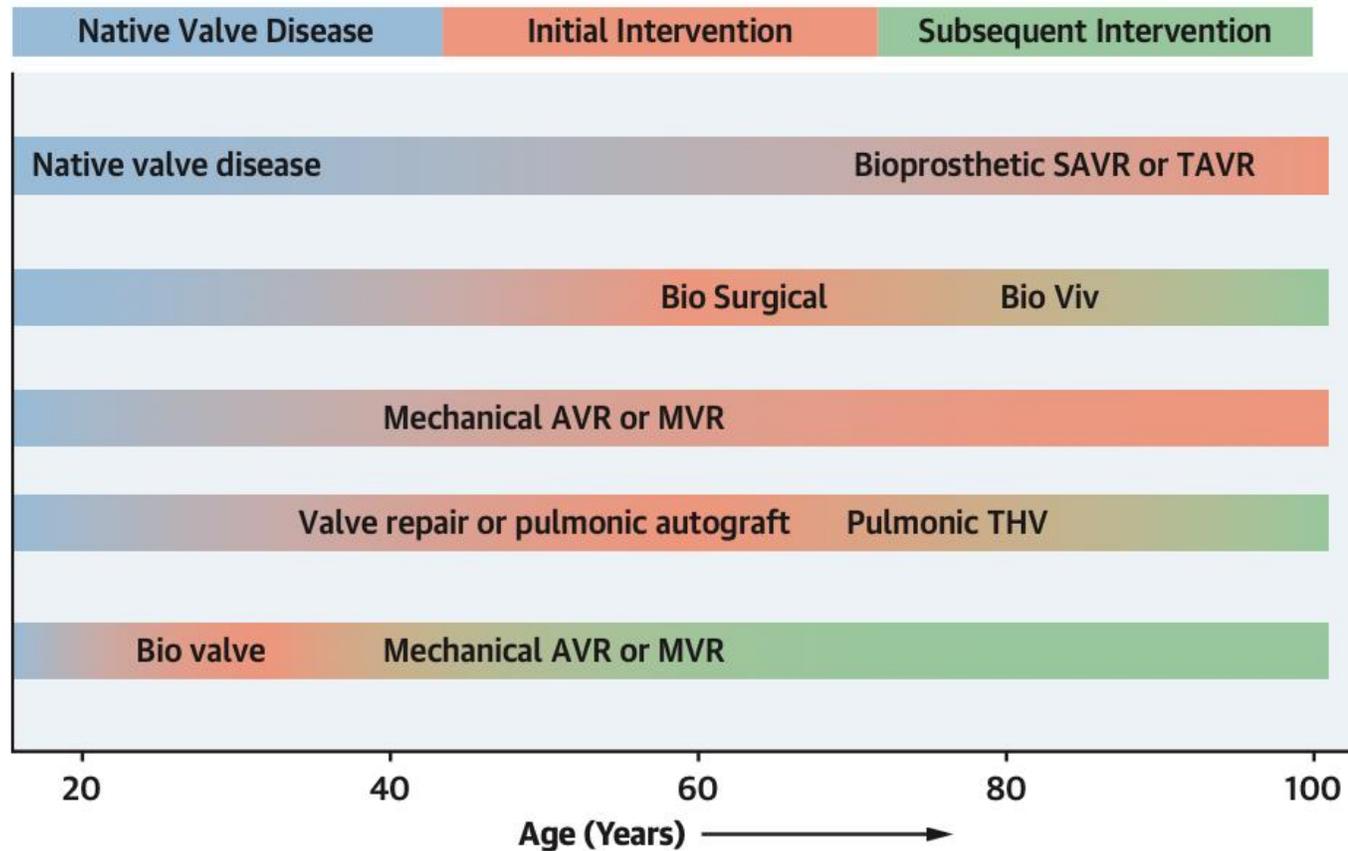
Anticoagulation

Morphologie (SC)

Age

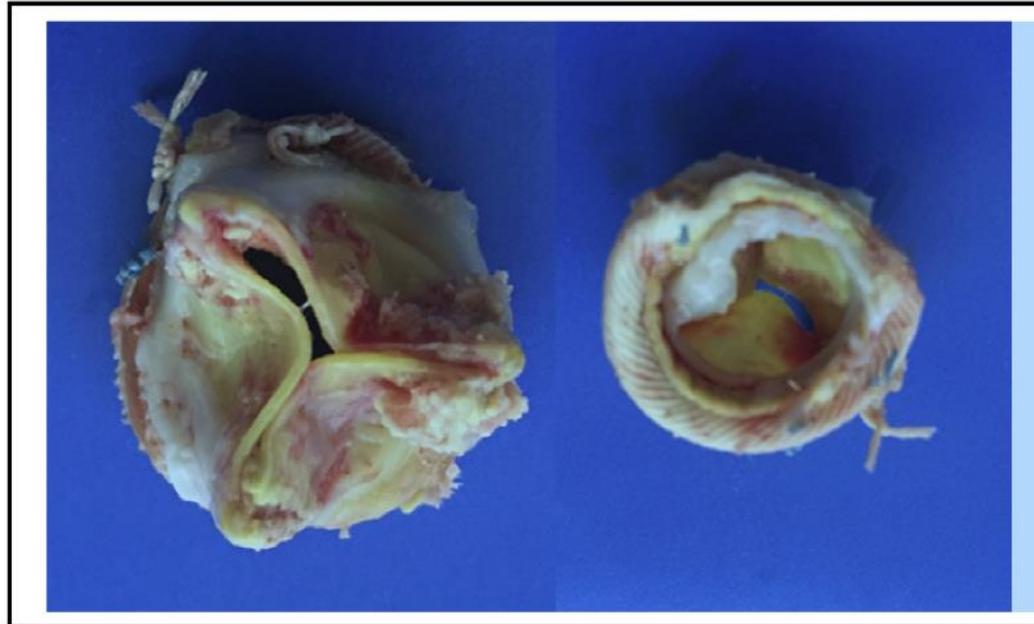
Antécédents du patient

Caractéristiques de la valve



*Standardized definitions for bioprosthetic Valve dysfunction following aortic or mitral valve replacement, JACC, state of art review, Pibarot et al 2022*

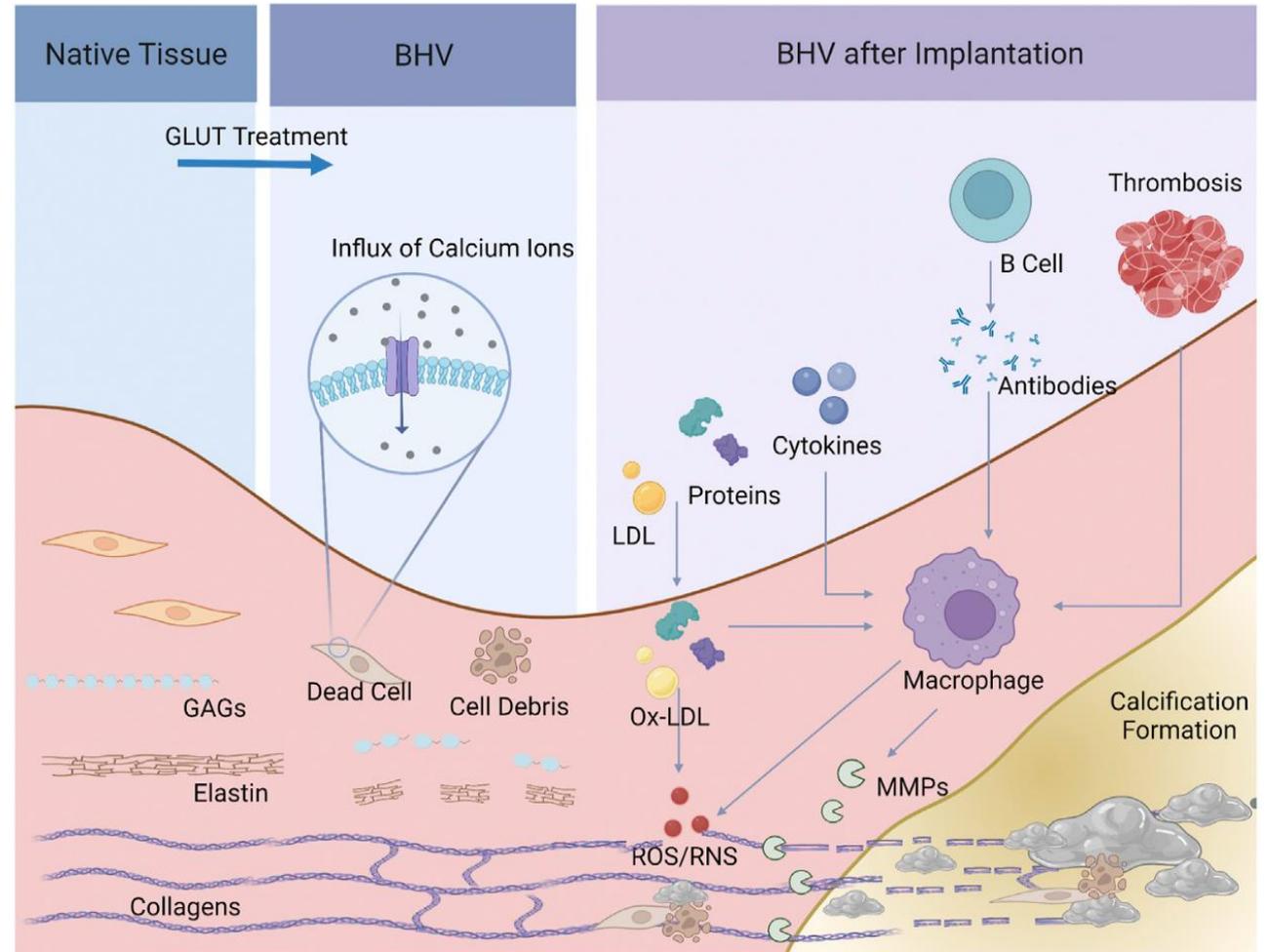
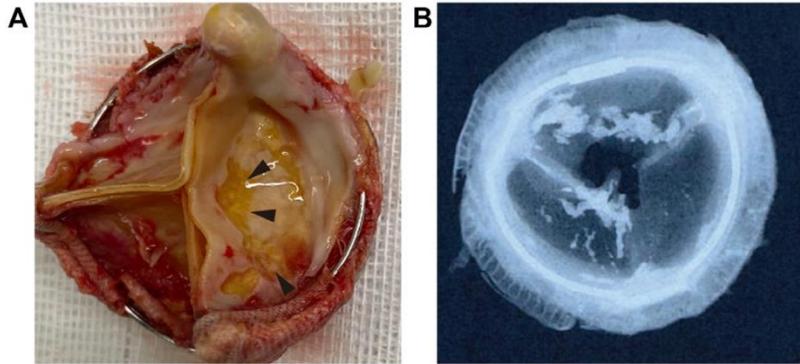
# Comment choisir ?



Explanted Trifecta valve with structural degeneration in inflow and outflow portions.

Early Trifecta valve failure: Report of a cluster of cases from a tertiary care referral center Kalra et al 2017 by The American Association for Thoracic Surgery

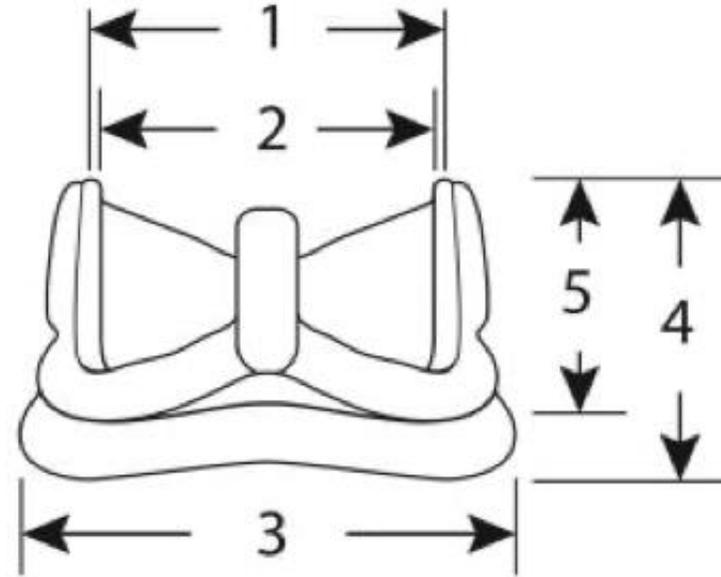
# Comment choisir ?



*Mechanisms and Drug Therapies of Bioprosthetic Heart Valve Calcification, Frontiers in pharmacology, Wen et al, 2022*

*The role of antibody responses against glycans in bioprosthetic heart valve calcification and deterioration, T senage et al Fev 2022 Nature medicine*

# Comment choisir ?



1

2

3

4

5

Modèle	Référence	Taille valve	Diamètre de l'orifice interne	Diamètre extérieur de l'anneau de suture	Hauteur du profil de la valve	Saillie aortique
AVALUS (modèle 400)	40019	19 mm	17,5 mm	27,0 mm	13,0 mm	11,0 mm
	40021	21 mm	19,5 mm	29,0 mm	14,0 mm	12,0 mm
	40023	23 mm	21,5 mm	31,0 mm	15,0 mm	13,0 mm
	40025	25 mm	23,5 mm	33,0 mm	16,0 mm	14,0 mm
	40027	27 mm	25,5 mm	36,0 mm	17,0 mm	15,0 mm

# Effective orifice area = EOA

Valve aortique

**Table 7** Normal reference values of effective orifice areas for the prosthetic aortic valves

Prosthetic valve size (mm)	19	21	23	25	27	29
Stented bioprosthetic valves						
Mosaic	1.1 ± 0.2	1.2 ± 0.3	1.4 ± 0.3	1.7 ± 0.4	1.8 ± 0.4	2.0 ± 0.4
Hancock II	–	1.2 ± 0.2	1.3 ± 0.2	1.5 ± 0.2	1.6 ± 0.2	1.6 ± 0.2
Carpentier-Edwards Perimount	1.1 ± 0.3	1.3 ± 0.4	1.5 ± 0.4	1.8 ± 0.4	2.1 ± 0.4	2.2 ± 0.4
Carpentier-Edwards Magna	1.3 ± 0.3	1.5 ± 0.3	1.8 ± 0.4	2.1 ± 0.5	–	–
Biocor (Epic)	1.0 ± 0.3	1.3 ± 0.5	1.4 ± 0.5	1.9 ± 0.7	–	–
Mitroflow	1.1 ± 0.2	1.2 ± 0.3	1.4 ± 0.3	1.6 ± 0.3	1.8 ± 0.3	–
Trifecta	1.4	1.6	1.8	2.0	2.2	2.4
Stentless bioprosthetic valves						
Medtronic Freestyle	1.2 ± 0.2	1.4 ± 0.2	1.5 ± 0.3	2.0 ± 0.4	2.3 ± 0.5	–
St Jude Medical Toronto SPV	–	1.3 ± 0.3	1.5 ± 0.5	1.7 ± 0.8	2.1 ± 0.7	2.7 ± 1.0
Prima Edwards	–	1.3 ± 0.3	1.6 ± 0.3	1.9 ± 0.4	–	–
Mechanical valves						
Medtronic-Hall	1.2 ± 0.2	1.3 ± 0.2	–	–	–	–
St Jude Medical Standard	1.0 ± 0.2	1.4 ± 0.2	1.5 ± 0.5	2.1 ± 0.4	2.7 ± 0.6	3.2 ± 0.3
St Jude Medical Regent	1.6 ± 0.4	2.0 ± 0.7	2.2 ± 0.9	2.5 ± 0.9	3.6 ± 1.3	4.4 ± 0.6
MCRI On-X	1.5 ± 0.2	1.7 ± 0.4	2.0 ± 0.6	2.4 ± 0.8	3.2 ± 0.6	3.2 ± 0.6
Carbomedics Standard and Top Hat	1.0 ± 0.4	1.5 ± 0.3	1.7 ± 0.3	2.0 ± 0.4	2.5 ± 0.4	2.6 ± 0.4
ATS Medical <sup>a</sup>	1.1 ± 0.3	1.6 ± 0.4	1.8 ± 0.5	1.9 ± 0.3	2.3 ± 0.8	–

Effective orifice area is expressed as mean values available in the literature. Further studies are needed to validate these reference values.

