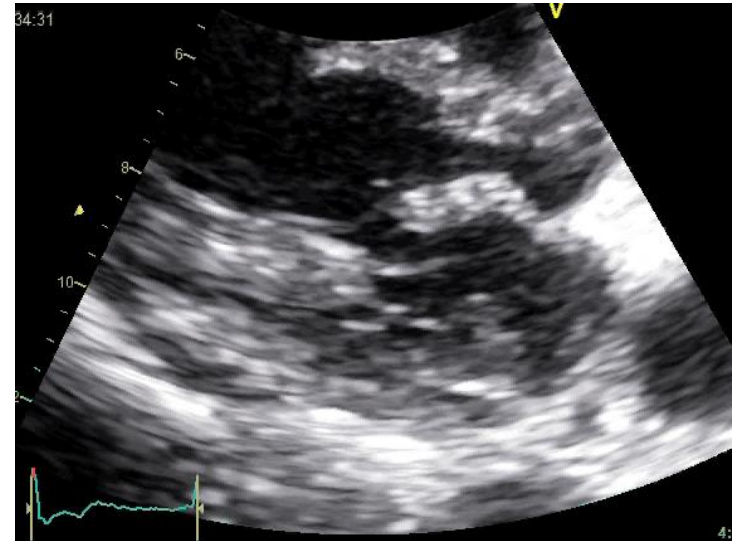
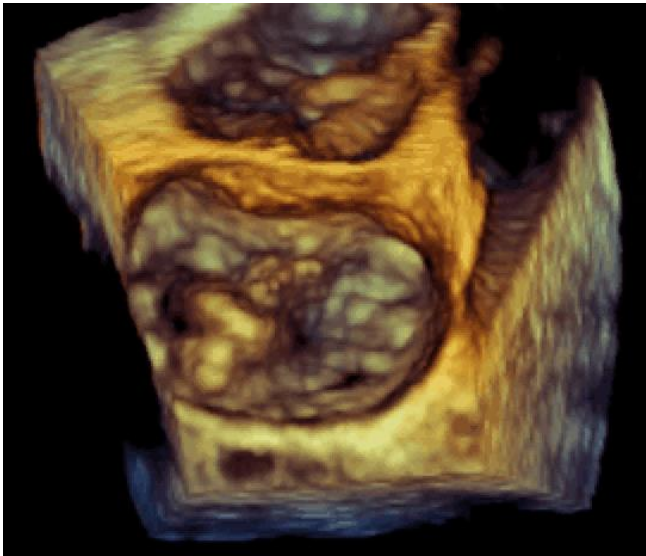


Echographie de L'Insuffisance Mitrale



Institut du Thorax, Nantes
Inserm UMR 1087

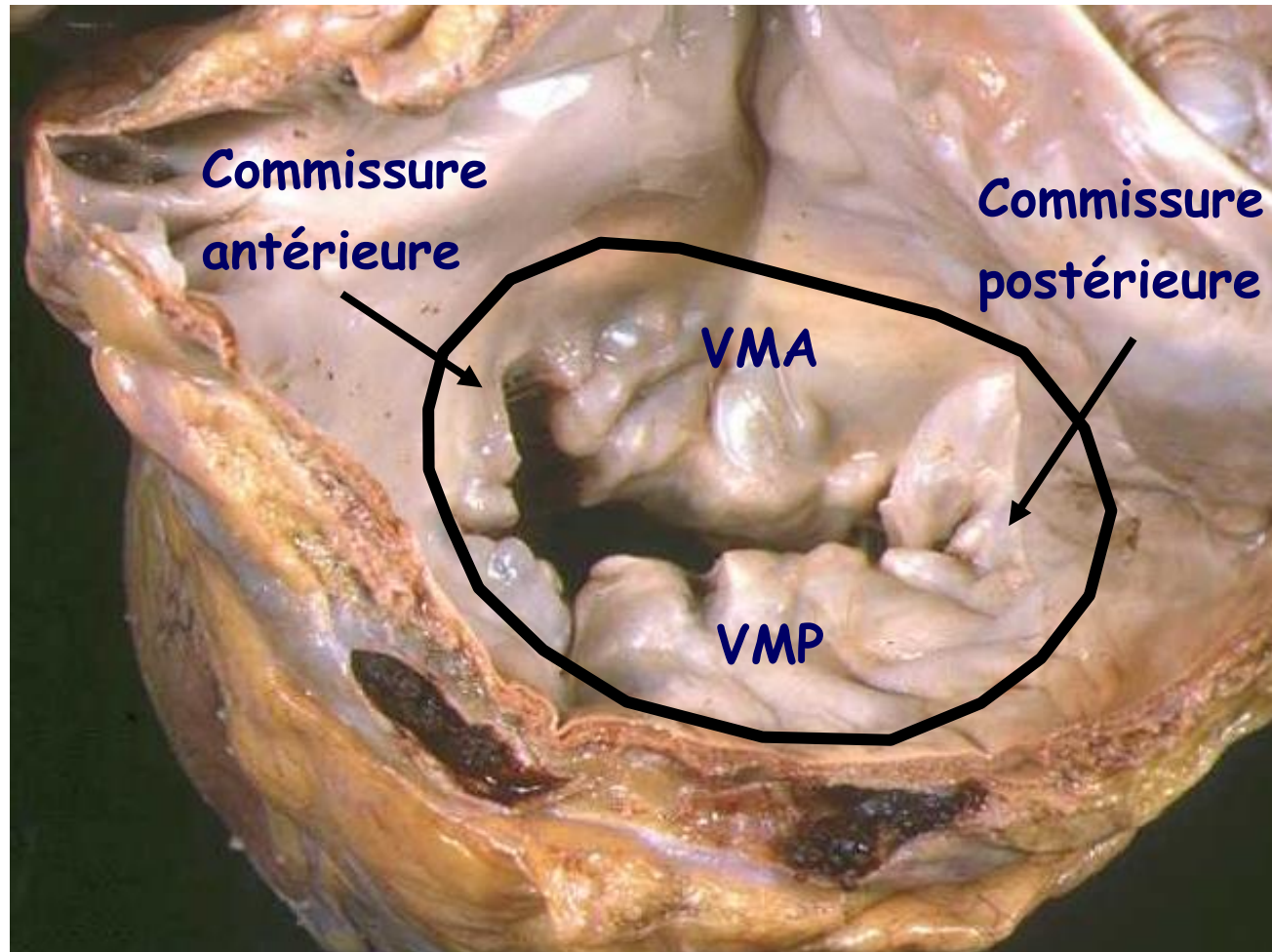
Thierry le Tourneau

DIU Echocardiographie Anesthésie-Réanimation

Place de l'échocardiographie

- Diagnostique
- Retentissement
- Quantification
- Mécanisme
- Guide
 - L'indication chirurgicale
 - Le geste opératoire
- Contrôle du résultat et suivi

Valve Mitrale

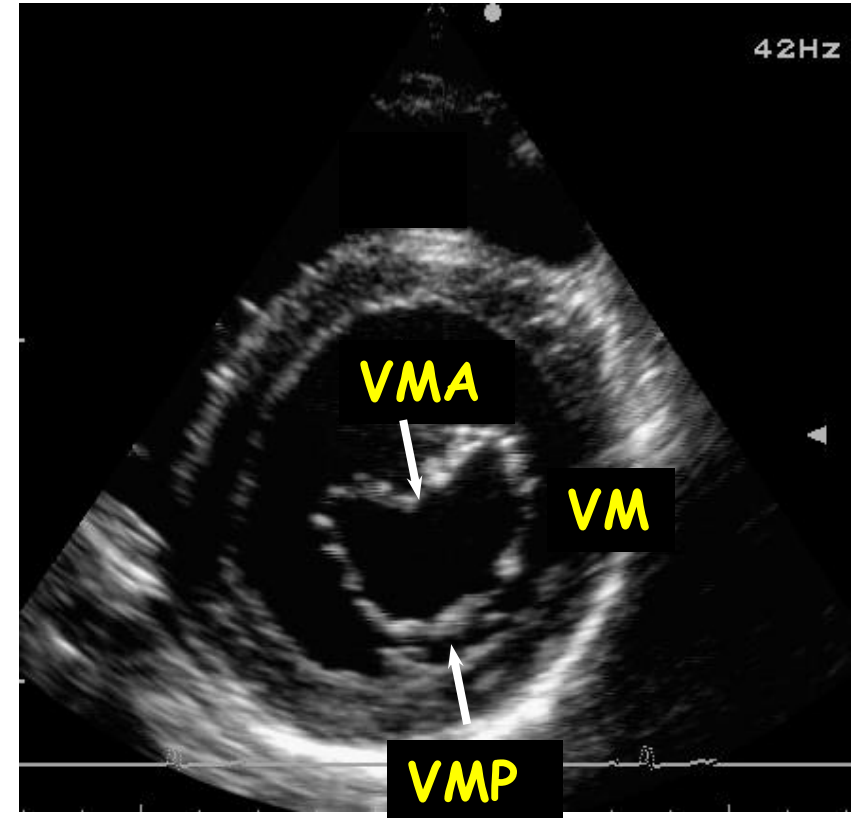


Vue depuis l'OG

1) Rappels

Valve Mitrale

- **Valve mitrale antérieure:**
position antérieure,
s'insère sur le 1/3 ant de l'anneau mitral
- **Valve mitrale postérieure:**
position postérieure
s'insère sur les 2/3 de l'anneau,
moins haute, mais de même
surface que la valve antérieure