<sup>a</sup>For the ATS medical valve, the label valve sizes are 18, 20, 22, 24, and 26 mm. High velocities are common in size 19 or 21 prostheses. Adapted with permission from Ref. 7.

# Effective orifice area = EOA

Valve mitrale

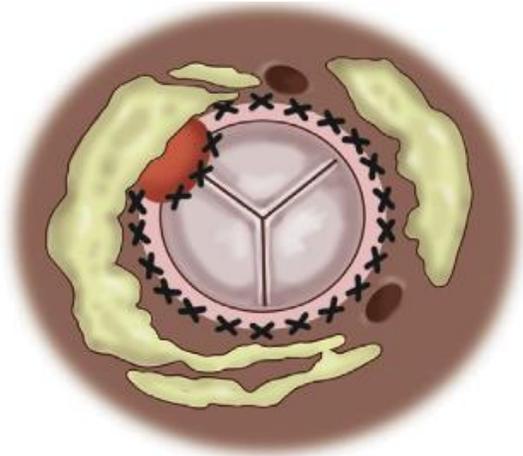
**Table 8** Normal reference values of effective orifice areas for the prosthetic mitral valves

Prosthetic valve size (mm)	25	27	29	31	33
Stented bioprosthetic valves					
Medtronic Mosaic	1.5 ± 0.4	1.7 ± 0.5	1.9 ± 0.5	1.9 ± 0.5	–
Hancock II	1.5 ± 0.4	1.8 ± 0.5	1.9 ± 0.5	2.6 ± 0.5	2.6 ± 0.7
Carpentier-Edwards Perimount	1.6 ± 0.4	1.8 ± 0.4	2.1 ± 0.5	–	–
Mechanical valves					
St Jude Medical Standard	1.5 ± 0.3	1.7 ± 0.4	1.8 ± 0.4	2.0 ± 0.5	2.0 ± 0.5
MCRI On-X <sup>a</sup>	2.2 ± 0.9	2.2 ± 0.9	2.2 ± 0.9	2.2 ± 0.9	2.2 ± 0.9

Effective orifice area is expressed as mean values available in the literature. Further studies are needed to validate these reference values.

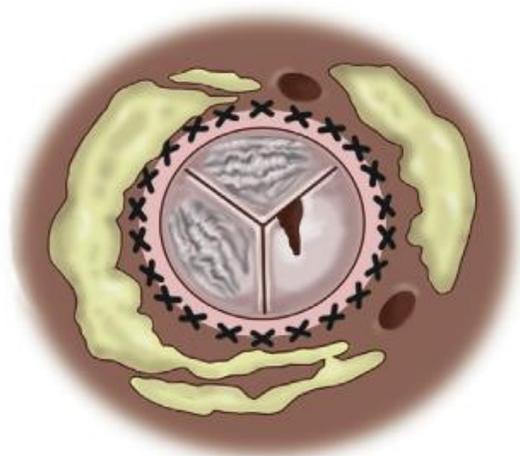
<sup>a</sup>The On-X valve has just 1 size for 27 to 29 and 31 to 33 mm prostheses. In addition, the strut and leaflets are identical for all sizes (25 to 33 mm); only the size of the sewing cuff is different. Adapted with permission from Ref. 7.

# Dysfonction de prothèses



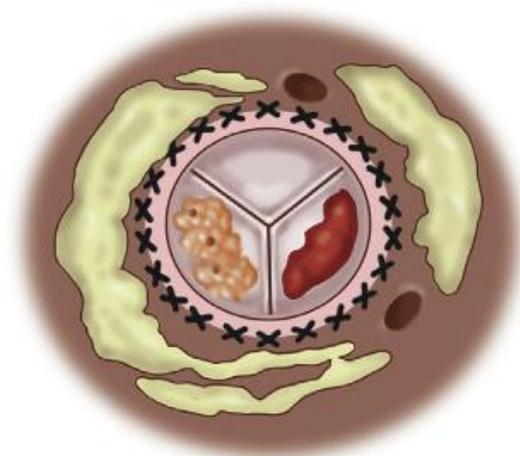
## Structurelles

- Concerne les bioprothèses +++



## Non structurelles

- Mismatch de prothèse (PPM)
- Fuite périprothétiques
- Autres
  - Feuillet attaché
  - Pannus
  - Malposition
  - Dilatation secondaire des cavités cardiaques



## endocardite

## thrombus

- Concerne les valves mécaniques +++

# Paramètres échographiques

= évaluation d'une valve native !

Analyse morphologique

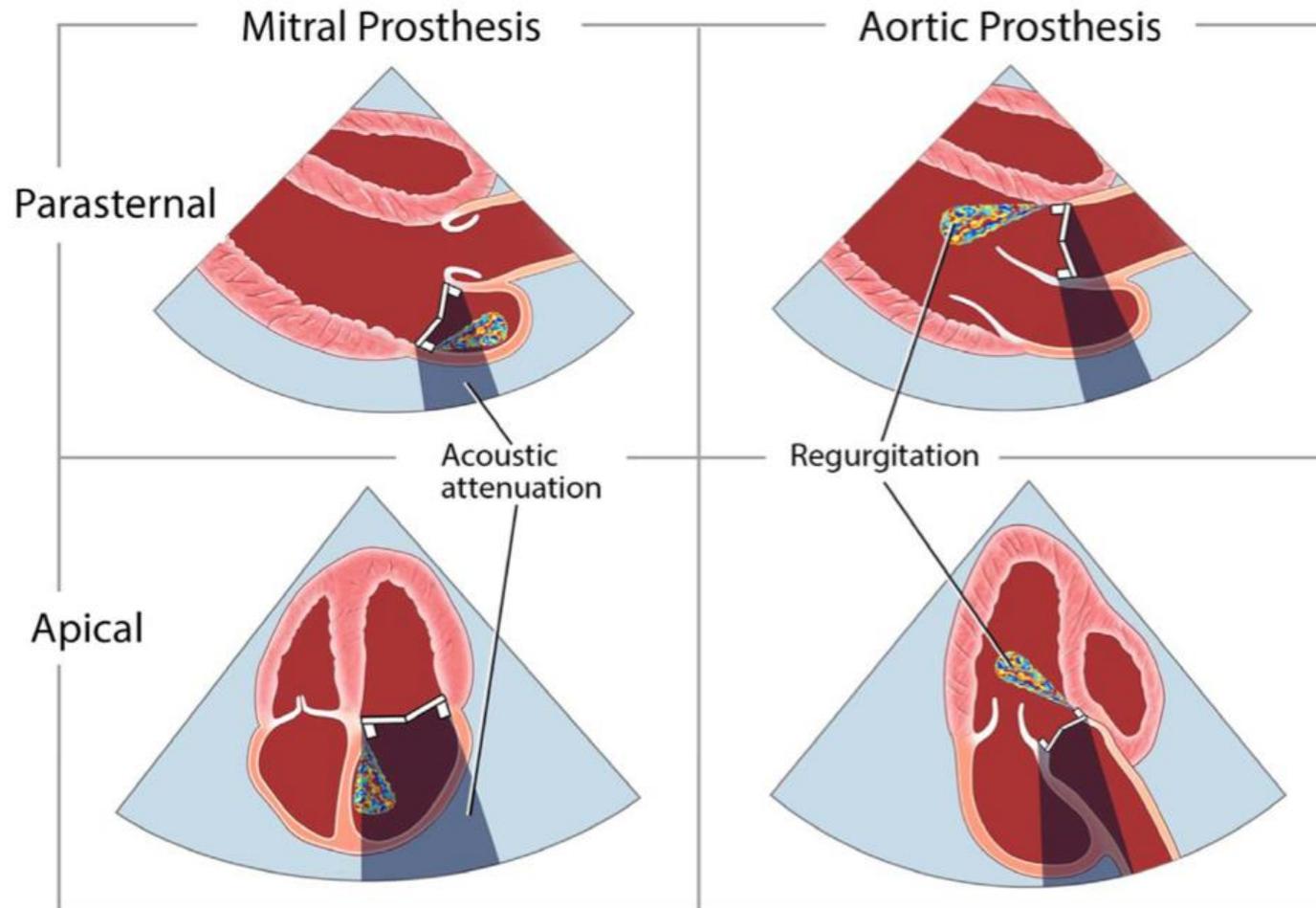
- Mobilité des feuillets / ailettes
- Images d'addition

Analyse hémodynamique

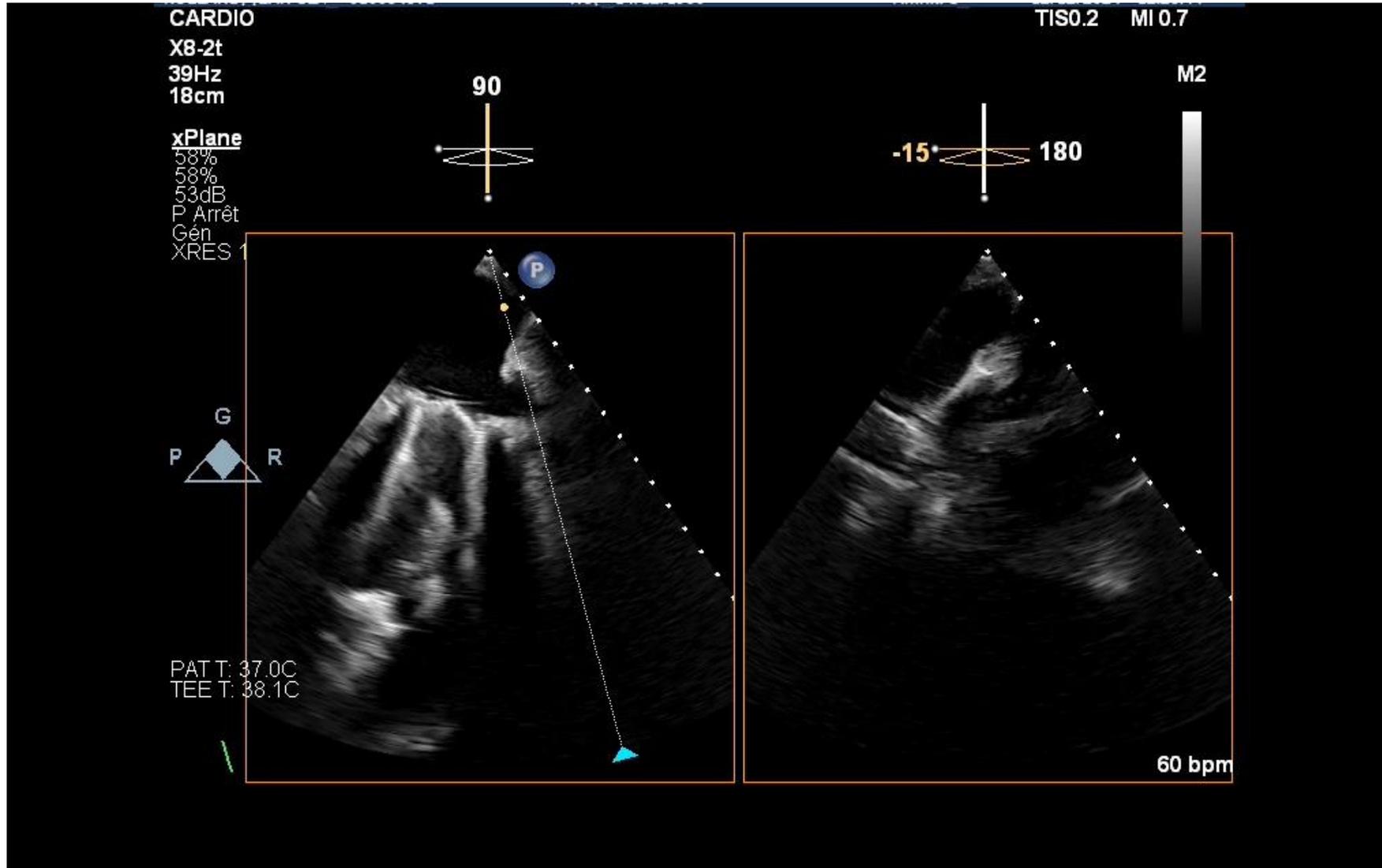
- Aspect du CW
- Temps accélération,  $V_{max}$
- gradient moyen
- Calculer EOA par équation de continuité
- Index de perméabilité (DVI)

Régurgitations

# Cônes d'ombre



# Valve mécanique double ailettes



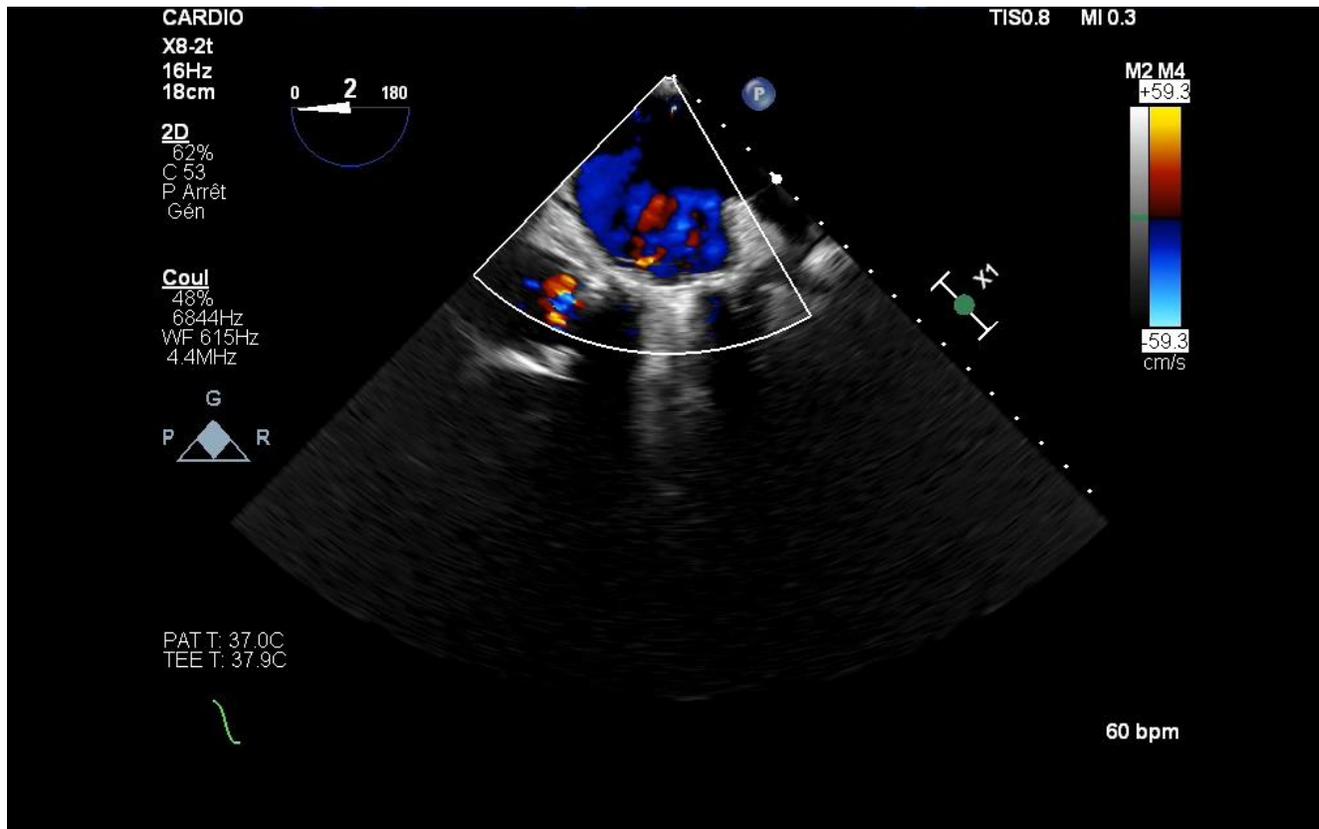
Mouvement des ailettes

# Valve mécanique double ailettes

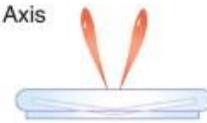


# Valve mécanique double ailettes

Fuite de  
« lavage »