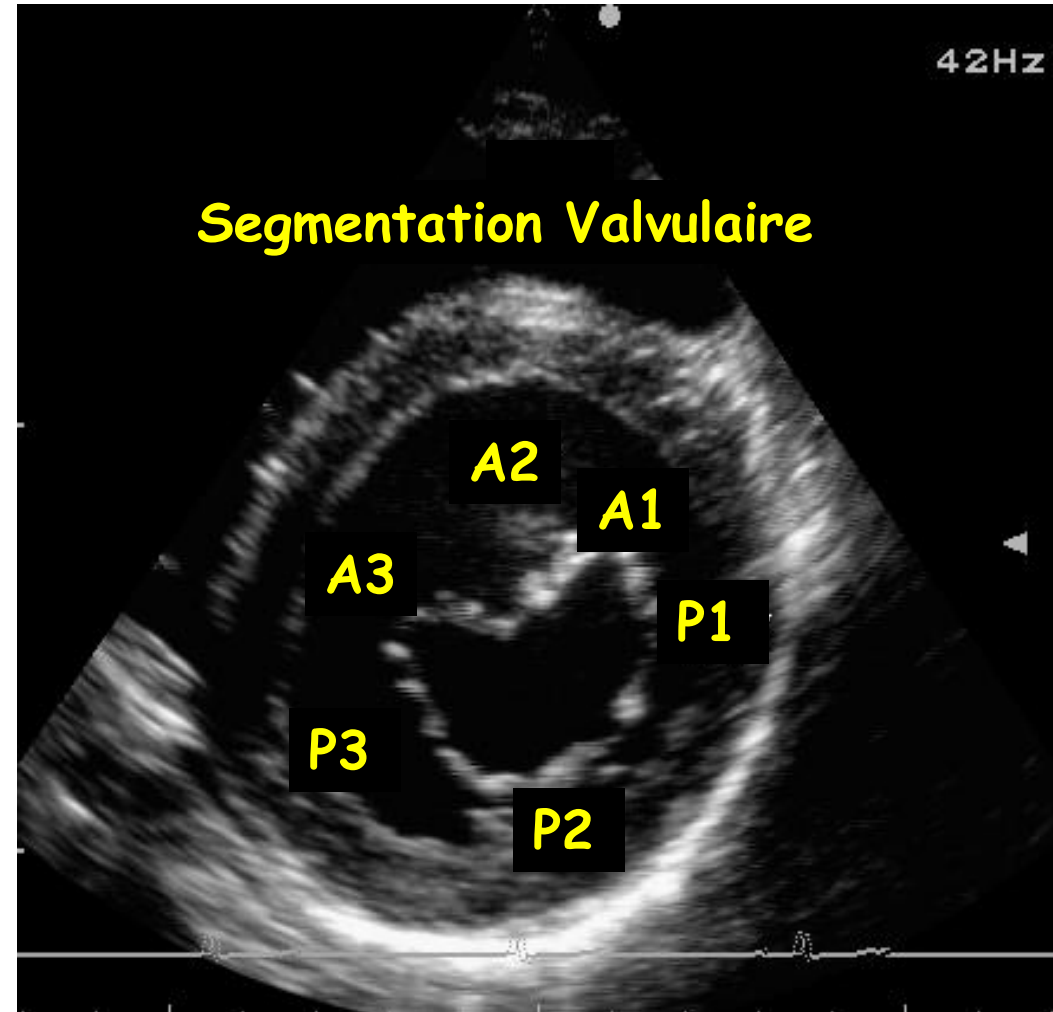
Vue depuis le VG

Valve Mitrale

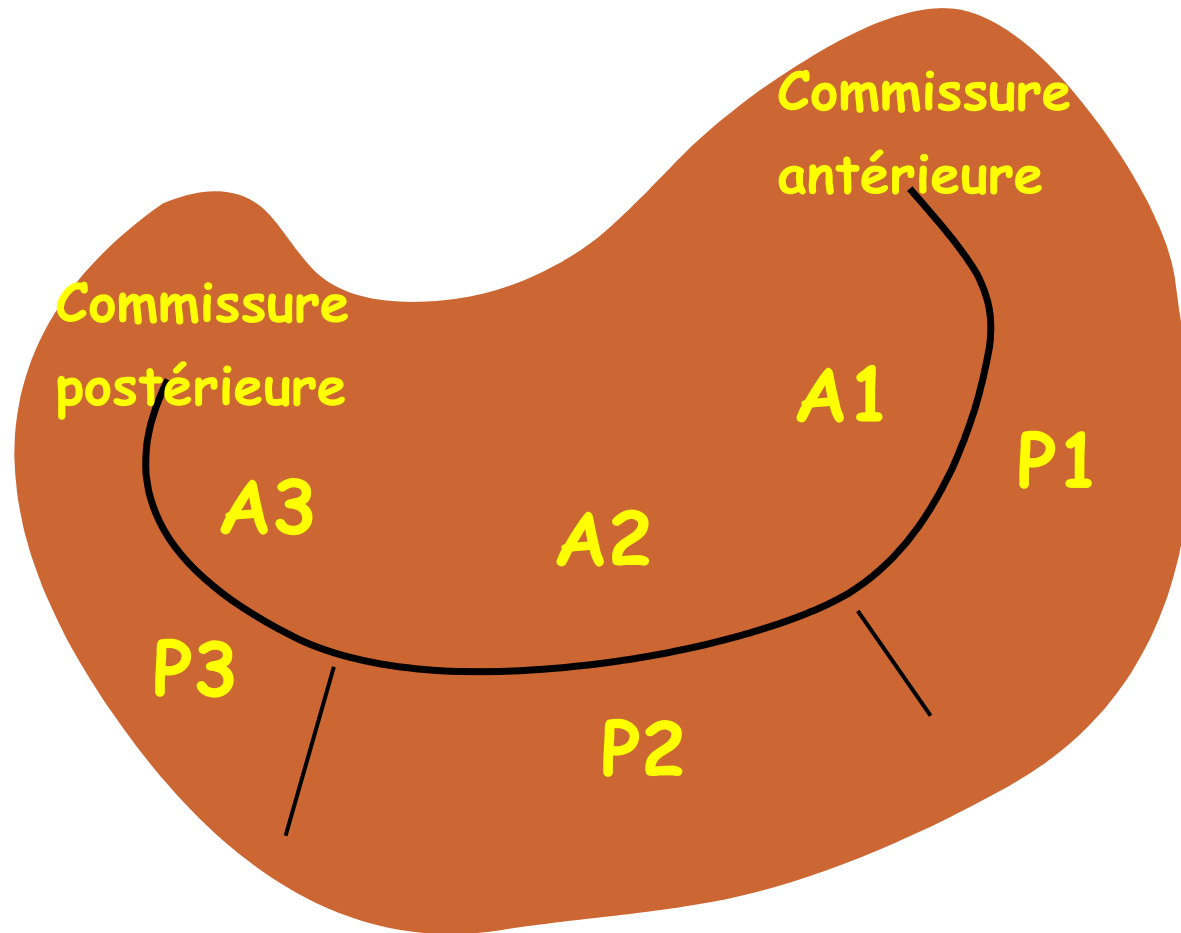
Vue depuis le VG

Segmentation de Carpentier

- Valve mitrale post:
P1, P2, P3 pour les trois festons de la valve
indentation entre P1 et P2,
et entre P2 et P3
- Segmentation de la VMA
par homologie
A1, A2, A3