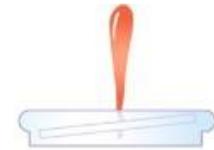
Long Axis



Bi-leaflet Mechanical



Björk-Shirley

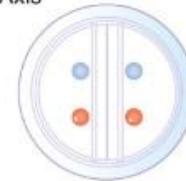


Medtronic-Hall

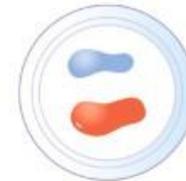


Caged Ball

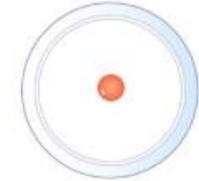
Short Axis



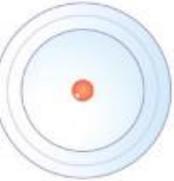
Bi-leaflet Mechanical



Björk-Shirley



Medtronic-Hall

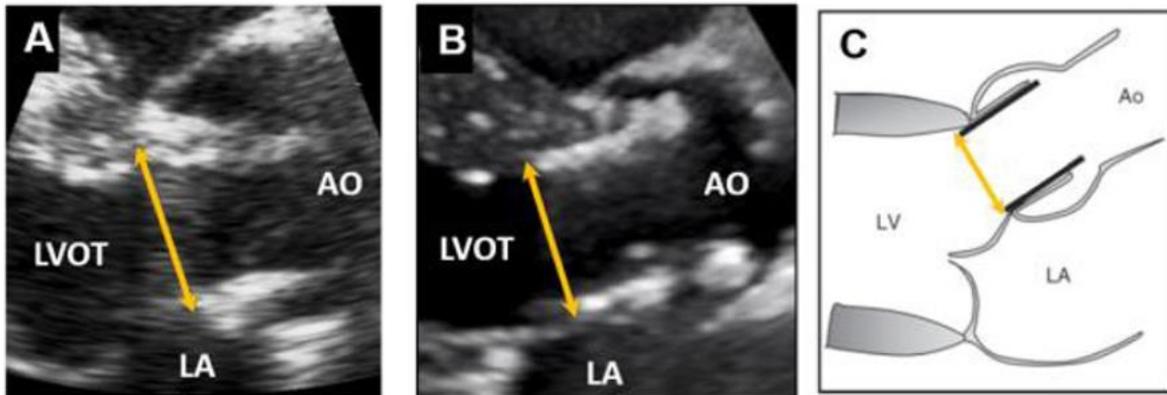


Caged Ball

# Analyse hémodynamique

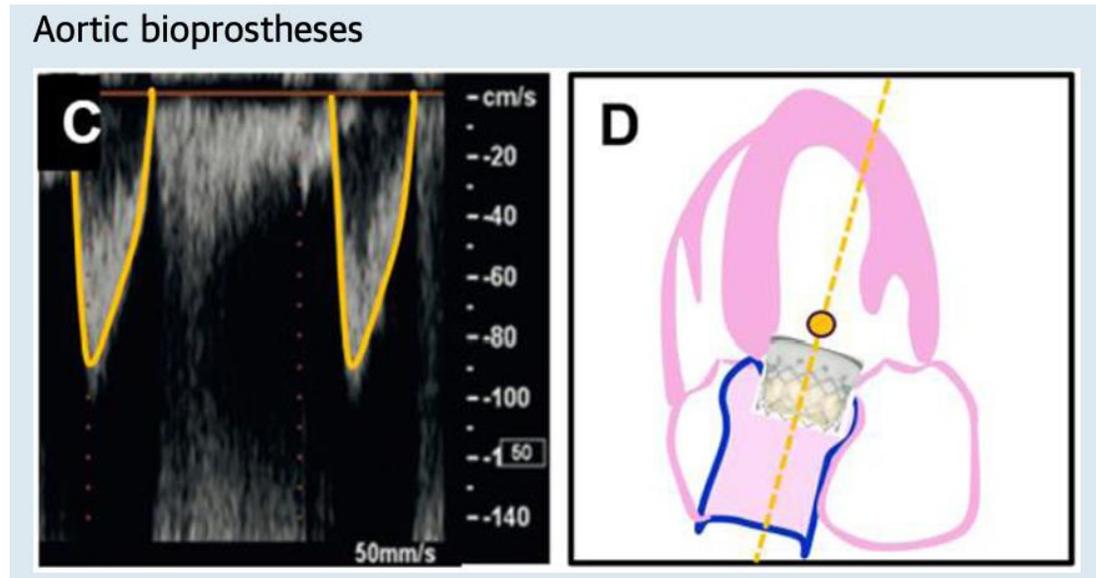
Mesure de la CCVG

Aortic bioprotheses



Externe !

Placer le curseur PW



En amont de la valve

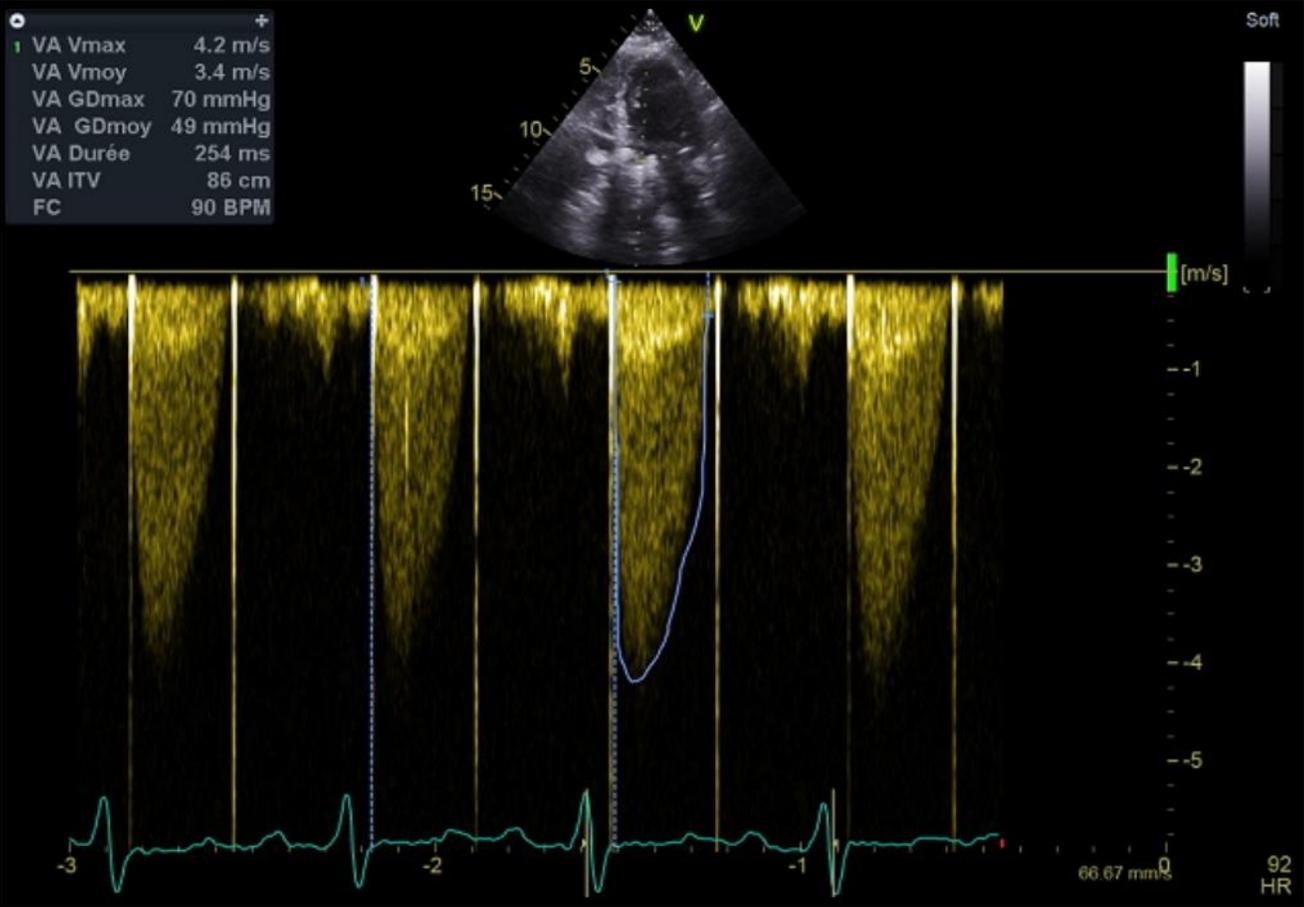
# Analyse hémodynamique

# Mesure du gradient moyen par doppler continu

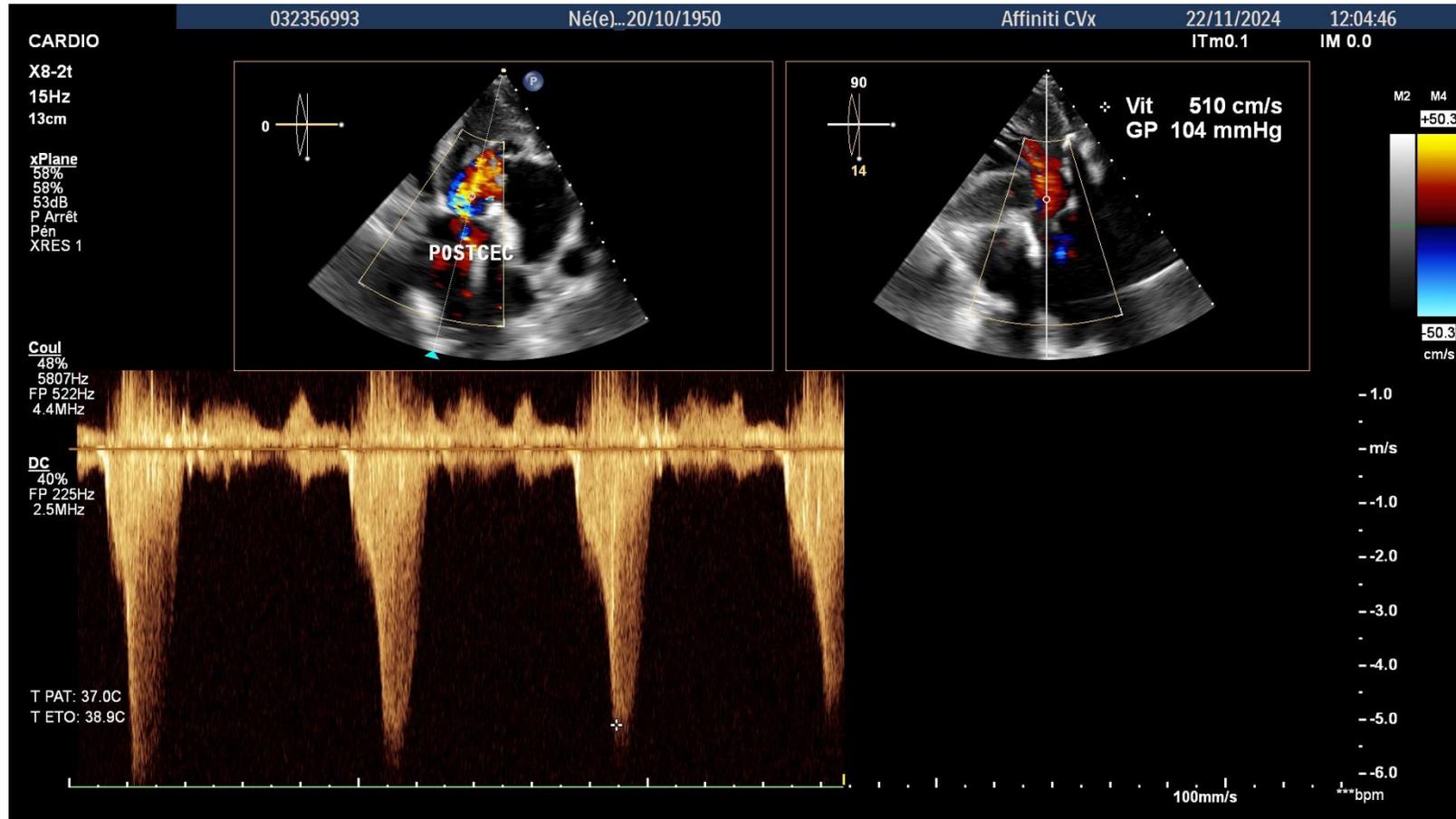
Valeurs normales

**Gm < 20mmHg (Vao)**

**Gm < 5mmHg (VM)**



# Piège = Obstruction sous aortique

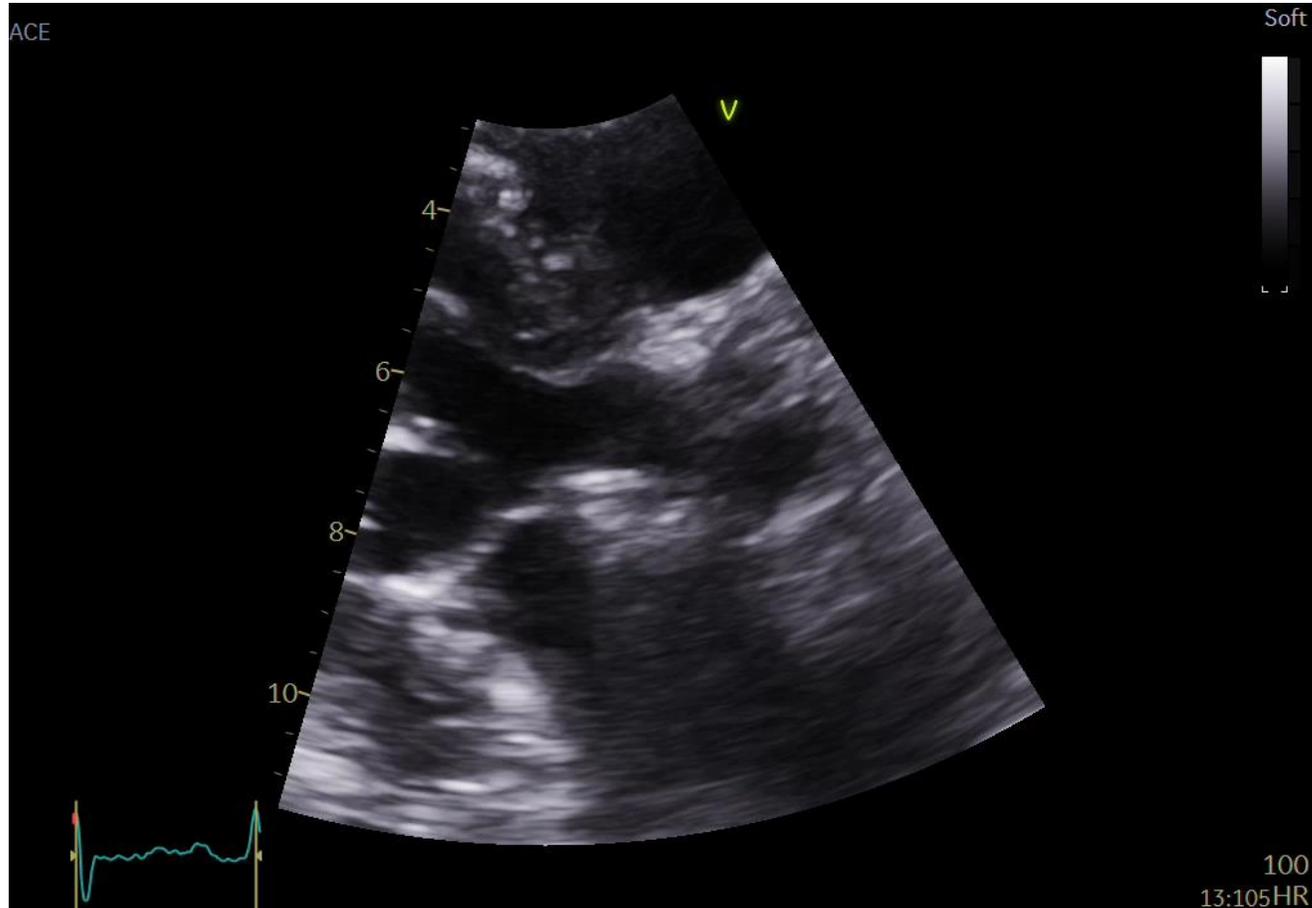


Aspect en lame de sabre

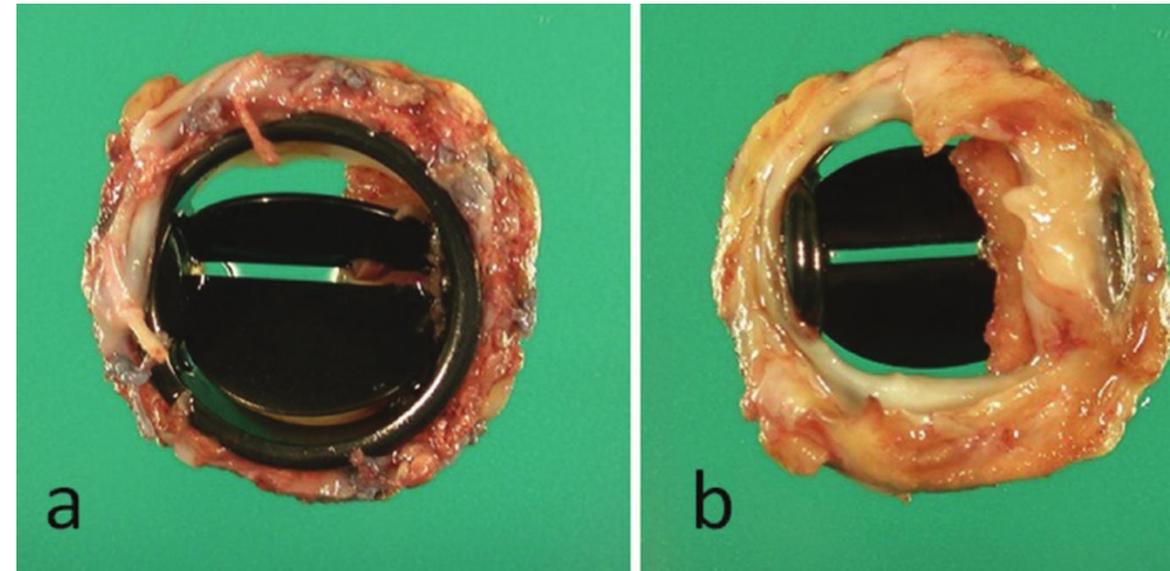
postRVAo biologique

HVG

# Obstruction sous aortique



Pannus



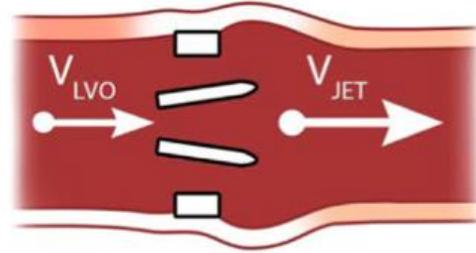
# Analyse hémodynamique

Sténose ?

**DVI (doppler velocity index) = index de perméabilité**

Valeurs normales

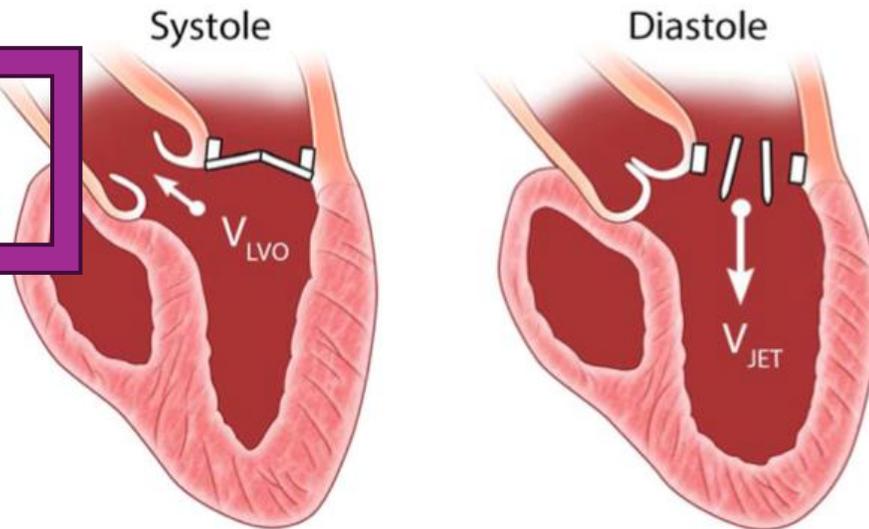
Prosthetic Aortic Valve



$$IP = \frac{ITV_{ssAo} (PW)}{ITV_{Vao} (CW)}$$

**$N \geq 0,35$**

Prosthetic Mitral Valve



$$IP = \frac{ITVMitral(CW)}{ITV_{ssAo} (PW)}$$

**$N < 2,2$**

**Indépendant**

- De la FC
- Du Qc
- Mesure CCVG

# Analyse hémodynamique

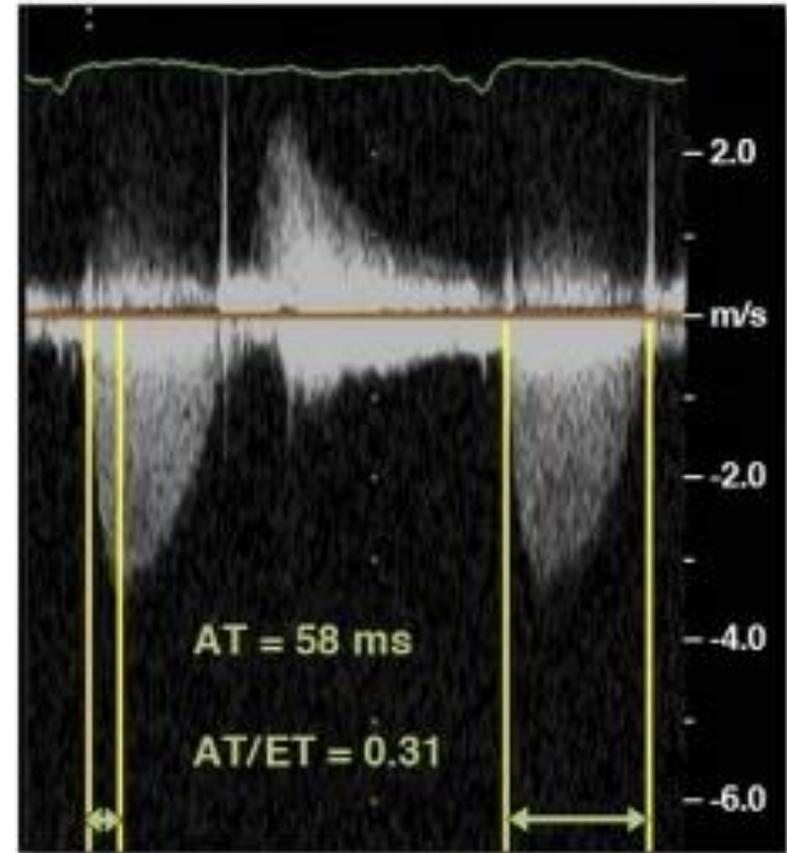
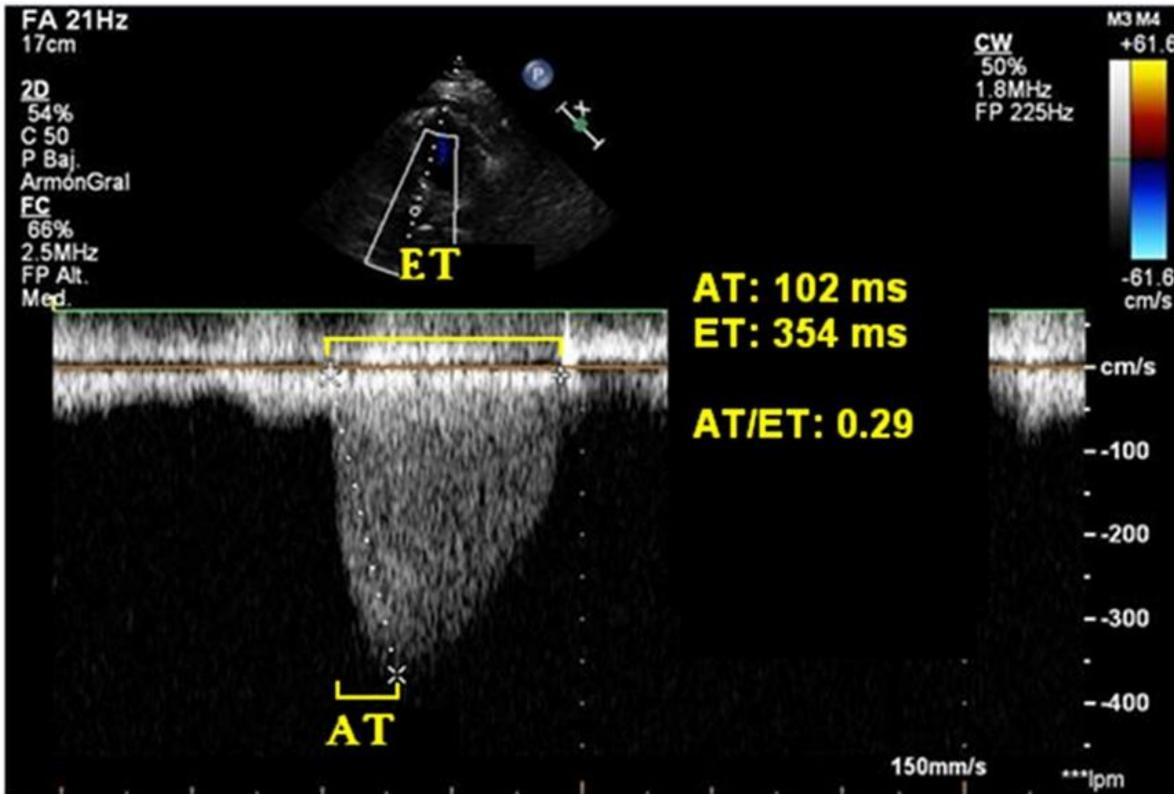
Sténose ?

Temps d'accélération

Arrondi contours  
symétriques  
temps accélération long

vs

Triangulaire  
Pic précoce  
Temps accélération court



Acceleration Time

Ejection Time

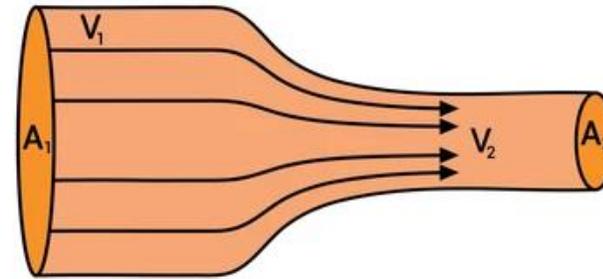
Attention TA faussement élevé en cas de bas débit

# Analyse hémodynamique

Sténose ?

EOA = effective orifice area

→ Équation de continuité



$$A_1 V_1 = V_2 A_2$$

$$\text{EOA}_{\text{aortique}} = \frac{\text{ITV}_{\text{ssAo}} (\text{PW}) \times \text{diamètre CCVG} \times \text{Pi} \times 0,785}{\text{ITV VAo} (\text{CW})}$$

**N > 1,1 cm<sup>2</sup>**

$$\text{EOA}_{\text{mitrale}} = \frac{\text{ITV}_{\text{ssAo}} (\text{PW}) \times \text{D CCVG} \times \text{Pi} \times 0,785}{\text{ITV mitral} (\text{CW})}$$

**N ≥ 2,2 cm<sup>2</sup>**

*!!peu fiable Si FA ou IAO associée*

## PROTHESE AORTIQUE

- $V_{max} > 3\text{m/s}$
- $G_m > \text{ou} = 20\text{mmHg}$
- $EOA < 1,1\text{cm}^2$
- $DVI < 0,25$
- $AT > 100\text{ms}$
- $AT/LVET > 0,4$

« RED FLAG »

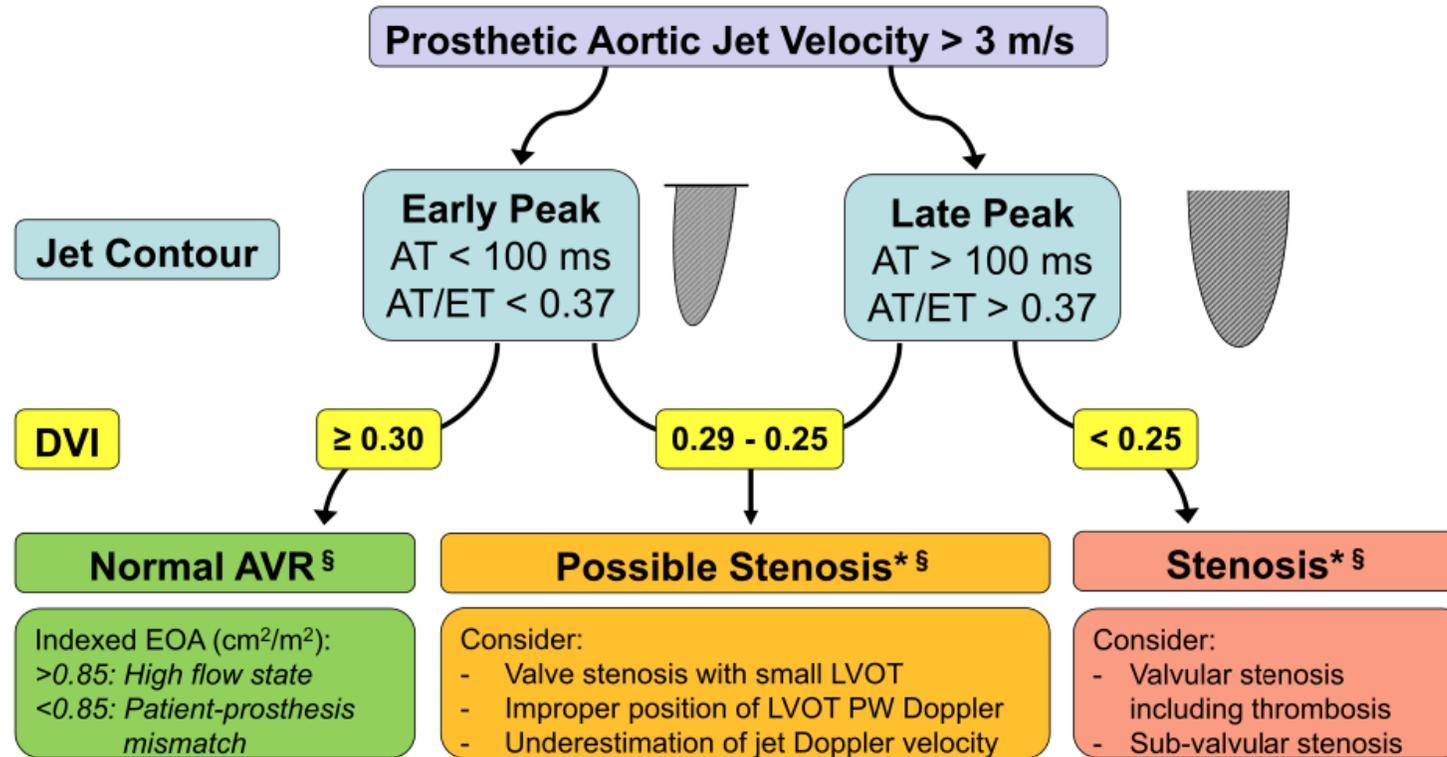


## PROTHESE MITRALE

- $V_{max} \text{ onde E} > 1,9\text{m/s}$
- $G_m > \text{ou} = 5\text{mmHg}$
- $EOA < 2,0\text{cm}^2$
- $DVI > \text{ou} = 2,2$
- $PHT > 130\text{ms}$

**Table 5** Doppler parameters of prosthetic valves in the aortic valve position

	Normal	Possible stenosis	Suggests significant stenosis
Appropriate for all prosthetic aortic valves			
Jet velocity contour*	Triangular, early peaking	Triangular to intermediate	Rounded, symmetric
Acceleration time, msec*	<80	80-100	>100
Acceleration time/LV ejection time ratio	<0.32	0.32-0.37	>0.37
Peak velocity, m/sec <sup>†‡</sup>	<3	3-4	≥4
Specific AVR considerations			
SAVR			
Mean gradient, mm Hg <sup>†</sup>	<20	20-34	≥35
DVI <sup>§¶</sup>	>0.35	0.25-0.35	<0.25
EOA <sup>§</sup>	Reference EOA ± 1 SD	1 SD smaller than reference EOA	2 SDs smaller than reference EOA
TAVI (change from baseline)			
Mean gradient <sup>†</sup>	Change <10 mm Hg from baseline <sup>†</sup>	Increase of 10-19 mm Hg from baseline	Increase ≥20 mm Hg from baseline
DVI <sup>§¶</sup>	Change <0.1 or 20% from baseline <sup>  </sup>	Decrease 0.1-0.19 or 20%-39% from baseline <sup>  </sup>	Decrease ≥0.2 or ≥40% from baseline <sup>  </sup>
EOA <sup>§</sup>	Change <0.3 cm <sup>2</sup> or 25% from baseline <sup>  </sup>	Decrease of 0.3-0.59 cm <sup>2</sup> or 25%-49% from baseline <sup>  </sup>	Decrease ≥0.6 cm <sup>2</sup> or ≥50% from baseline <sup>  </sup>



\* Valve stenosis is further substantiated by EOA compared to respective reference values of similar valve type and size.  
 § Assessment of mechanical valve motion: fluroscopy & CT > TEE; Etiology of Valve stenosis: CT angiography & TEE > CMR.