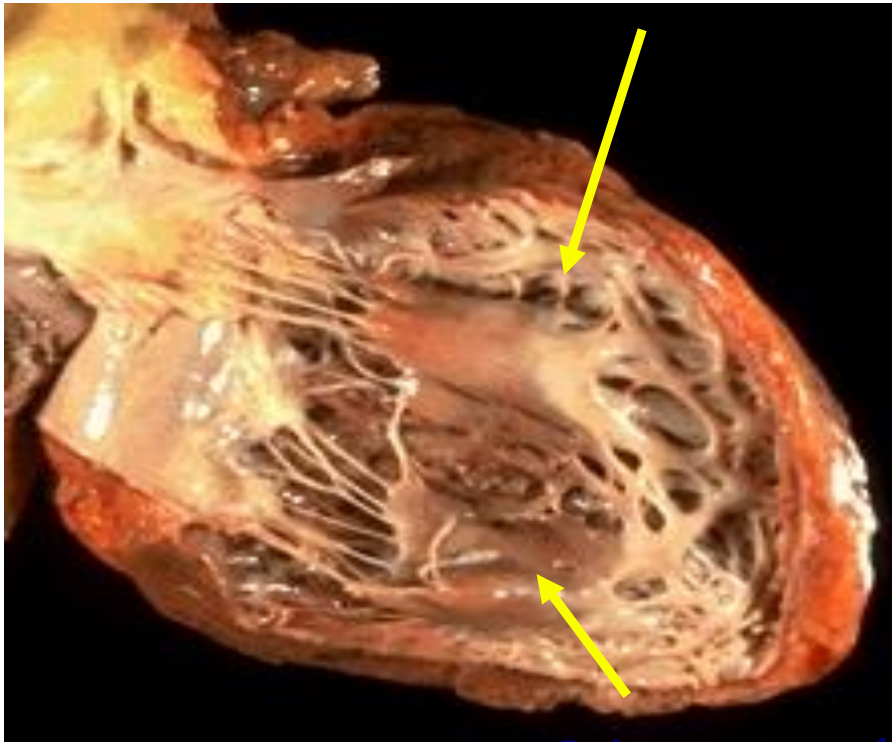
Valve Mitrale



Vue depuis le VG

Appareil sous-valvulaire mitral

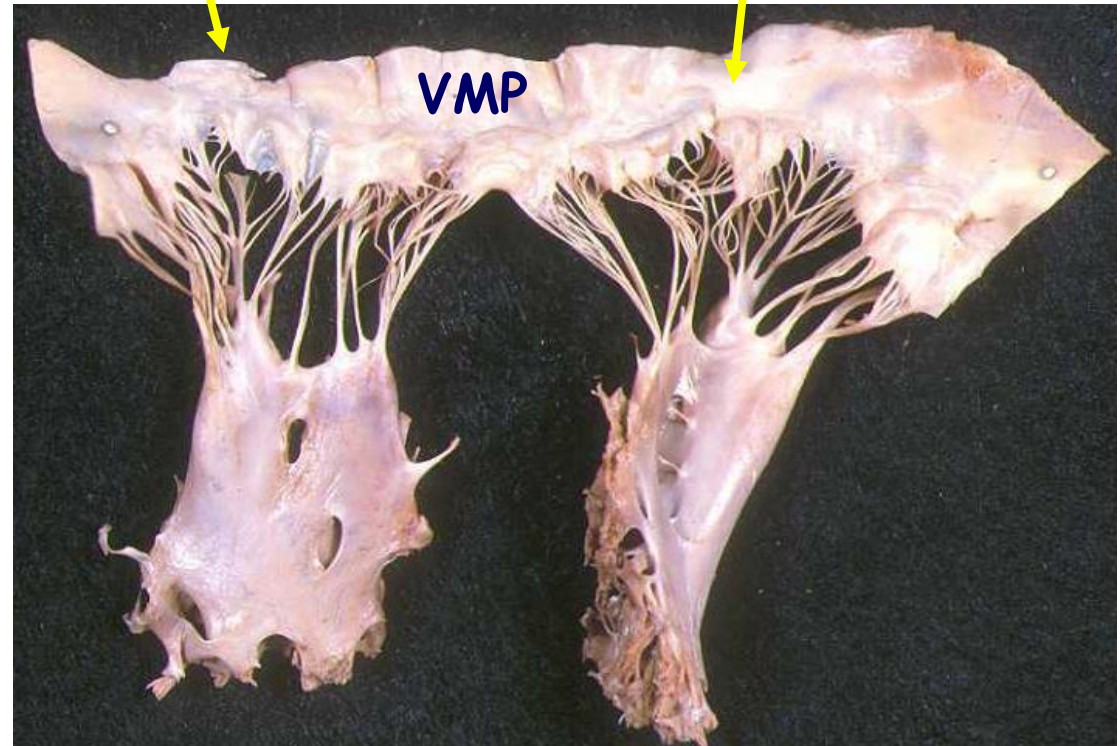
Pilier antéro-externe



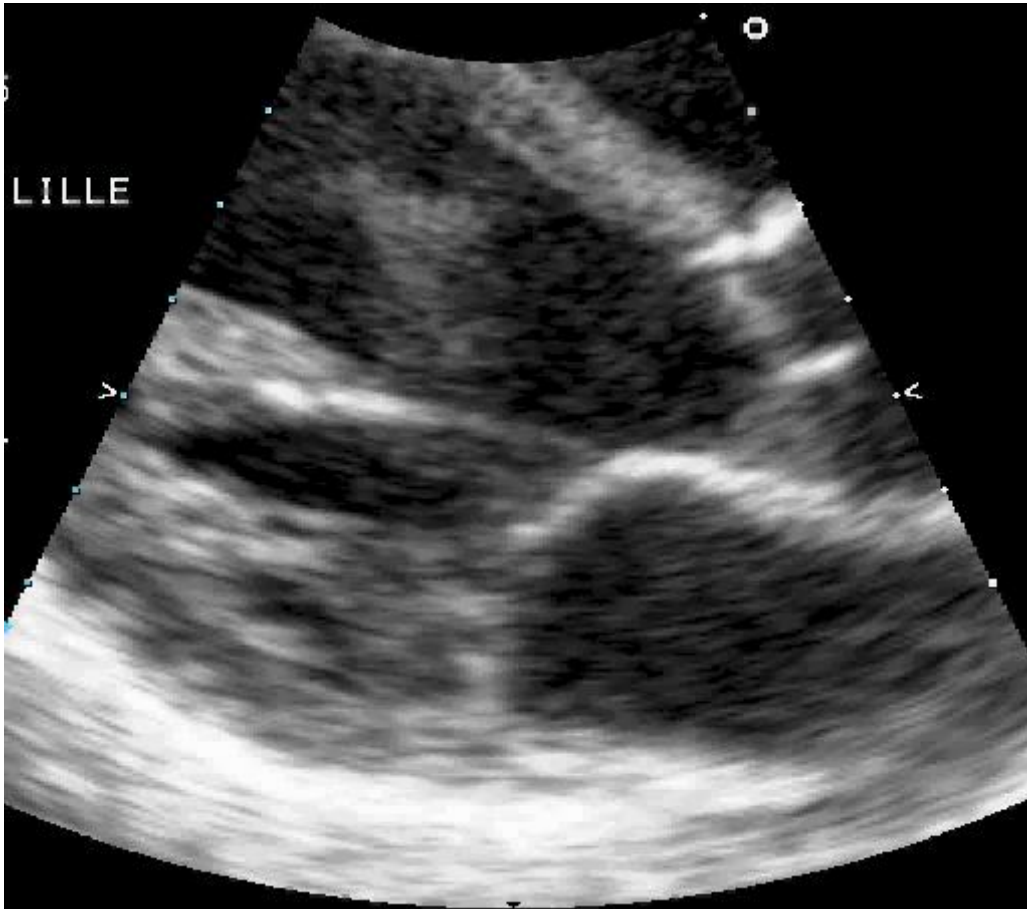
Pilier postéro-médian

Commissure postérieure

Commissure antérieure



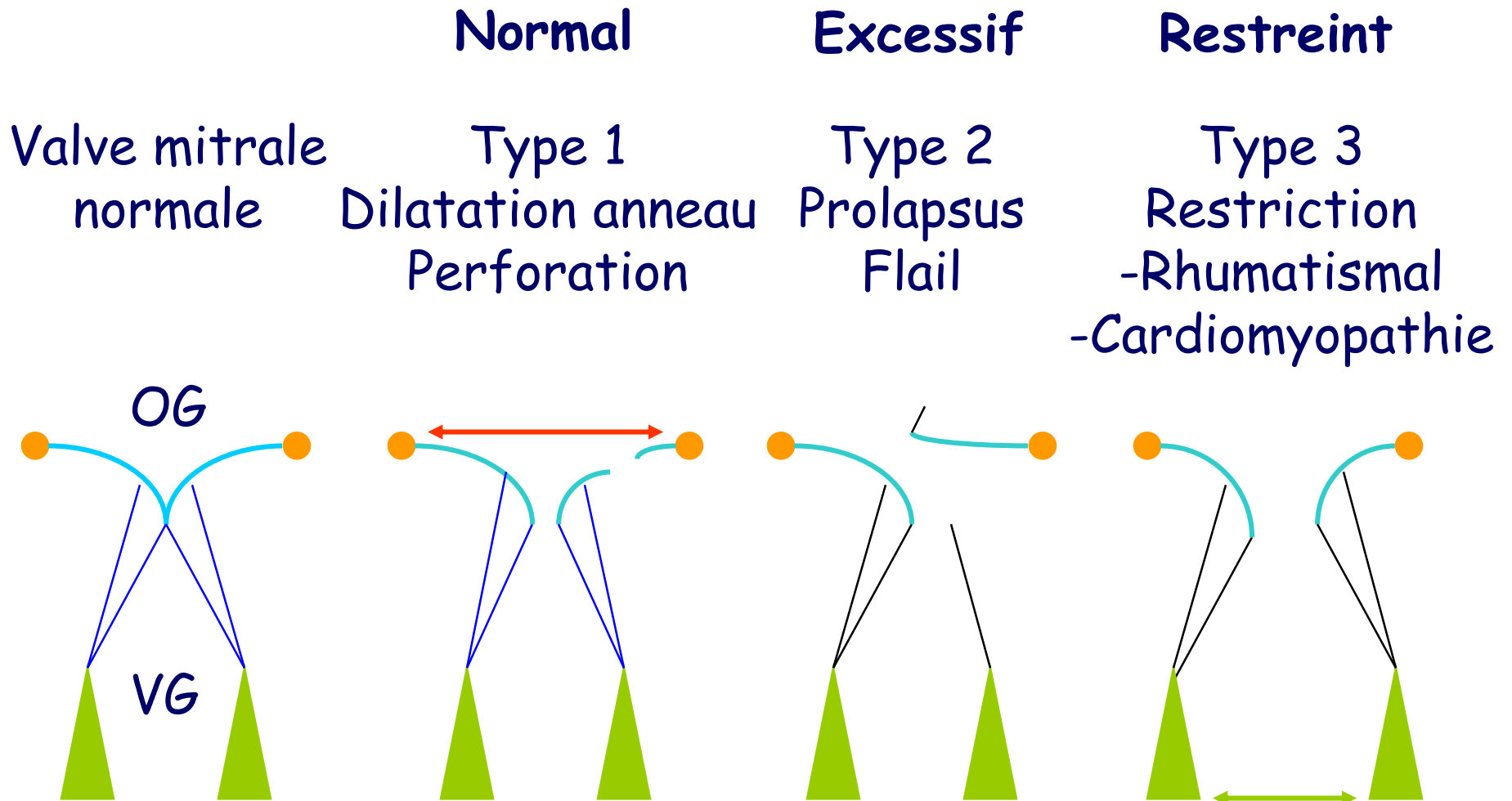
Appareil sous-valvulaire mitral



2) Mécanismes-Etiologies

Mécanismes de l'IM

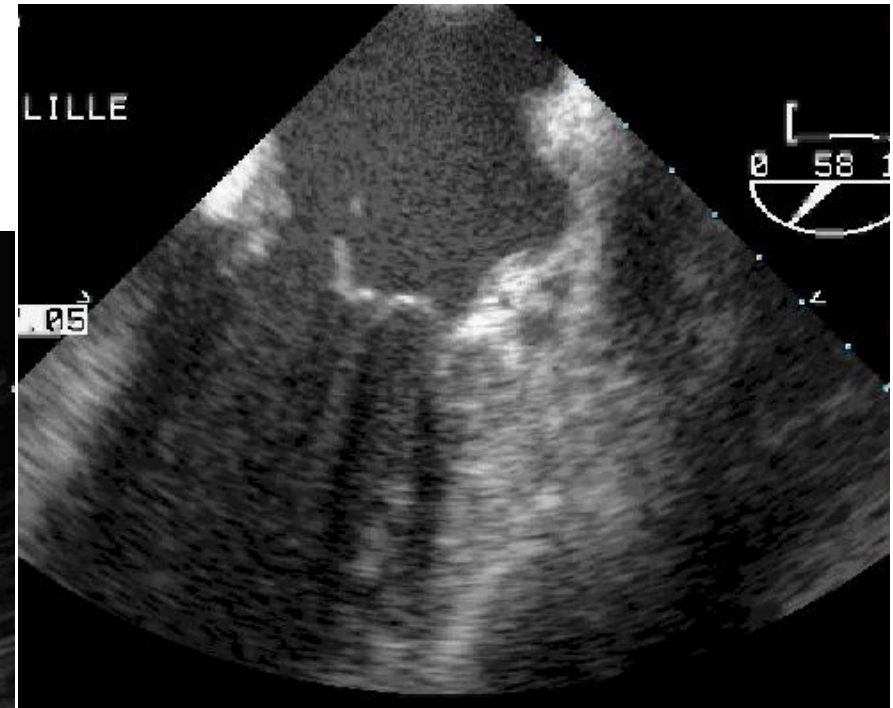
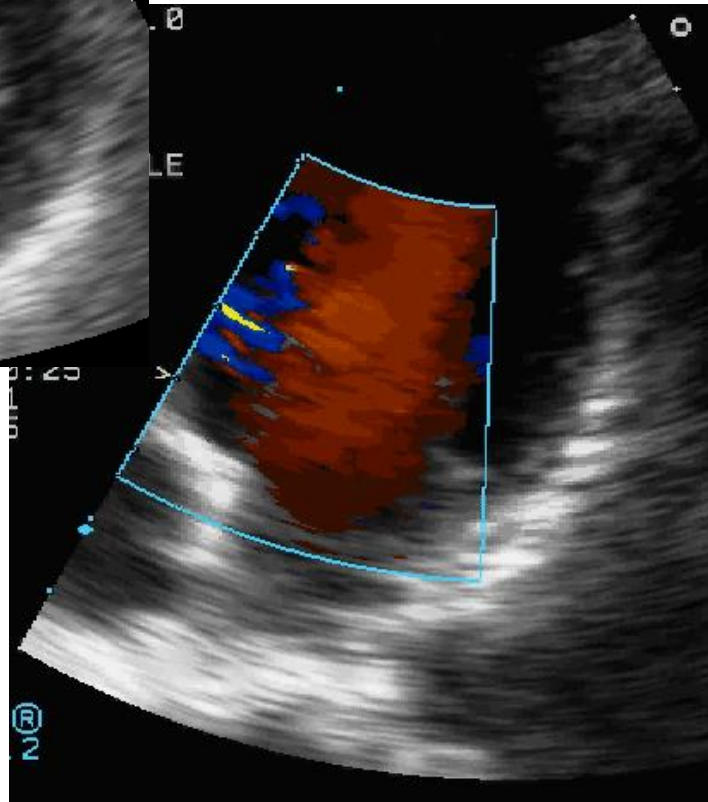
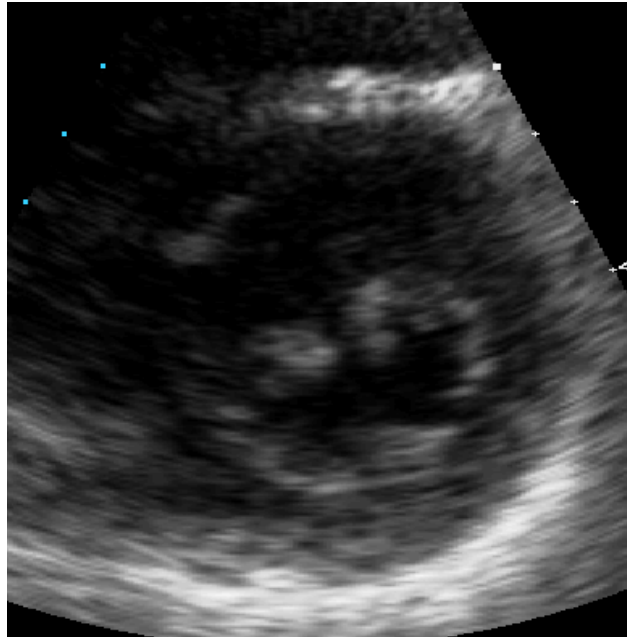
Mouvement valvulaire



Etiologies

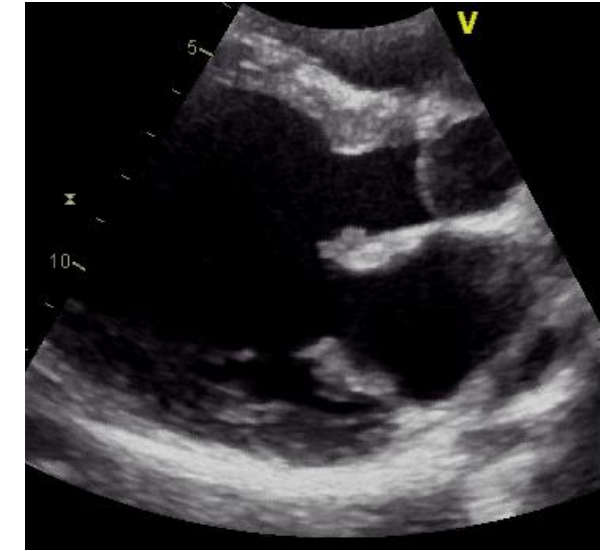
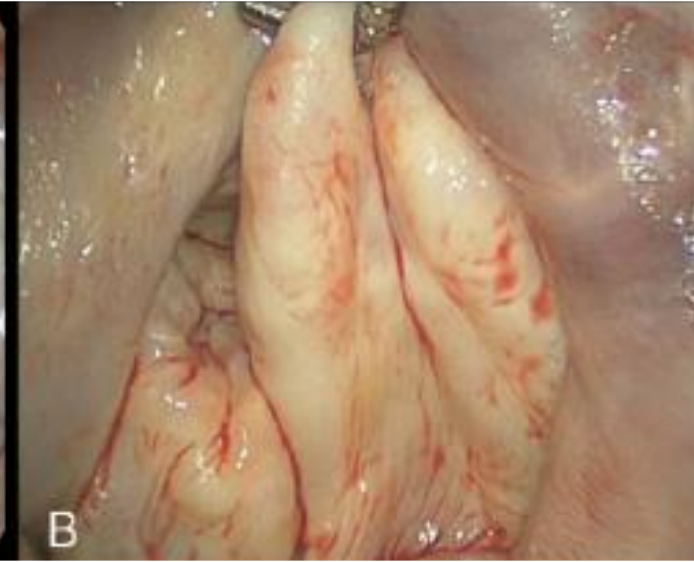
- Organique:
 - Endocardite } Type 1
 - Fente mitrale } Type 2
 - Prolapsus } Type 3
 - Rhumatismale }
- Fonctionnelle Type 3
 - Cardiomyopathie dilatée
 - Cardiomyopathie ischémique
 - Cardiomyopathie hypertrophique