# PROTHESE MITRALE

**Table 11** Doppler findings suggestive of prosthetic mitral valve stenosis

	Normal*	Possible stenosis <sup>†</sup>	Suggests significant stenosis* <sup>†</sup>
Peak velocity, m/sec <sup>‡§</sup>	<1.9	1.9-2.5	≥2.5
Mean gradient, mm Hg <sup>‡§</sup>	≤5	6-10	>10
VTI <sub>PrMv</sub> /VTI <sub>LVOT</sub> <sup>‡§</sup>	<2.2	2.2-2.5	>2.5
EOA, cm <sup>2</sup>	≥2.0	1-2	<1
PHT, msec	<130	130-200	>200

!! Aussi présent en cas de fuite

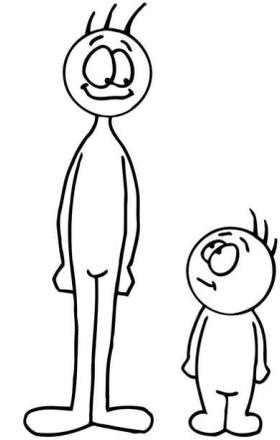
!! Gradient augmenté → attention à l'hyperdébit

*fuite*

*Obstruction*

*PHT dpt FC/compliance VG/OG*

# PPM = mismatch patient/prothèse



- Étape 1 : SC du patient
- Étape 2 : x 0,85cm<sup>2</sup>/m<sup>2</sup> (aortique) x1,2cm<sup>2</sup>/m<sup>2</sup> (mitrale)

## AORTIQUE

If BMI <30 kg/m <sup>2</sup>		If BMI ≥30 kg/m <sup>2</sup>	
Severity	Indexed EOA (cm <sup>2</sup> /m <sup>2</sup> )	Severity	Indexed EOA (cm <sup>2</sup> /m <sup>2</sup> )
Insignificant	>0.85	Insignificant	>0.70
Moderate	0.85-0.66	Moderate	0.70-0.56
Severe	≤0.65	Severe	≤0.55

## MITRALE

If BMI <30 kg/m <sup>2</sup>		If BMI ≥30 kg/m <sup>2</sup>	
Severity	Indexed EOA (cm <sup>2</sup> /m <sup>2</sup> )	Severity	Indexed EOA (cm <sup>2</sup> /m <sup>2</sup> )
Insignificant	>1.2	Insignificant	>1.0
Moderate	0.91-1.2	Moderate	0.76-1.0
Severe	≤0.90	Severe	≤0.75

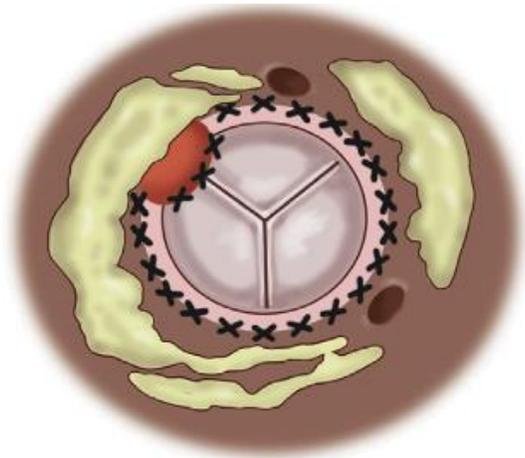
!!! Attention différent chez le patient obèse

aortique

Prosthesis size (mm)	EOAi by Prosthesis size (mm)					
	19	21	23	25	27	29
Average EOA (cm <sup>2</sup> )	1.1	1.3	1.5	1.8	2.3	2.7
<b>BSA (m<sup>2</sup>)</b>						
0.6	1.83	2.17	2.50	3.00	3.83	4.50
0.7	1.57	1.86	2.14	2.57	3.29	3.86
0.8	1.38	1.63	1.88	2.25	2.88	3.38
0.9	1.22	1.44	1.67	2.00	2.56	3.00
1	1.10	1.30	1.50	1.80	2.30	2.70
1.1	1.00	1.18	1.36	1.64	2.09	2.45
1.2	0.92	1.08	1.25	1.50	1.92	2.25
1.3	0.85	1.00	1.15	1.38	1.77	2.08
1.4	0.79	0.93	1.07	1.29	1.64	1.93
1.5	0.73	0.87	1.00	1.20	1.53	1.80
1.6	0.49	0.88	0.88	0.88	0.88	1.69
1.7	0.65	0.76	0.88	1.06	1.35	1.59
1.8	0.61	0.72	0.83	1.00	1.28	1.50
1.9	0.58	0.68	0.79	0.95	1.21	1.42
2	0.55	0.65	0.75	0.90	1.15	1.35
2.1	0.52	0.62	0.71	0.86	1.10	1.29
2.2	0.50	0.59	0.68	0.82	1.05	1.23
2.3	0.48	0.57	0.65	0.78	1.00	1.17
2.4	0.46	0.54	0.63	0.75	0.96	1.13
2.5	0.44	0.52	0.60	0.72	0.92	1.08

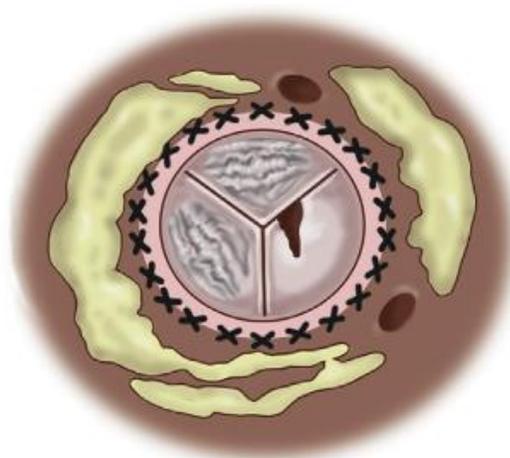
Ex : patient de 190cm 90kg, SC 1,9cm<sup>2</sup>, 1,6 x 0,85 = 1,36cm<sup>2</sup> d'EOA minimum

# Dysfonction de prothèses



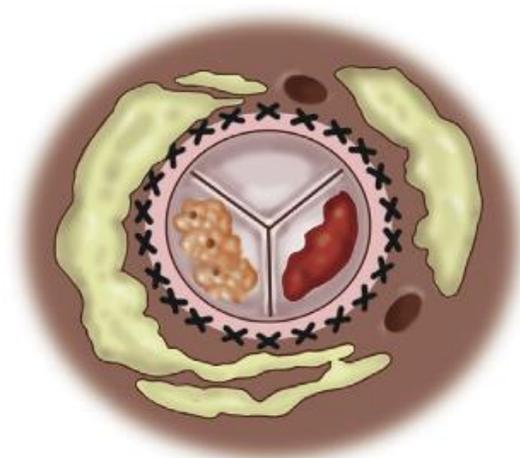
## Structurelles

- Concerne les bioprothèses +++



## Non structurelles

- Mismatch de prothèse (PPM)
- Fuite périprothétiques
- Autres
  - Feuillet attaché
  - Pannus
  - Malposition
  - Dilatation secondaire des cavités cardiaques

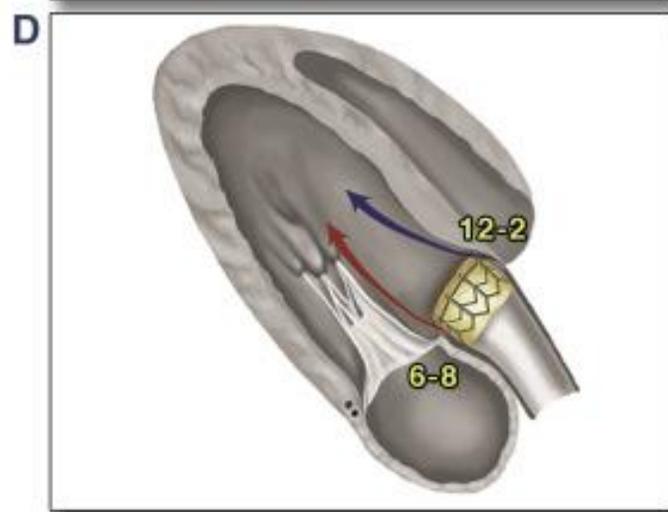
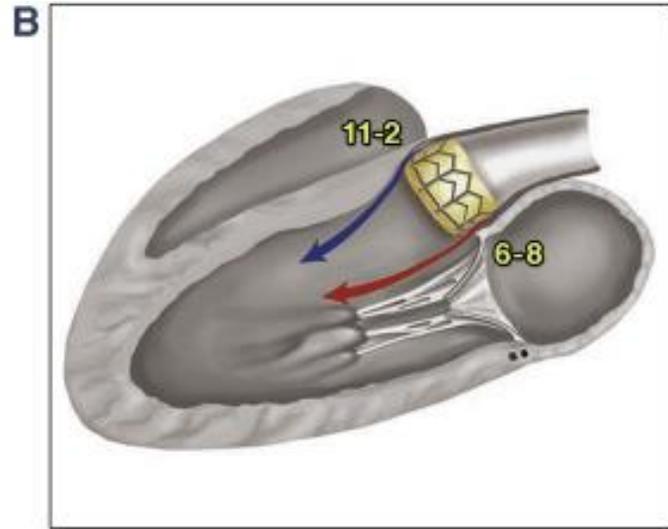
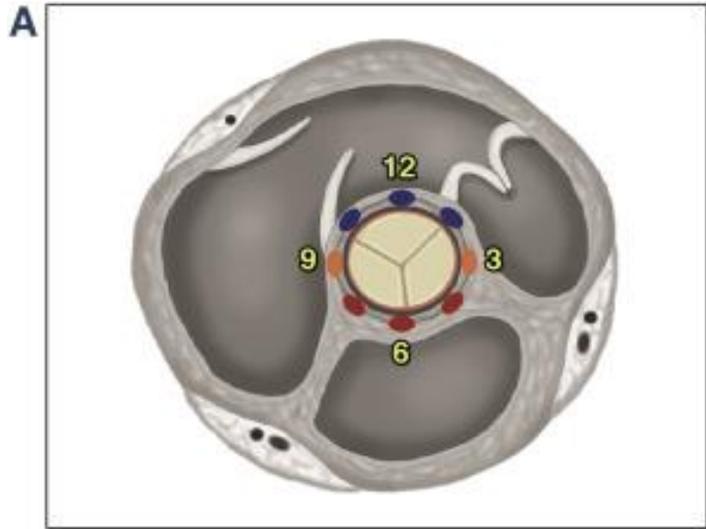


## endocardite

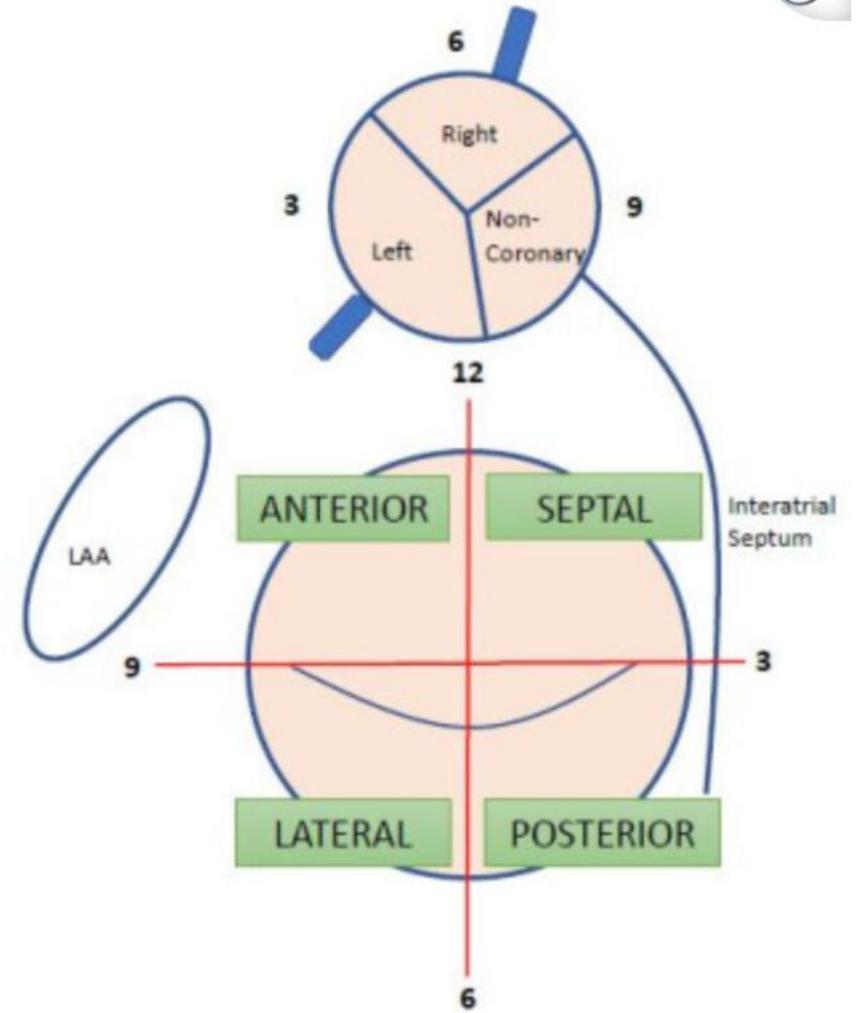
## thrombus

- Concerne les valves mécaniques +++

# Régurgitations



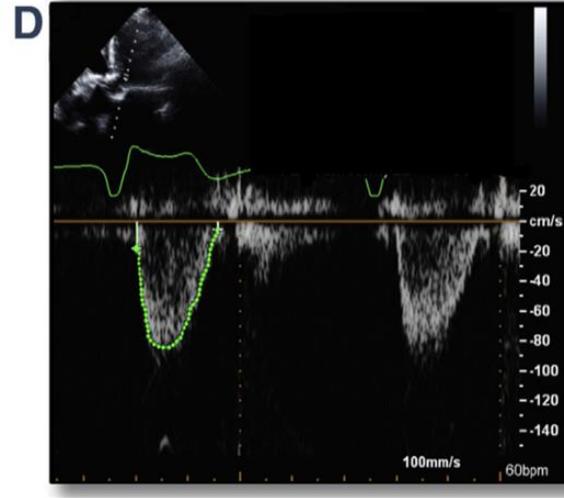
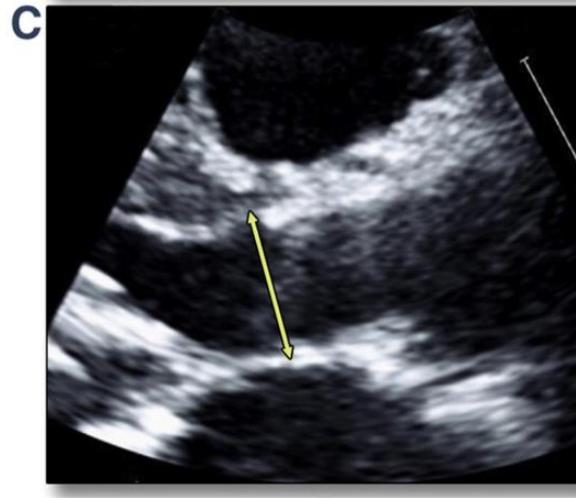
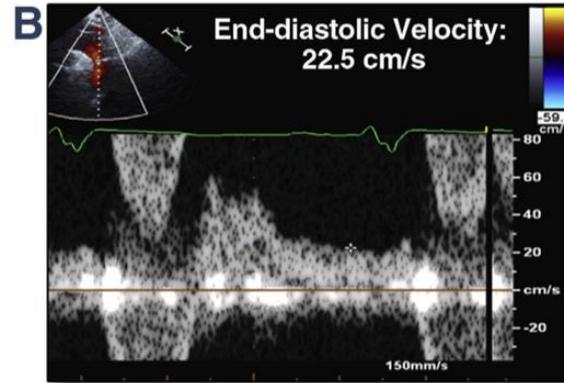
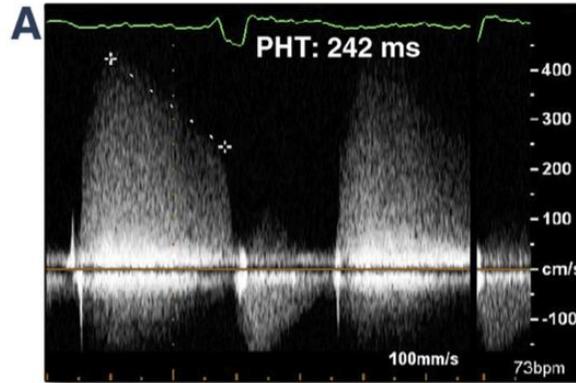
**B**



# Régurgitations

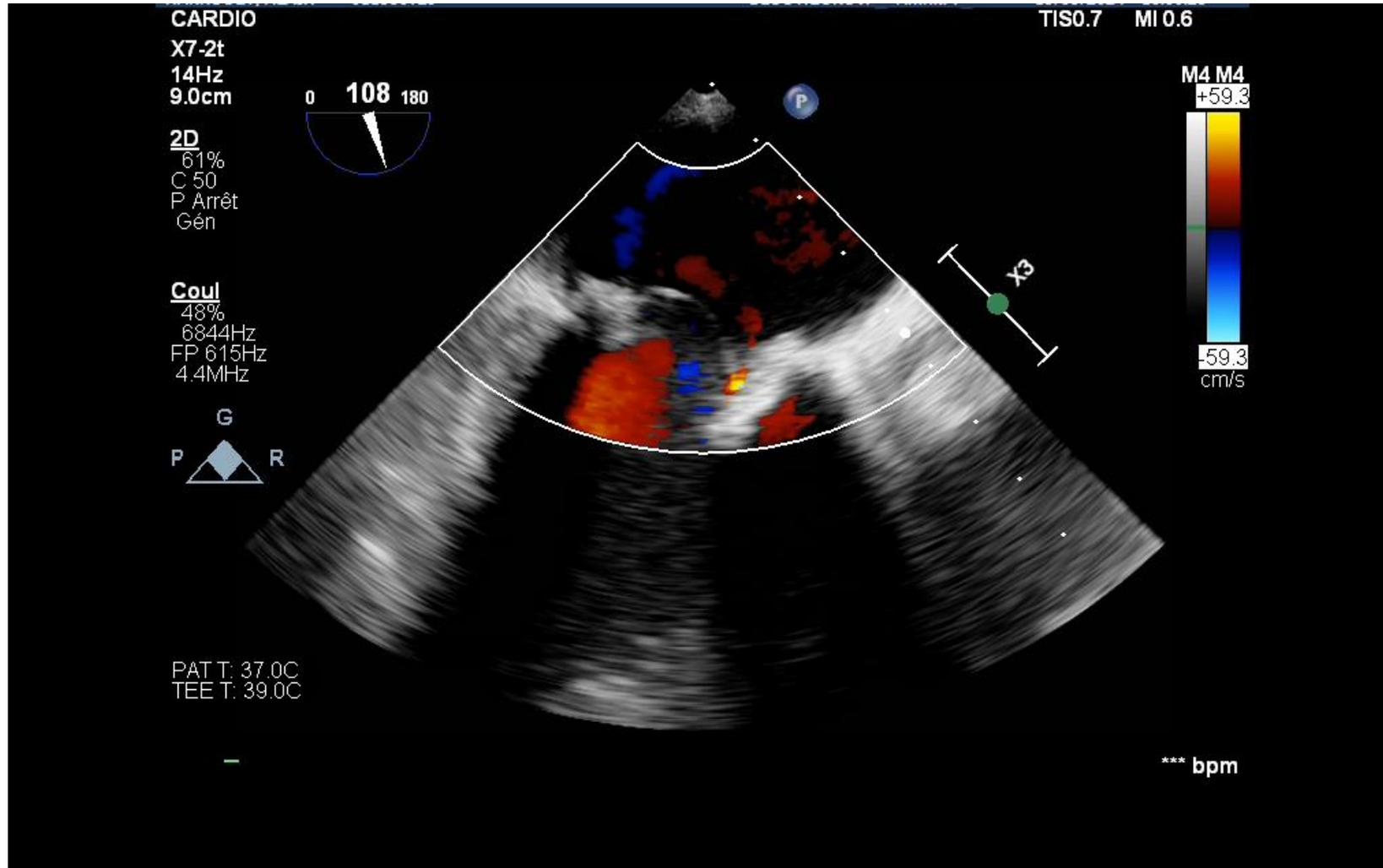
## Prothèse valvulaire aortique

PHT < 200ms



Vitesse télédiastolique  
aorte descendante >  
20cm/s

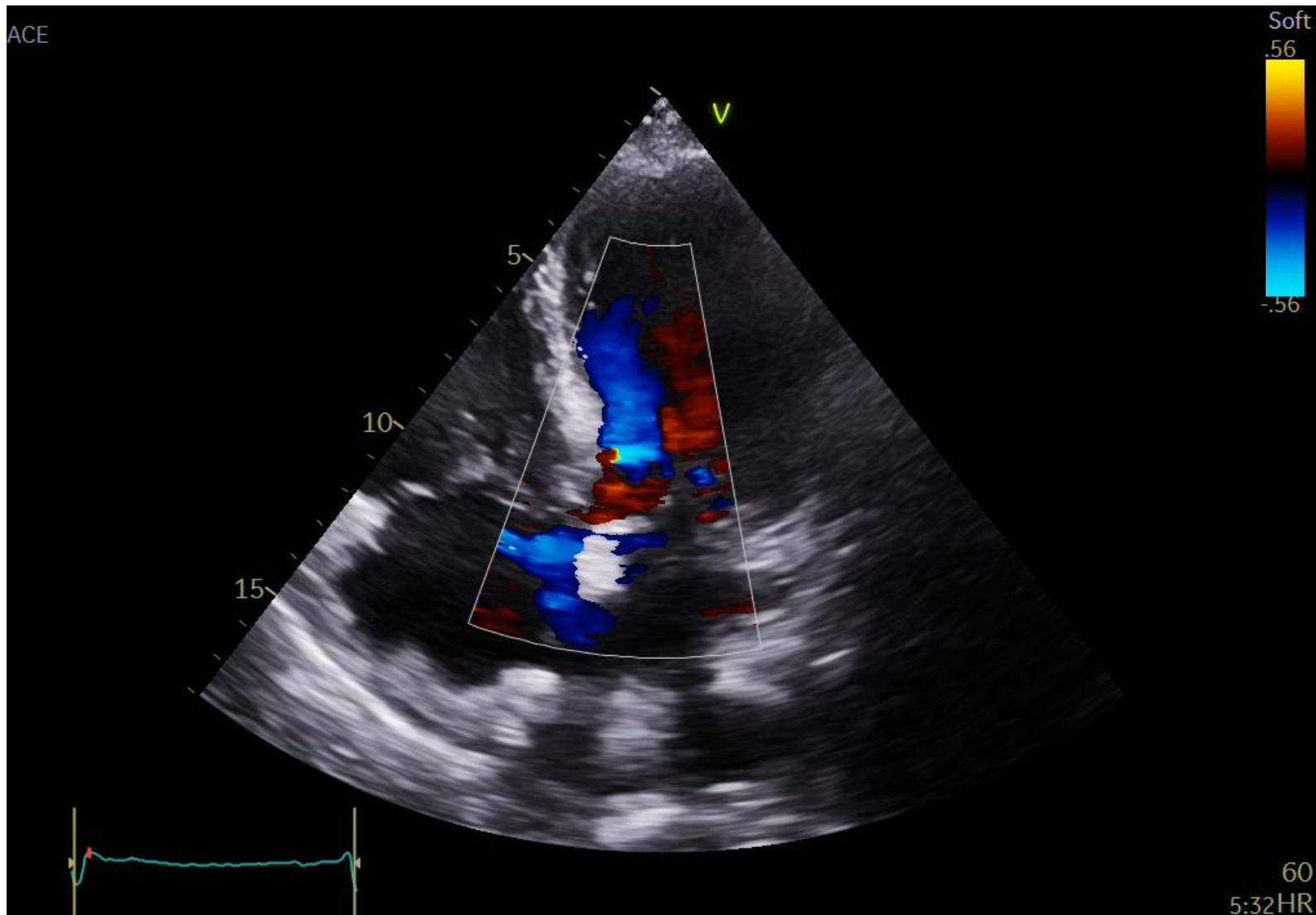
# Fuite intraprothétique



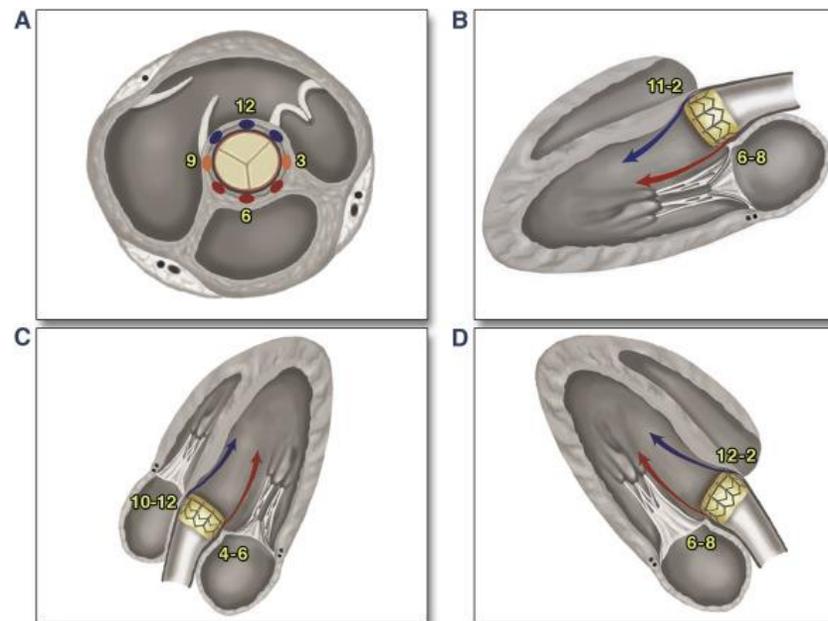
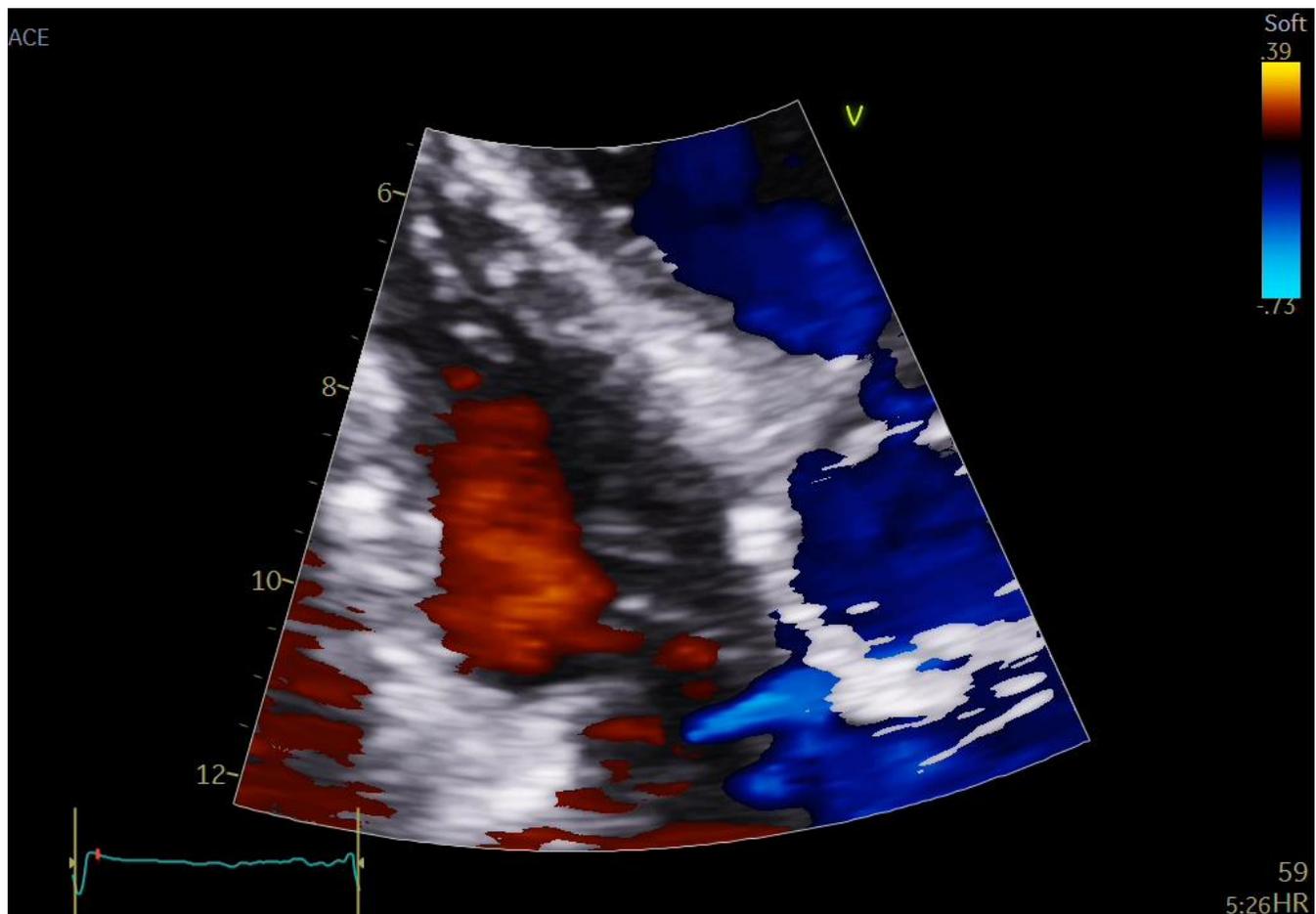
Petite taille  
 $V_{max} < 1,5\text{m/s}$