IM Organique: Type 1

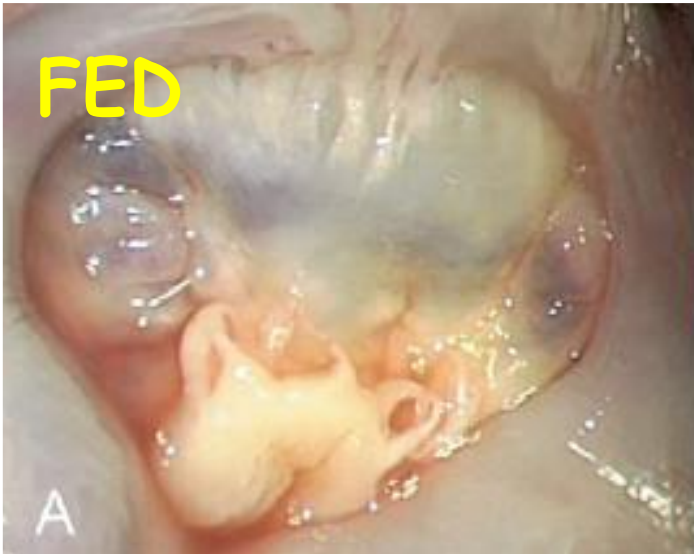


IM Organique: Type 2

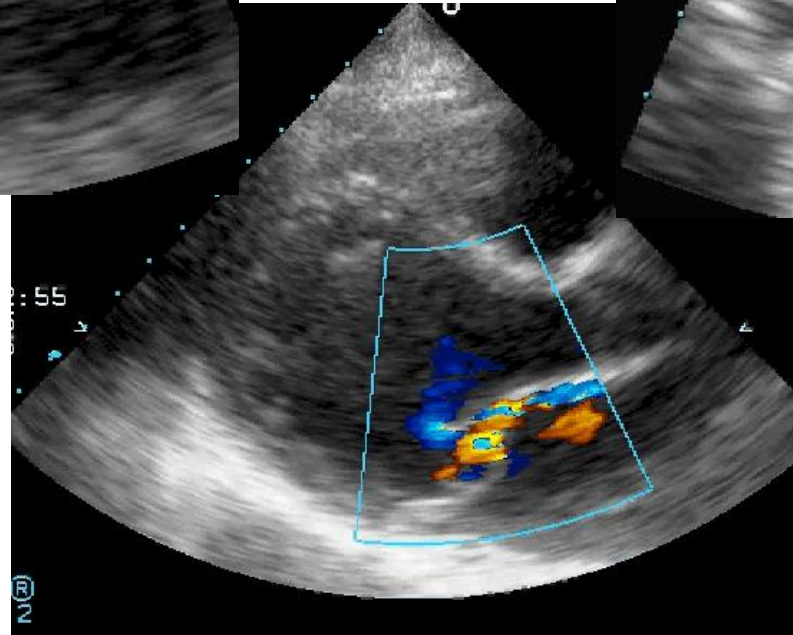
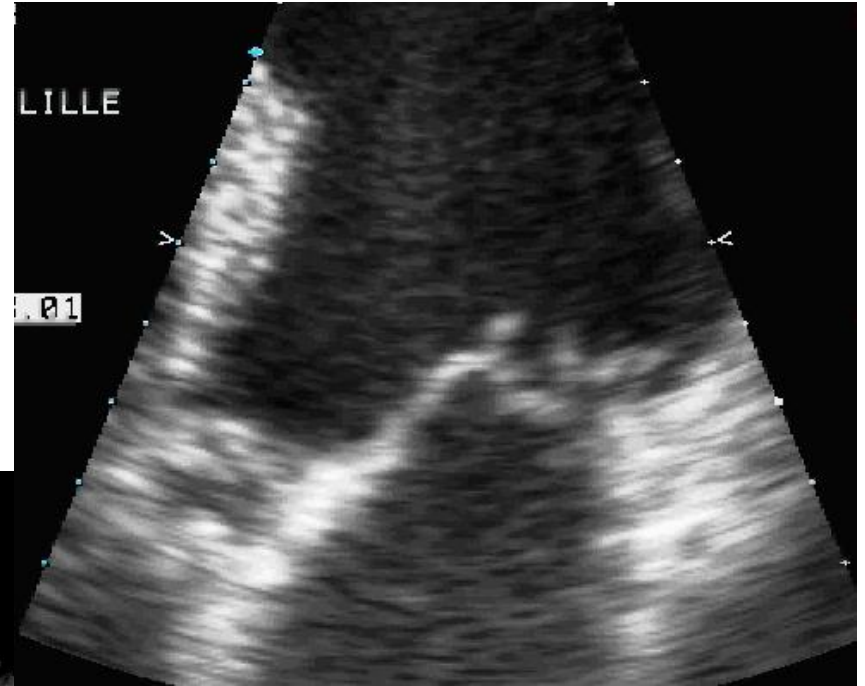
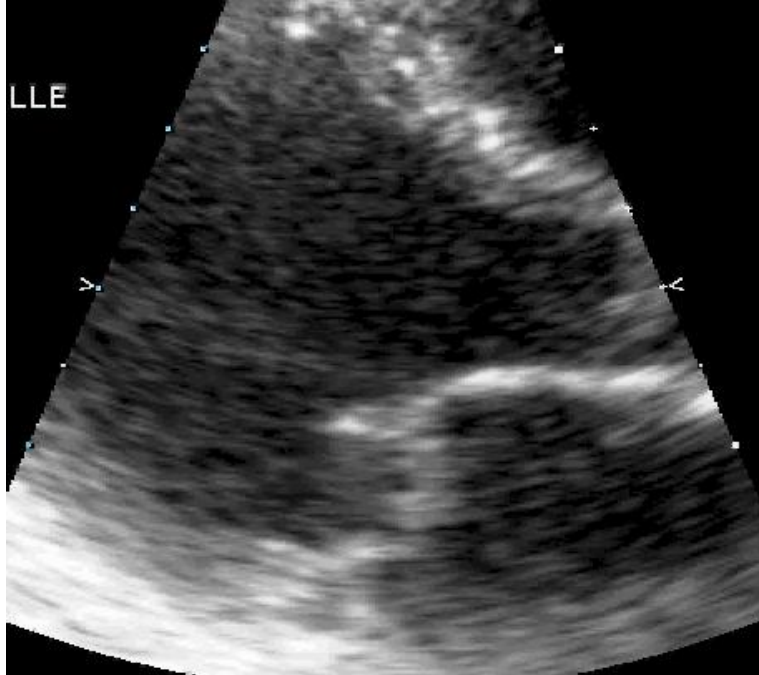
Barlow



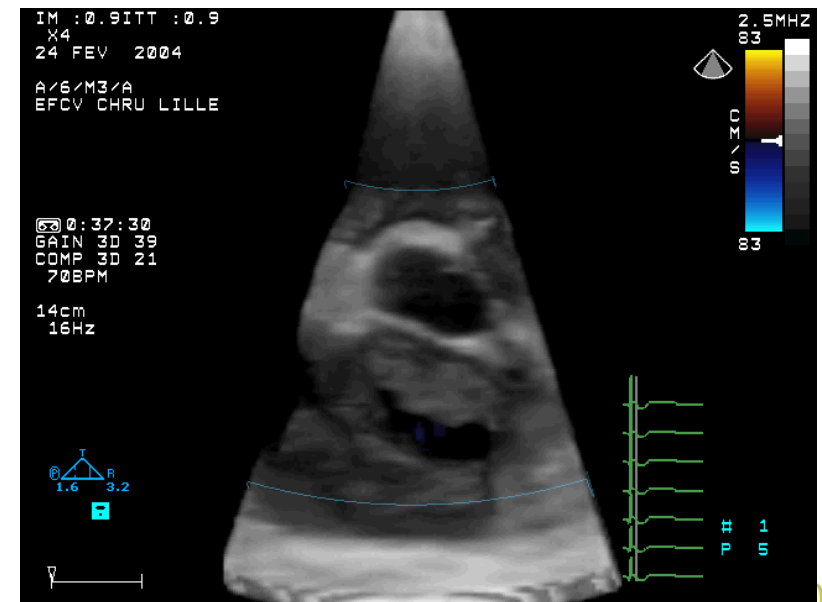
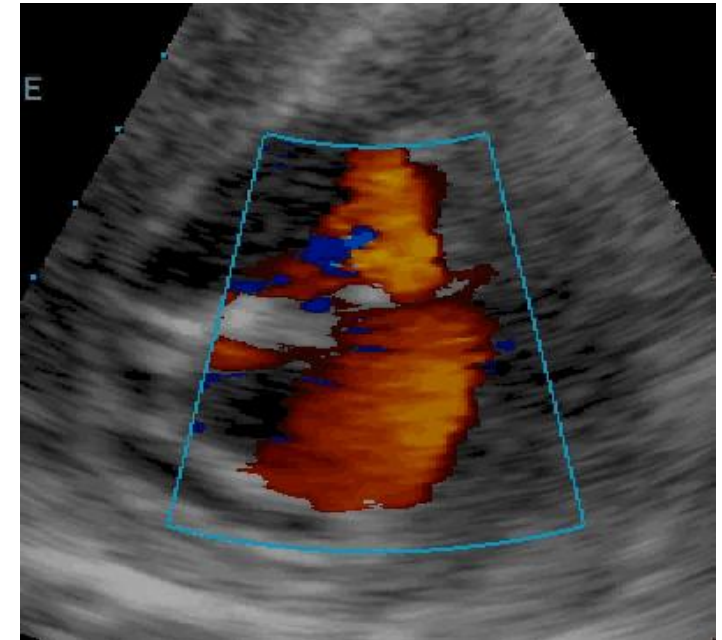
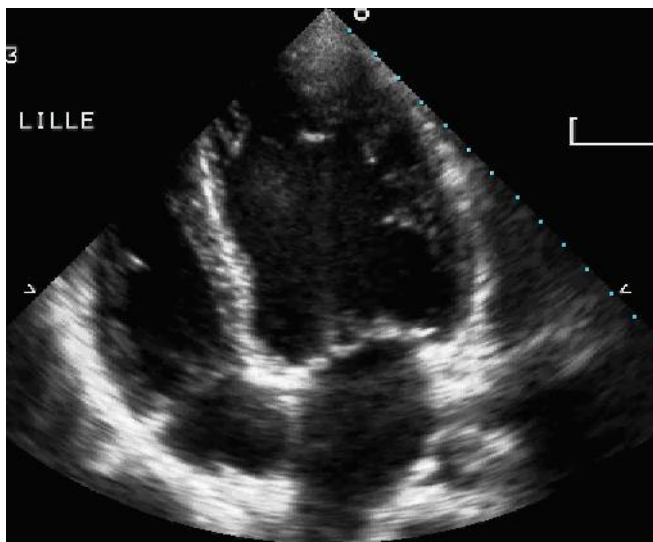
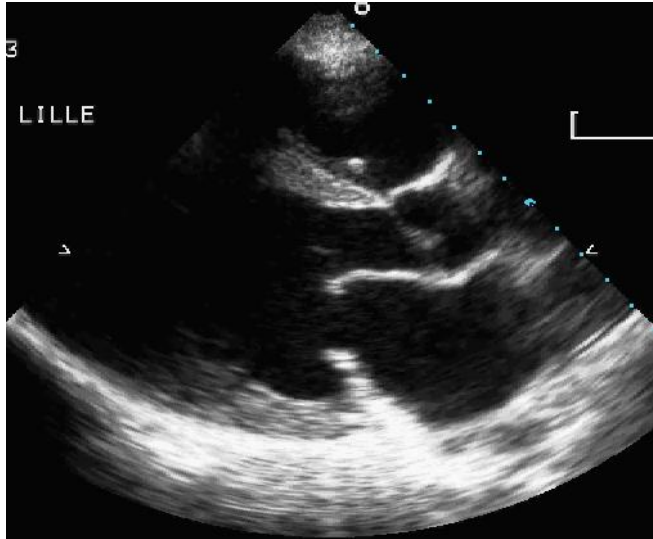
FED