Plutôt central

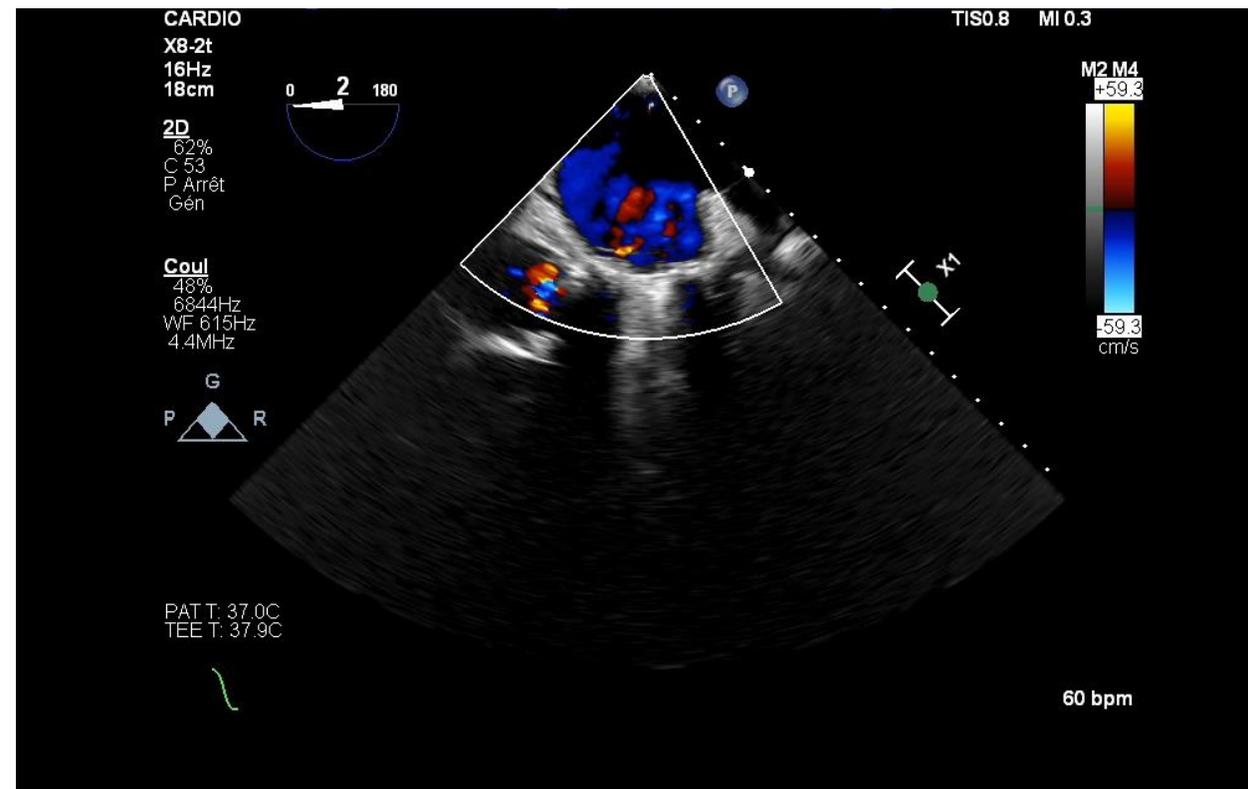
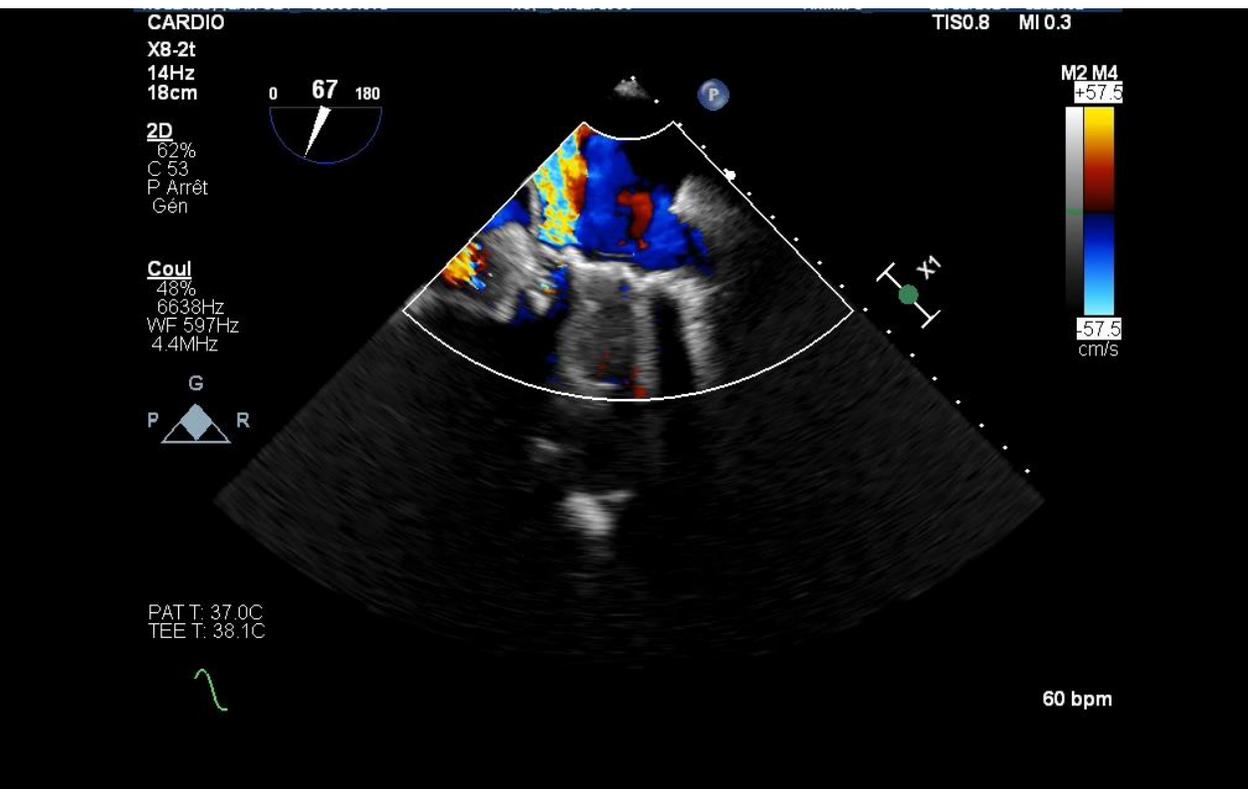
# Fuite périprothétique



# Fuite périprothétique



# Fuite périprothétique



**Table 8** Parameters for evaluation of the severity of prosthetic aortic valve regurgitation

Parameters	Mild	Moderate	Severe
<b>Valve structure and motion</b>			
Mechanical or bioprosthetic	Usually normal	Abnormal*	Abnormal*
<b>Structural parameters</b>			
LV size	Normal <sup>†</sup>	Normal or mildly dilated <sup>†</sup>	Dilated <sup>†</sup>
<b>Doppler parameters (qualitative or semiquantitative)</b>			
Jet width in central jets, % LVOT diameter, (CD) <sup>‡</sup>	Narrow ( $\leq 25\%$ )	Intermediate (26%-64%)	Large ( $\geq 65\%$ )
VC width, cm (CD)	<0.3	0.3-0.6	>0.6
VC area, cm <sup>2</sup> (2D/3D CD) <sup>§</sup>	<0.10	0.10-0.29	$\geq 0.30$
Circumferential extent of PVL, % (CD) <sup>¶  </sup>	<10	10-29	$\geq 30$
Jet density (CW)	Incomplete or faint	Dense	Dense
Jet deceleration rate (PHT), msec (CW) <sup>#</sup>	Slow (>500)	Variable (200-500)	Steep (<200)
Diastolic flow reversal in the descending aorta (PW)	Absent or brief early diastolic	Intermediate	Prominent, holodiastolic
<b>Doppler parameters (quantitative)</b>			
Regurgitant volume, mL/beat	<30	30-59	$\geq 60$
Regurgitant fraction, %	<30	30-50	$\geq 50$

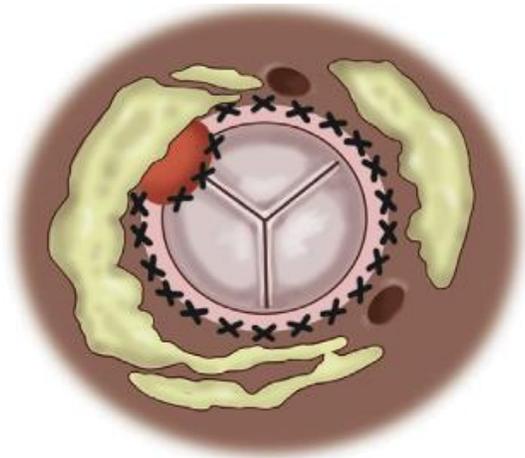
## Régurgitations

# PROTHESE MITRALE

**Table 13** Echocardiographic criteria for severity of prosthetic mitral valve regurgitation using findings from TTE and TEE

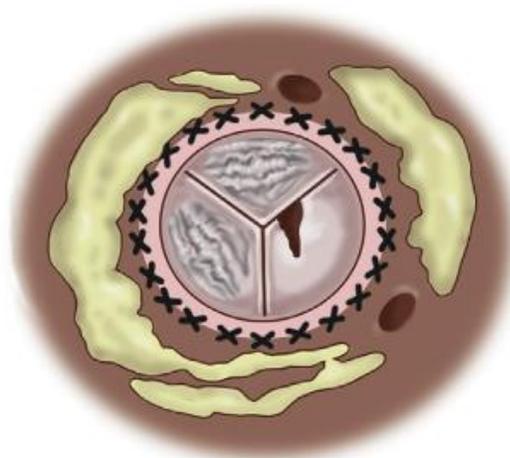
	Mild	Moderate	Severe
<b>Structural parameters</b>			
LV size	Normal*	Normal or dilated	Usually dilated <sup>†</sup>
Prosthetic valve <sup>‡</sup>	Usually normal	Abnormal <sup>§</sup>	Abnormal <sup>§</sup>
<b>Doppler parameters</b>			
Color flow jet area <sup>¶¶</sup>	Small, central jet (usually <4 cm <sup>2</sup> or <20% of LA area)	Variable	Large central jet (usually >8 cm <sup>2</sup> or >50% of LA area) or variable size wall-impinging jet swirling in left atrium
Flow convergence <sup>  </sup>	None or minimal	Intermediate	Large
Jet density (CW) <sup>‡</sup>	Incomplete or faint	Dense	Dense
Jet contour (CW) <sup>‡</sup>	Parabolic	Usually parabolic	Early peaking: triangular
Pulmonary venous flow <sup>‡</sup>	Systolic dominance <sup>#</sup>	Systolic blunting <sup>#</sup>	Systolic flow reversal <sup>**</sup>
<b>Quantitative parameters<sup>††</sup></b>			
VC width (cm) <sup>‡</sup>	<0.3	0.3-0.69	≥0.7
RVol, mL/beat	<30	30-59 <sup>††</sup>	≥60 <sup>††</sup>
RF, %	<30	30-49	≥50
EROA, cm <sup>2</sup>	<0.20	0.20-0.39	≥0.40

# Dysfonction de prothèses



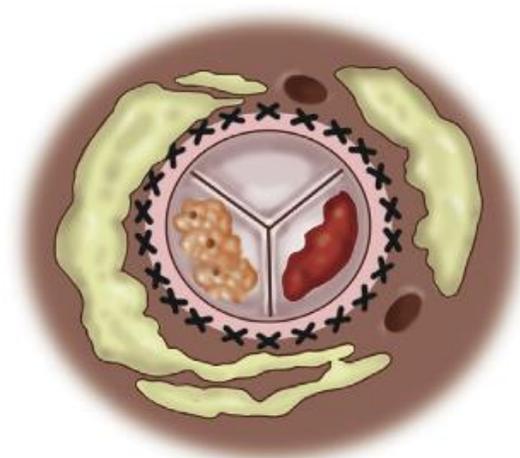
## Structurelles

- Concerne les bioprothèses +++



## Non structurelles

- Mismatch de prothèse (PPM)
- Fuite périprothétiques
- Autres
  - Feuillet attaché
  - Pannus
  - Malposition
  - Dilatation secondaire des cavités cardiaques



## endocardite

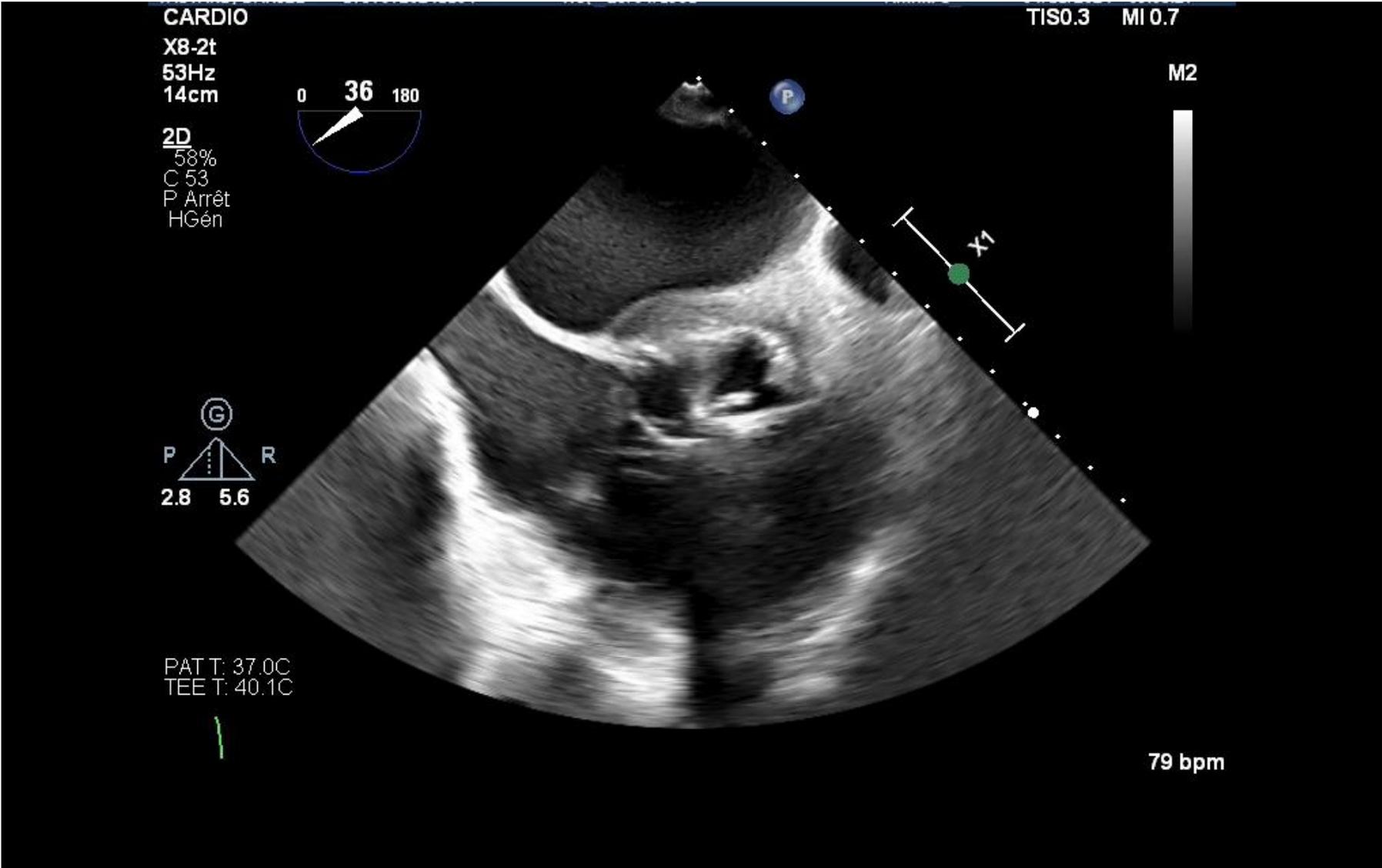
- Concerne les valves mécaniques +++

## thrombus

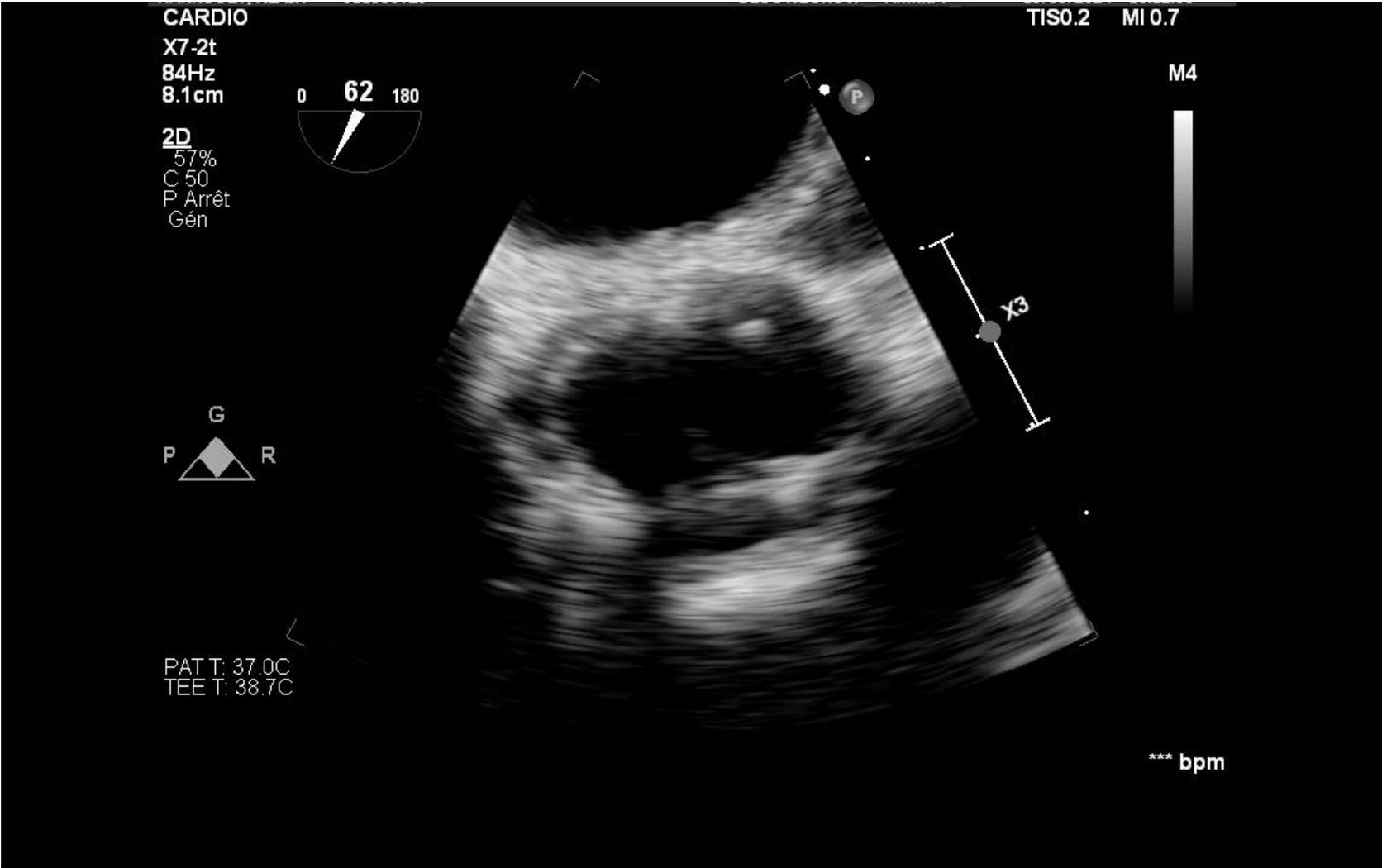
# Endocardite

- Prévalence 1 à 6%
- 70% d abcès periprothétique (plus rare pour une valve native)
- Abcès / Pseudoanévrisme (7 à 25% des cas) / Fistule
- Plus rarement végétations seule appendue