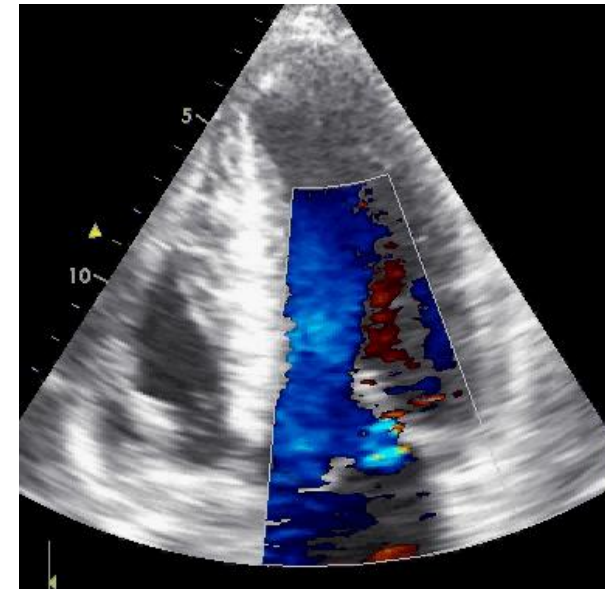
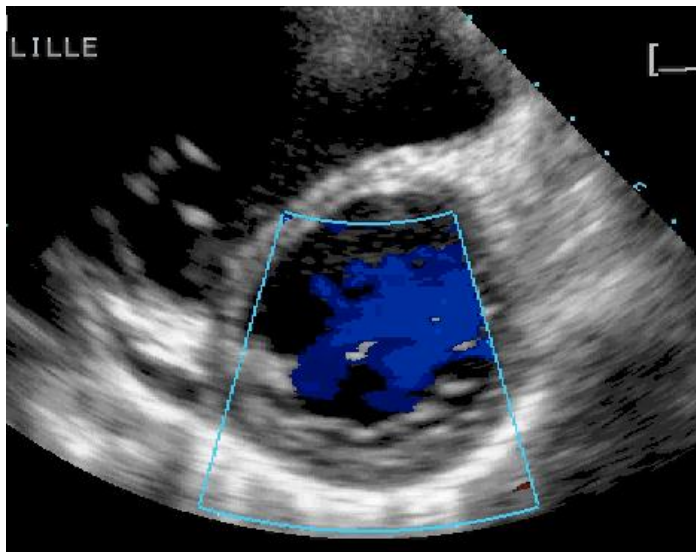
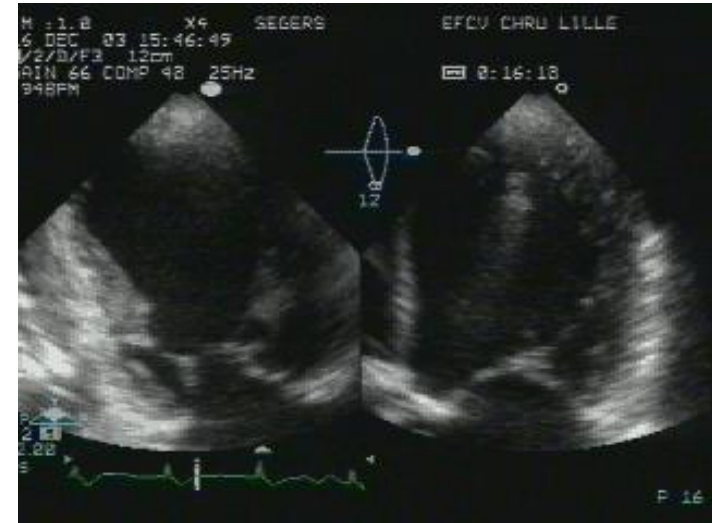
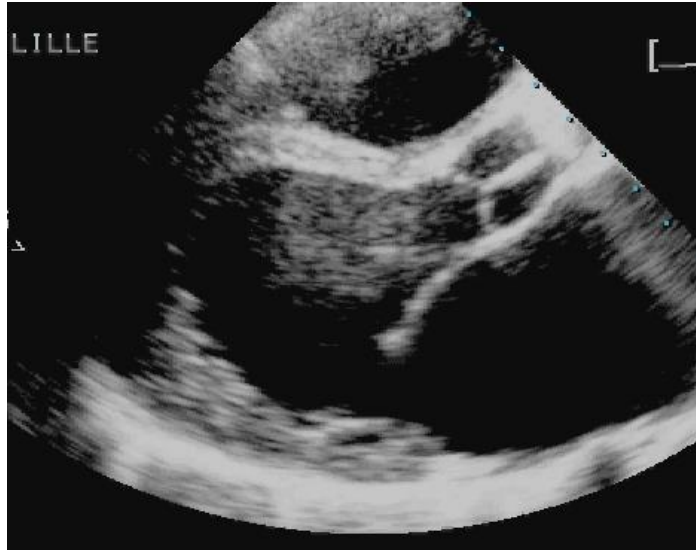
IM Organique: Type 2