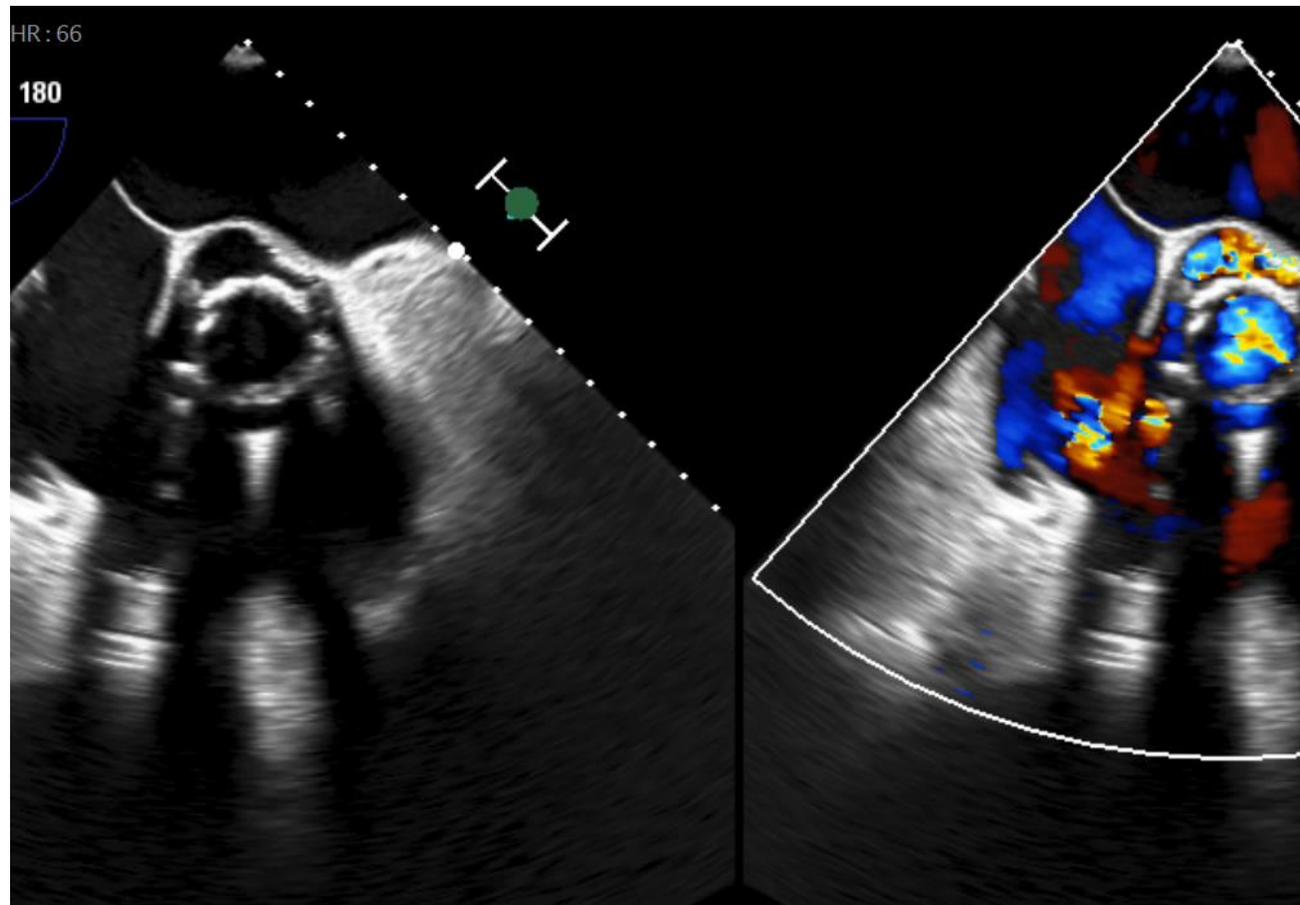
# Abcès



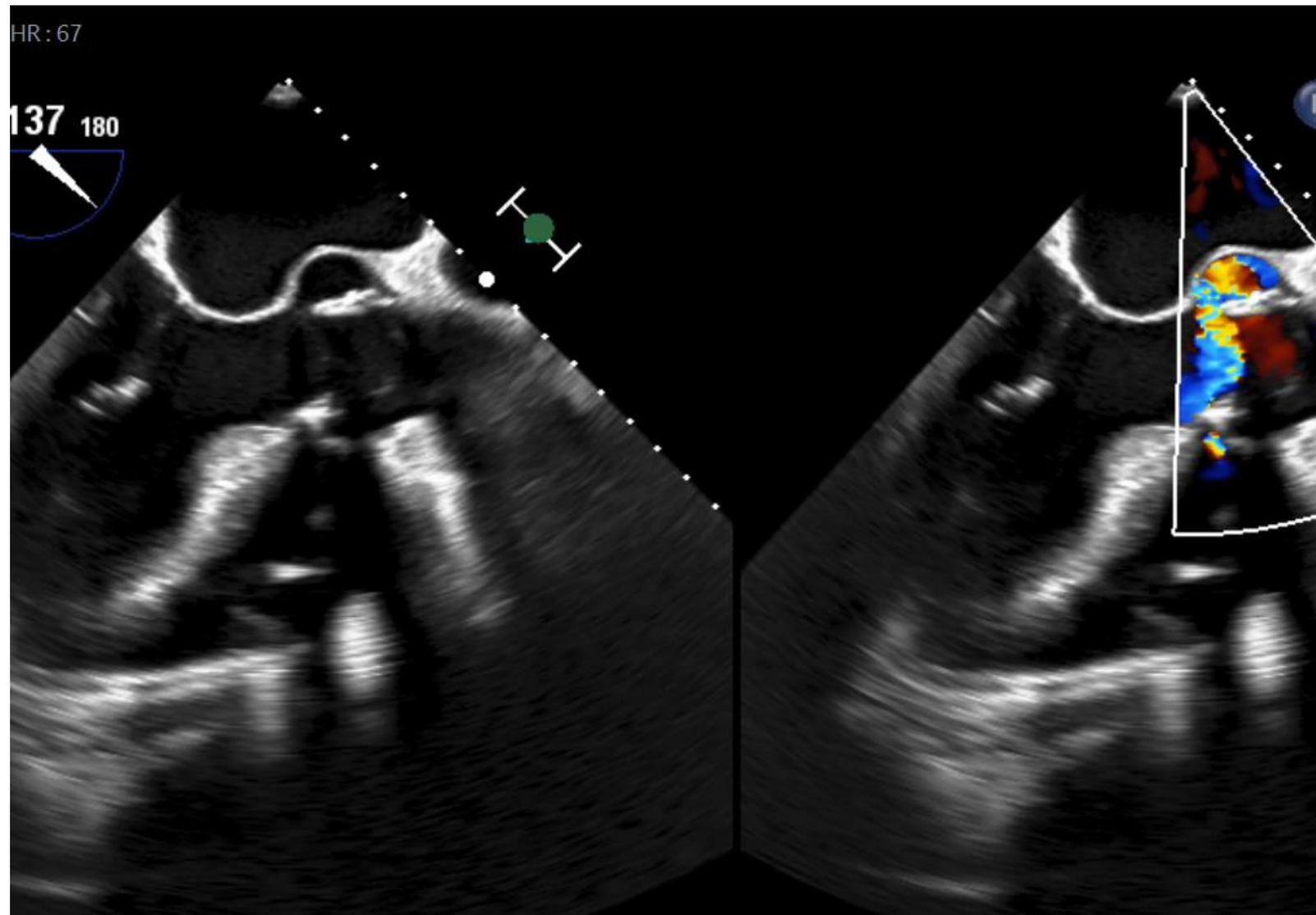
# Abcès



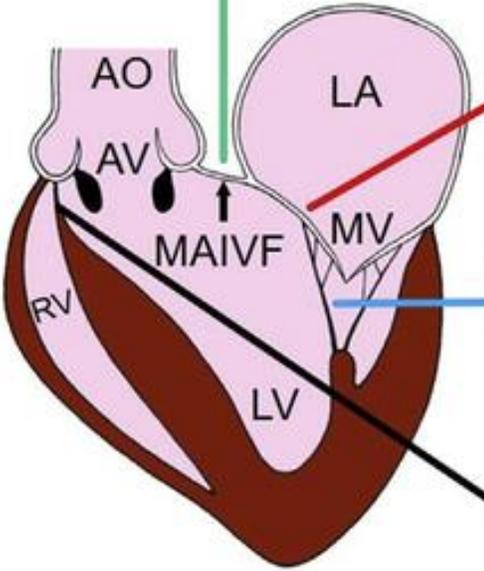
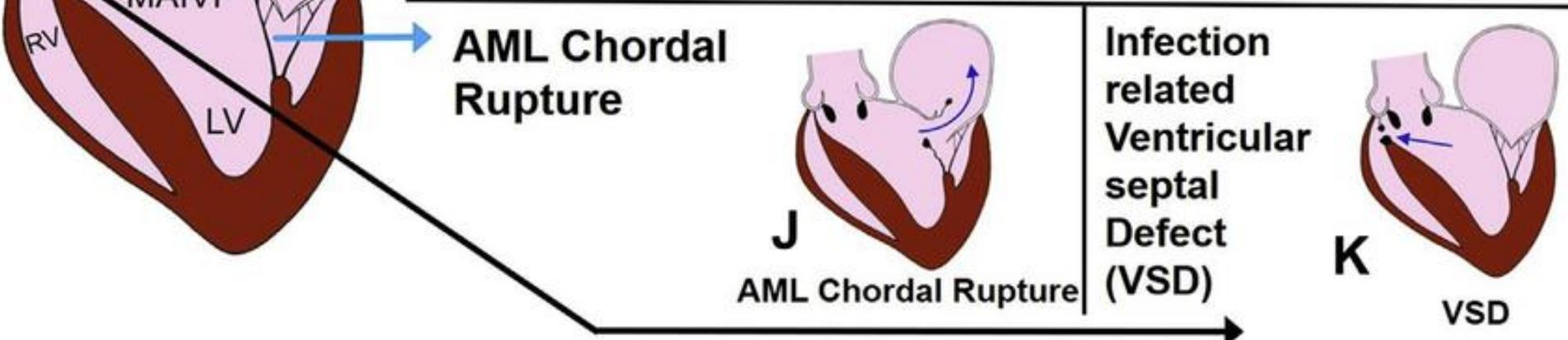
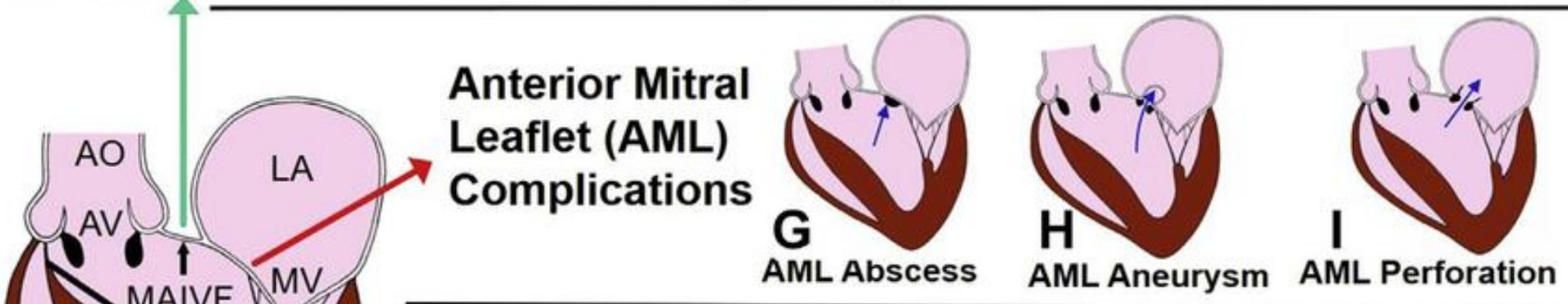
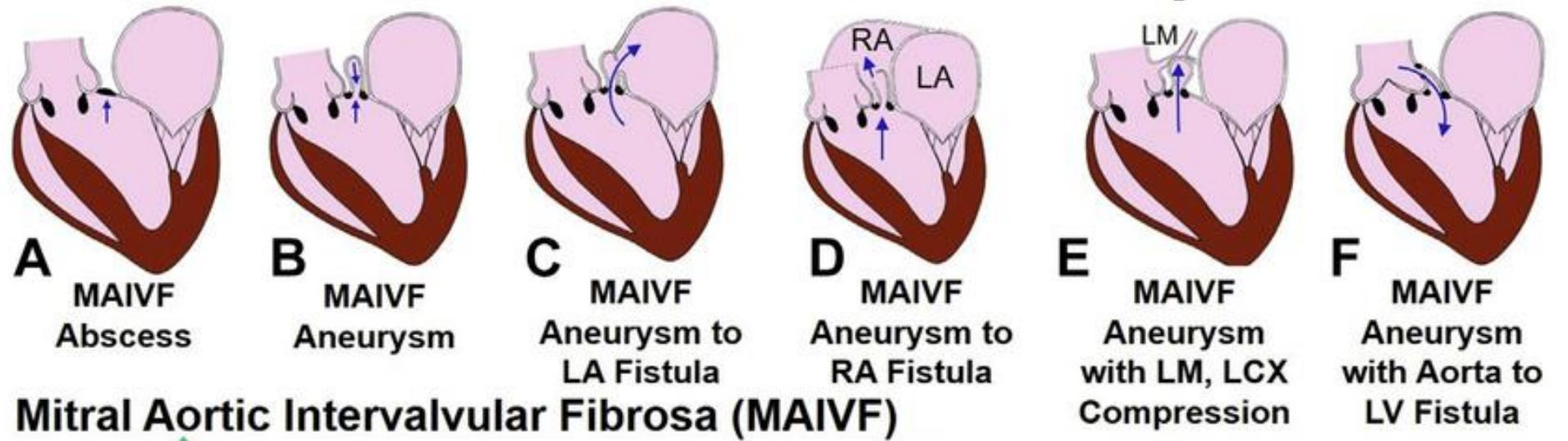
# Fistule ou pseudoanévrisme ?



# Fistule



# AV Endocarditis: Sub-aortic Complications



# Conclusions

- Bien connaitre les types de prothèses (littérature+++)
- Plusieurs types « dysfonctions » associées
- Endocardite +++
- Diagnostic parfois difficile, en cas de doute → AVIS cardiologue++