IM Organique: Type 3a

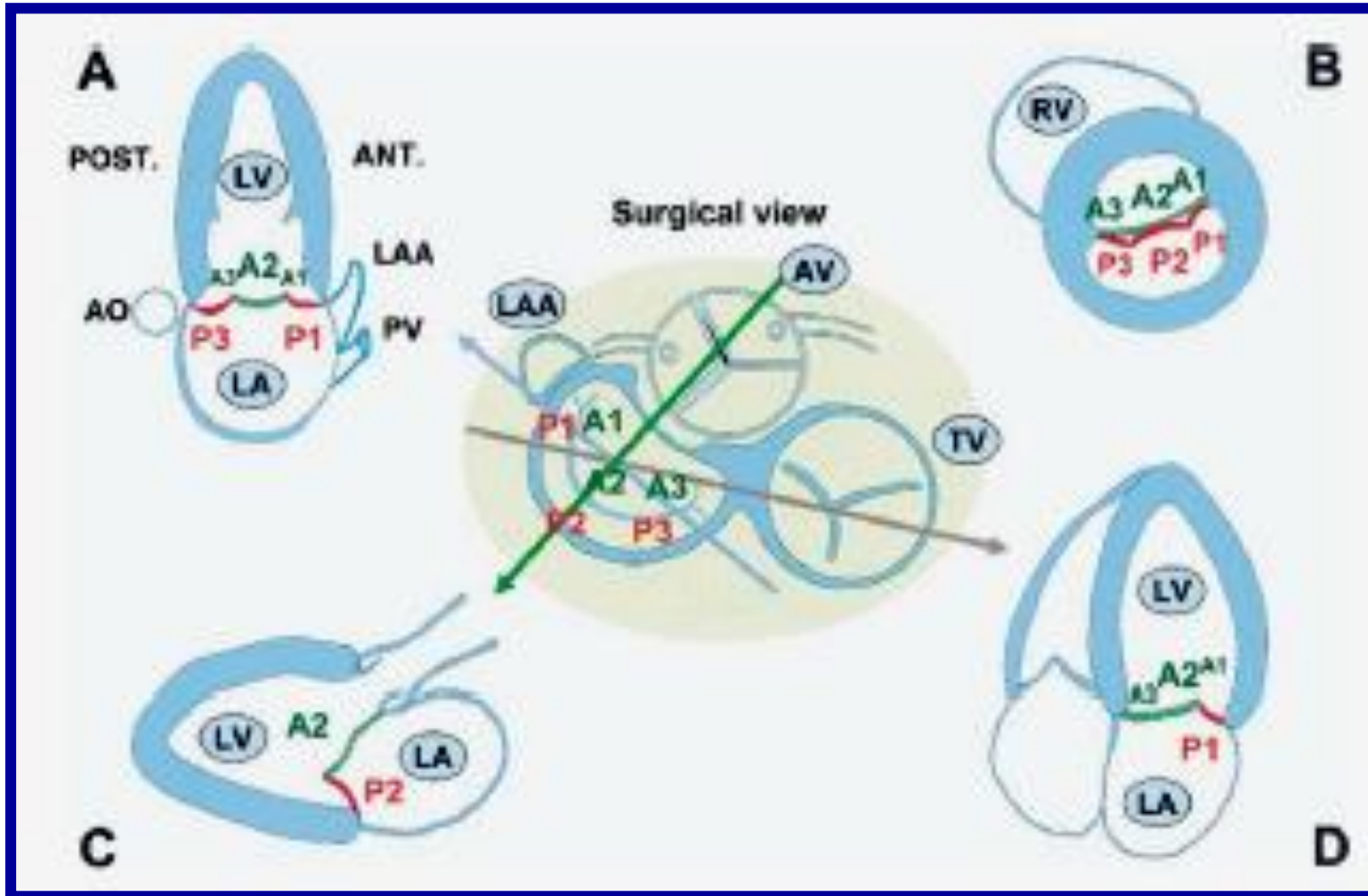


IM Fonctionnelle: Type 3b



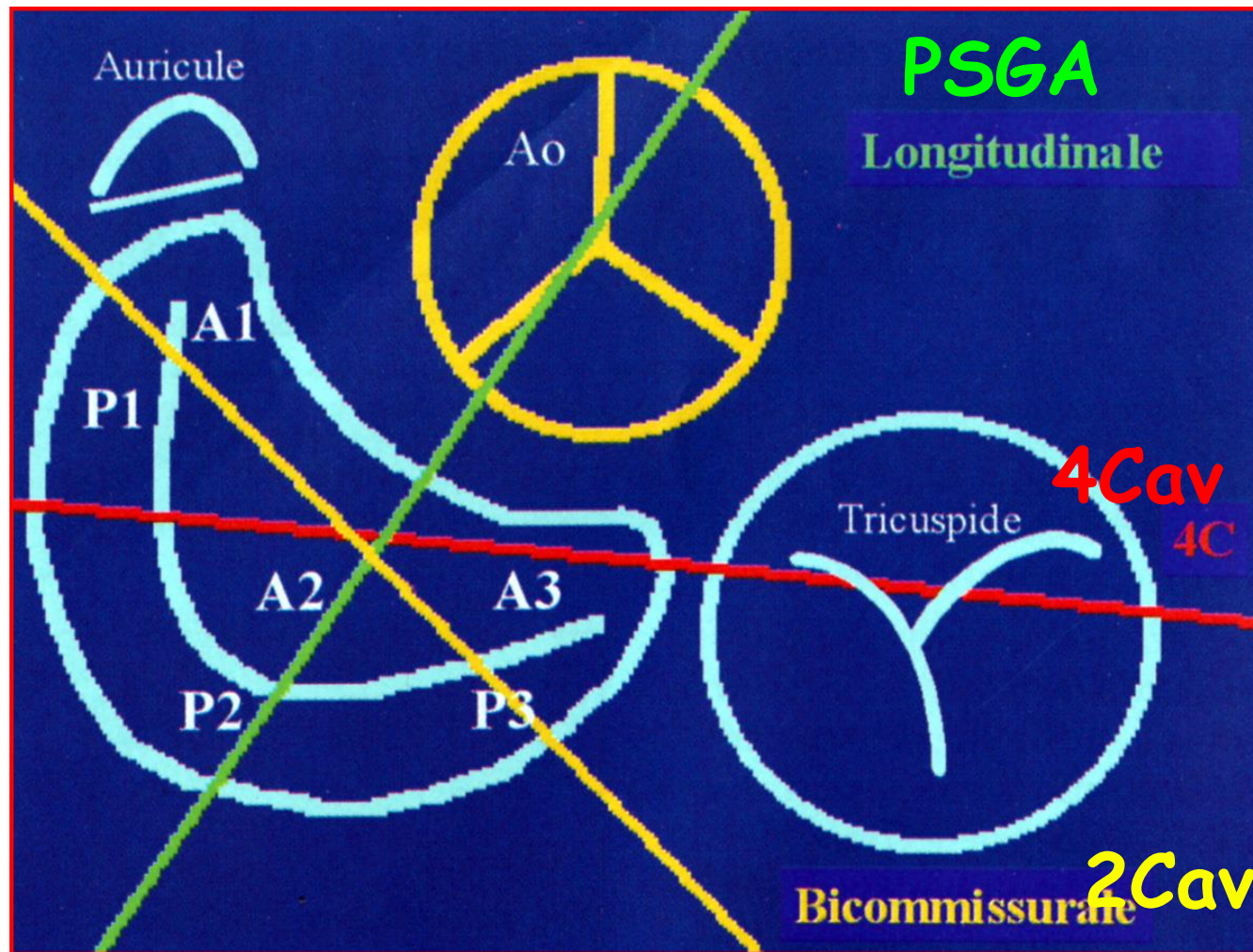
3) Exploration de la valve

Exploration Mitrale



Monin JL, JACC 2005; 46: 306-309

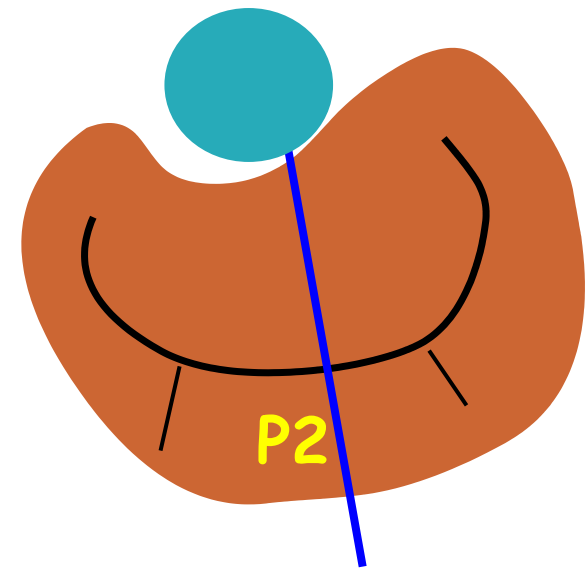
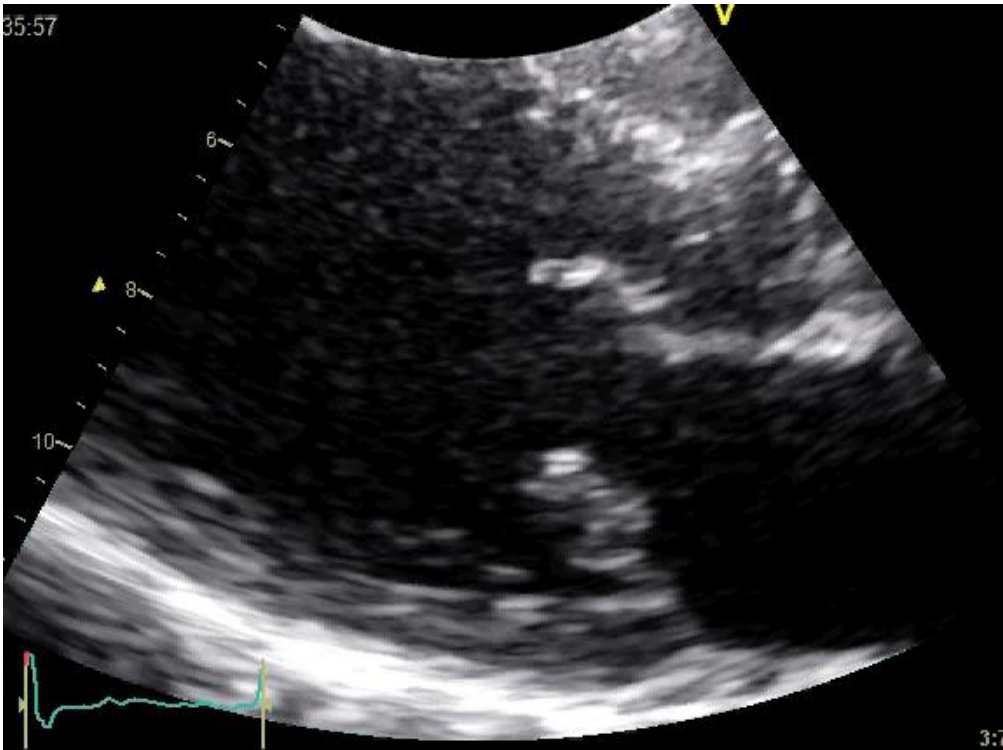
Exploration Mitrale



Monin JL, JACC 2005; 46: 306-309

Exploration Mitrale

1) PSGA



Vue PSGA avec l'aorte

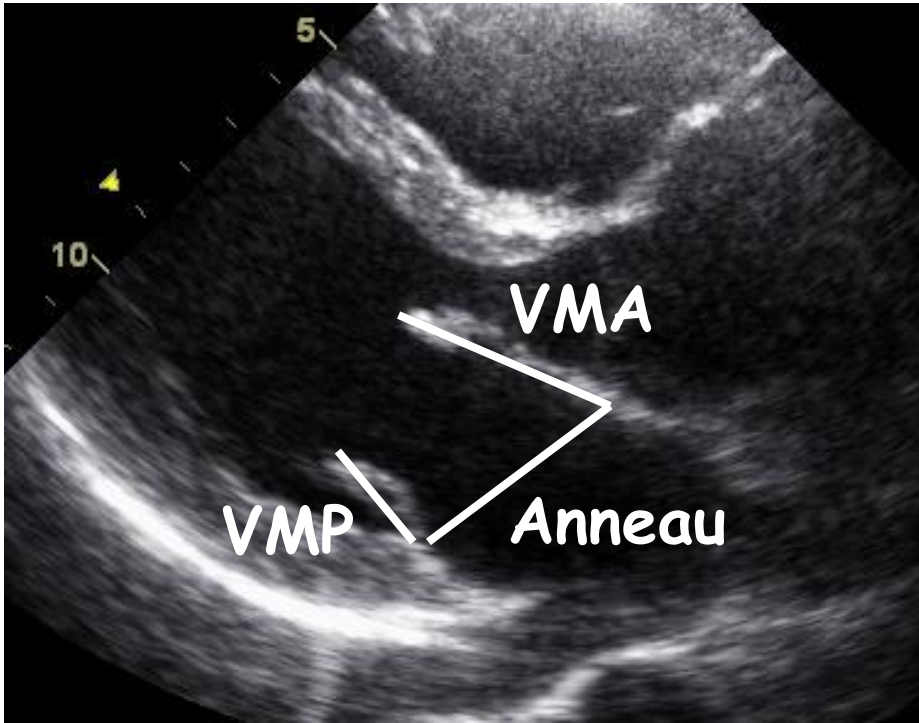
⇒ A2P2

Prolapsus de P2 avec
rupture de cordages (+A2)

Valve M Post redondante,
modérément épaissie

Exploration Mitrale

1) PSGA



Valeurs Normales

VMA: 20-22 mm

VMP: 10-12 mm

Ann/VMA < 1.3

Patient

VMA: 36 mm

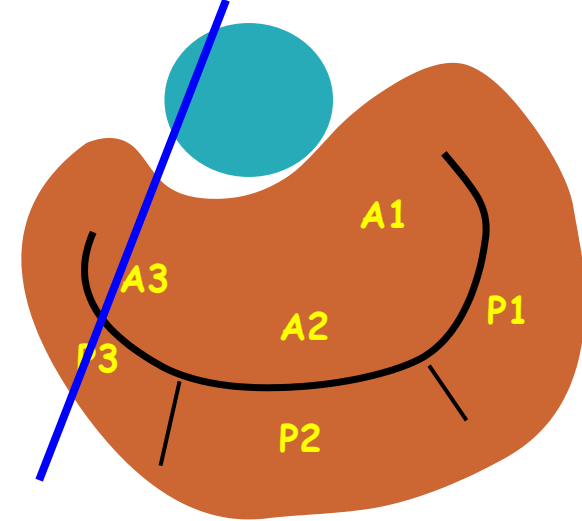
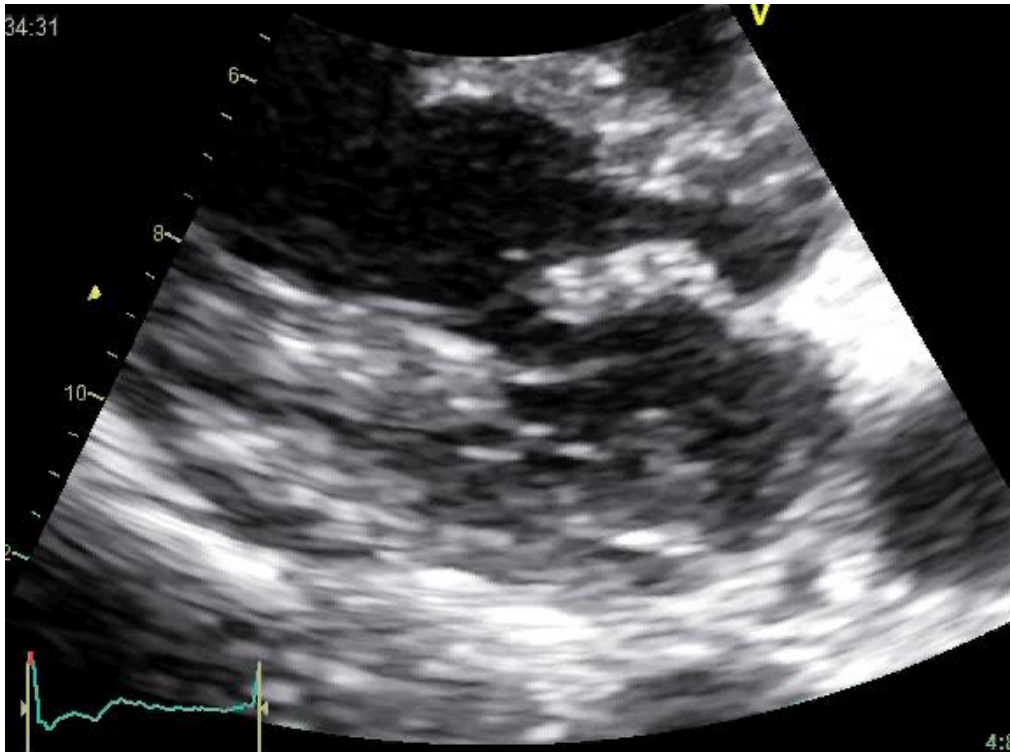
VMP: 23 mm

Anneau: 45 mm

Ann/VMA: 1.4

Exploration Mitrale

1) PSGA

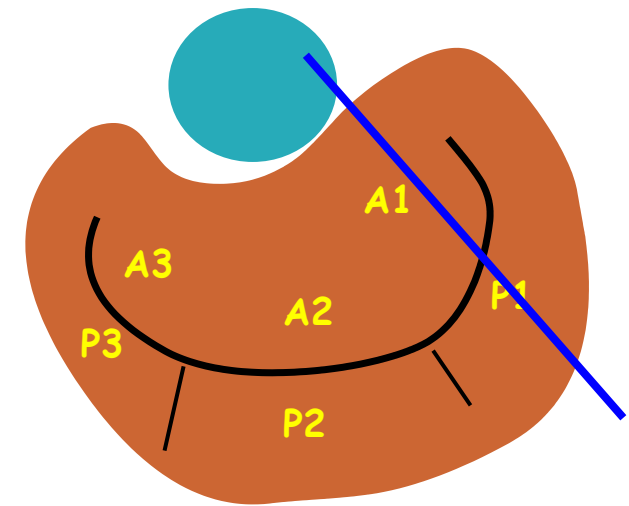
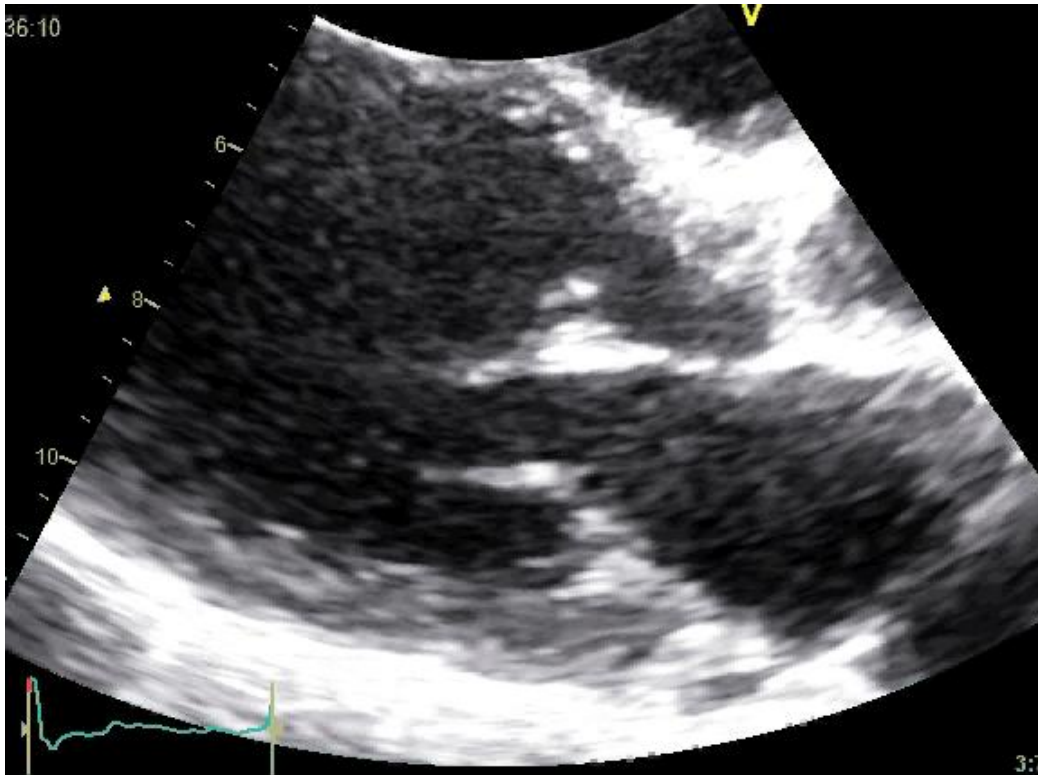


Becquer vers la droite
⇒ A3P3 (pilier postérieur)

Prolapsus de A3P3 sans
rupture de cordage

Exploration Mitrale

1) PSGA

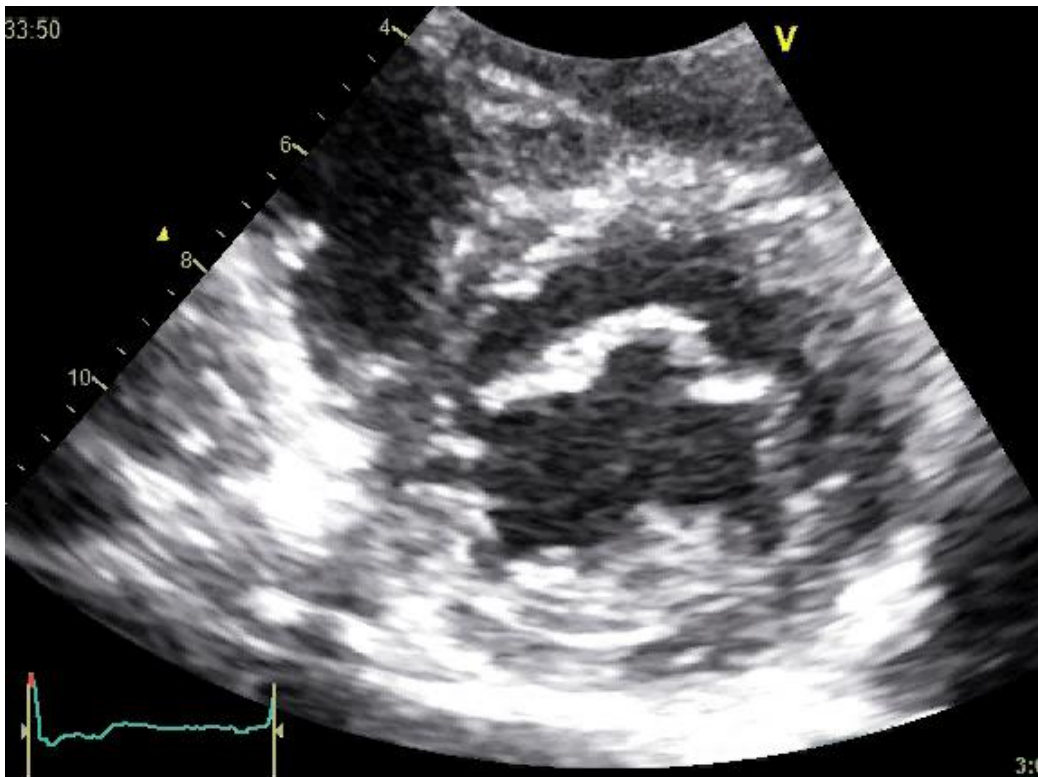


Becquer vers la gauche
⇒ A1P1 (pilier antérieur)

Discrète ballonisation de
A1P1

Exploration Mitrale

2) PSPA



Balayage depuis la valve
vers l'apex

⇒ VMA-VMP

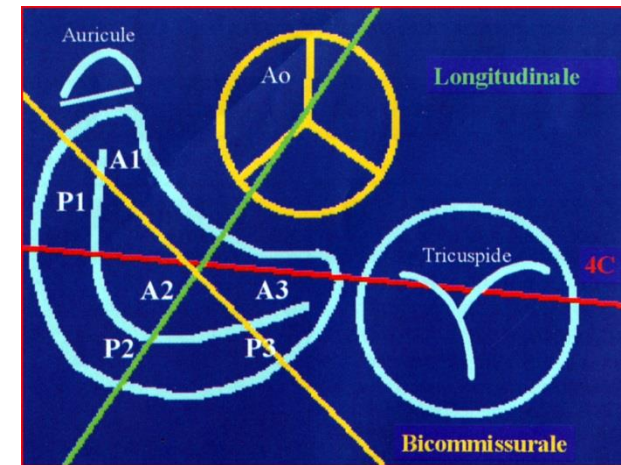
⇒ Commissures

⇒ Cordages, Piliers

⇒ Cinétique segmentaire

Exploration Mitrale

3) Apicale 4 Cavités

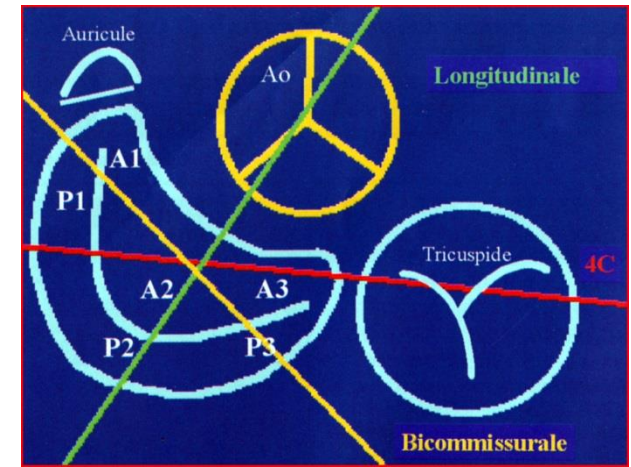


⇒ A3A2P2 ou P1



Exploration Mitrale

3) Apicale 2 Cav



⇒ P3-A2-P1

⇒ Prolapsus de P2
avec rupture de cordage

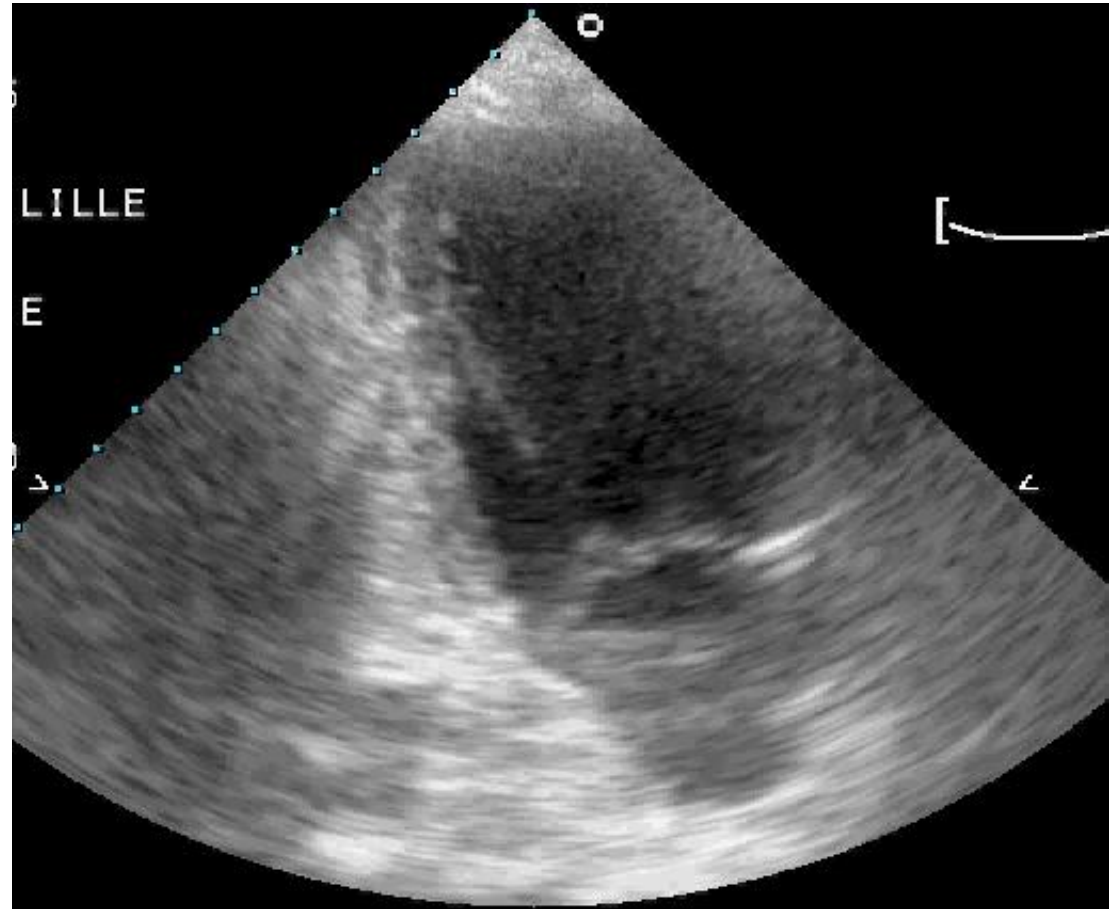
⇒ Prolapsus de P3

Exploration Mitrale

4) Apical 2 cavités

⇒ P3-A2-P1

⇒ Prolapsus de P1

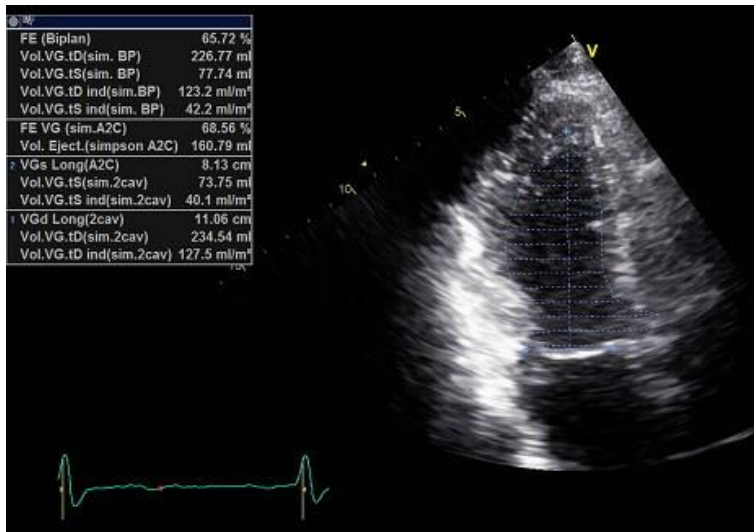
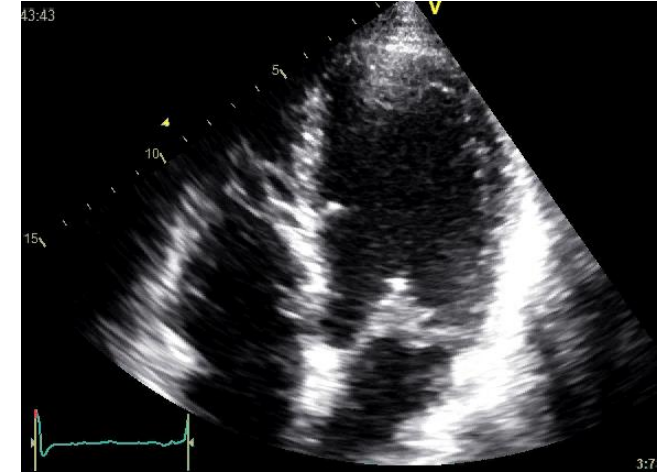
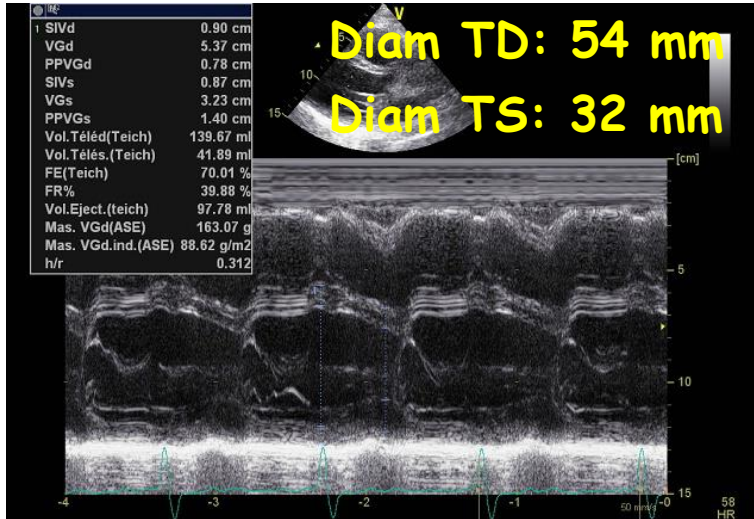


4) Quantification

Quantification: IM Massive

- VG dilaté (IM chronique, $> 30 \text{ mm/m}^2$ en DTD base)
- OG dilatée (IM chronique)
- HTAP
- IM holosystolique
- S'étendant jusqu'au fond de l'OG
- Large zone de convergence, large vena contracta, ou fuite étendue sur la zone de coaptation (apical 2 cavités)
- Orifice de régurgitation visible

Quantification: Retentissement



Vol VG TD: 227 mL

Vol VG TS: 78 mL

FE 66%

OG biplan: 82 mL/m²

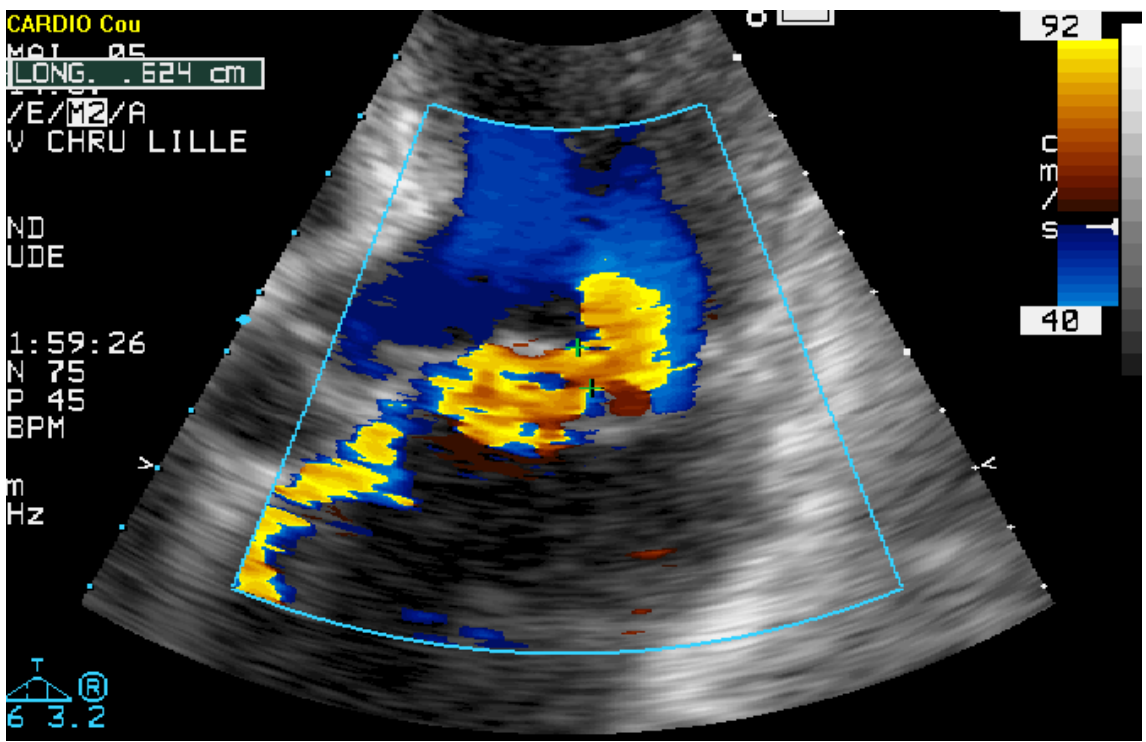
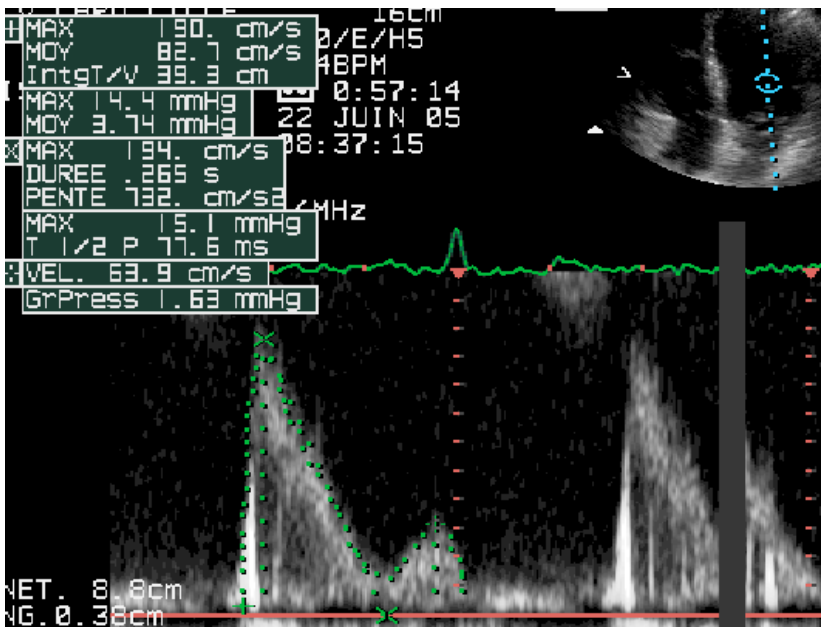
IC normal bas: 2.7 L/min/m²

PAPs: 25 mmHg

Quantification

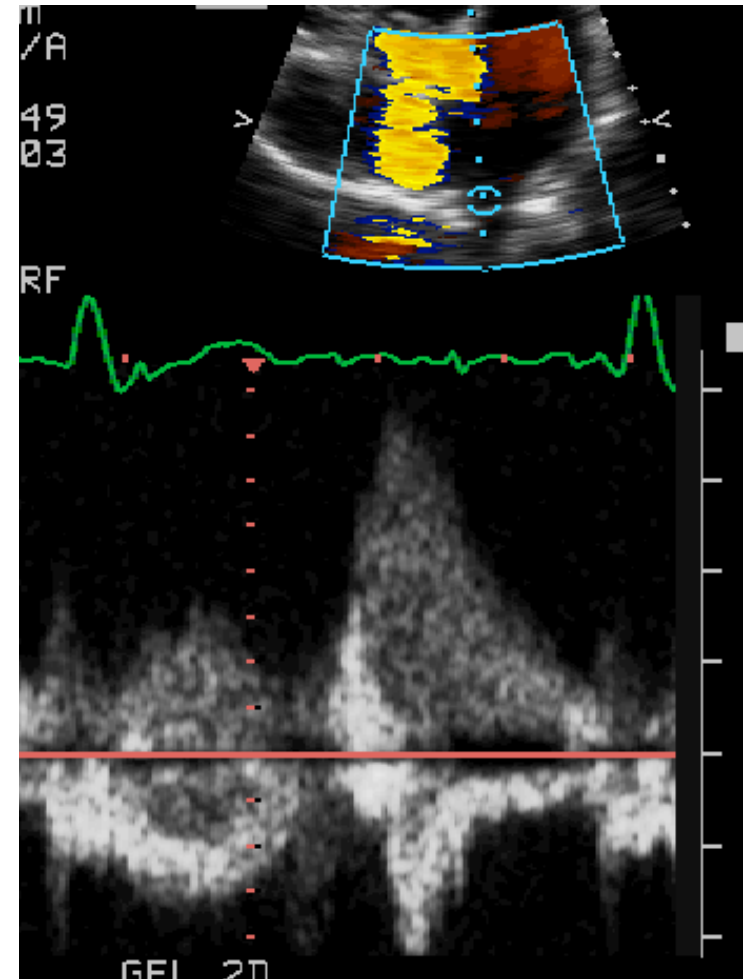
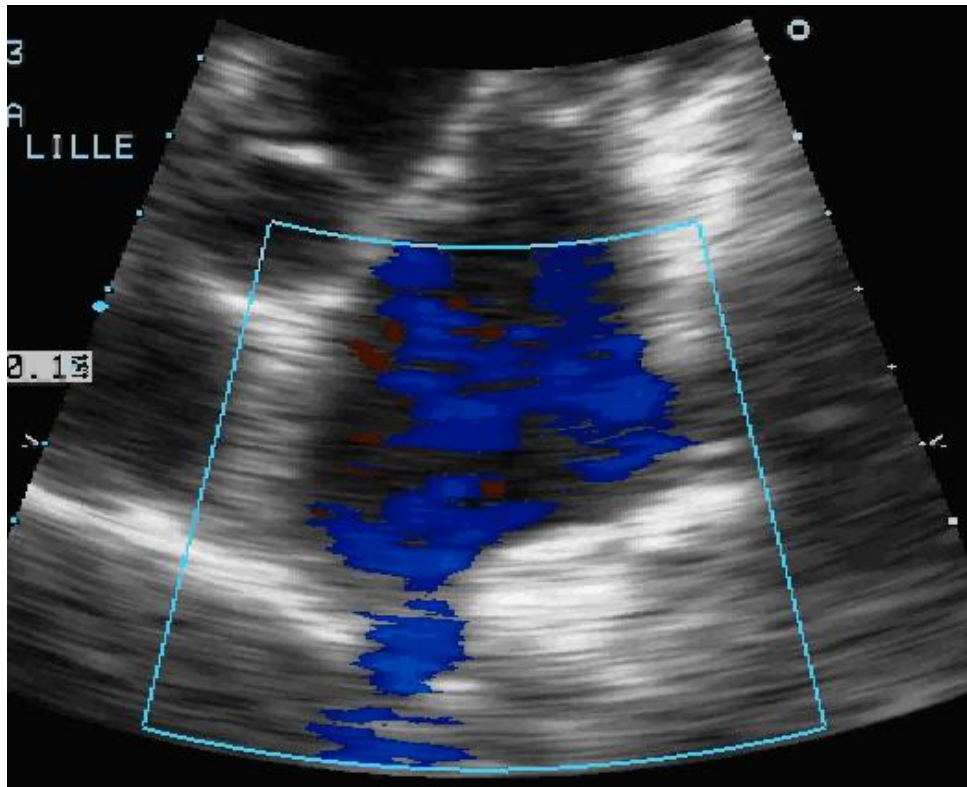
- $V_{\max}$ onde E mitrale $> 1,2$ m/s
- VTI mitrale/ VTI aortique $> 1,3$
- ~~• Surface jet régurgitant dans l'OG $> 8-9$ cm²
(A4Cavités: surface zone d'aliasing)~~
- ~~• Surface jet régurgitant $> 40\%$ Surface OG~~
- Diamètre du jet à l'origine ≥ 7 mm (PSGA)

Quantification



Quantification

Flux V pulmonaire



**Reflux systolique
= IM sévère**

Quantification

- Prolapsus ou "Flail" ?
 - 85% des "flail": grade 4 (vol reg > 60 ml)
- Reflux systolique veine pulmonaire ?

⇒ IM sévère

Quantification

- Objective:
 - PISA
 - Equation de continuité
 - Volumes VG - Doppler chambre de chasse

Quantification: PISA

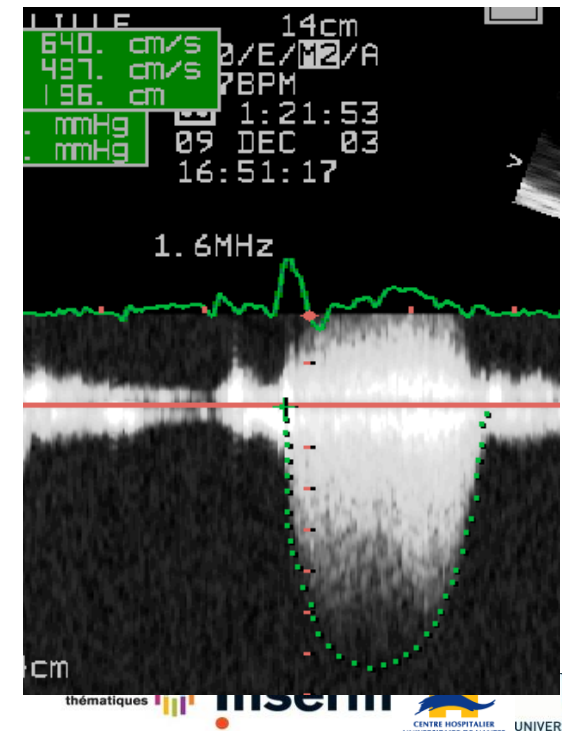
Doppler couleur, Apical 4 Cavités, Zoom

Vit aliasing 20 à 50 cm/s

(5-10% de la Vmax du flux régurgitant)

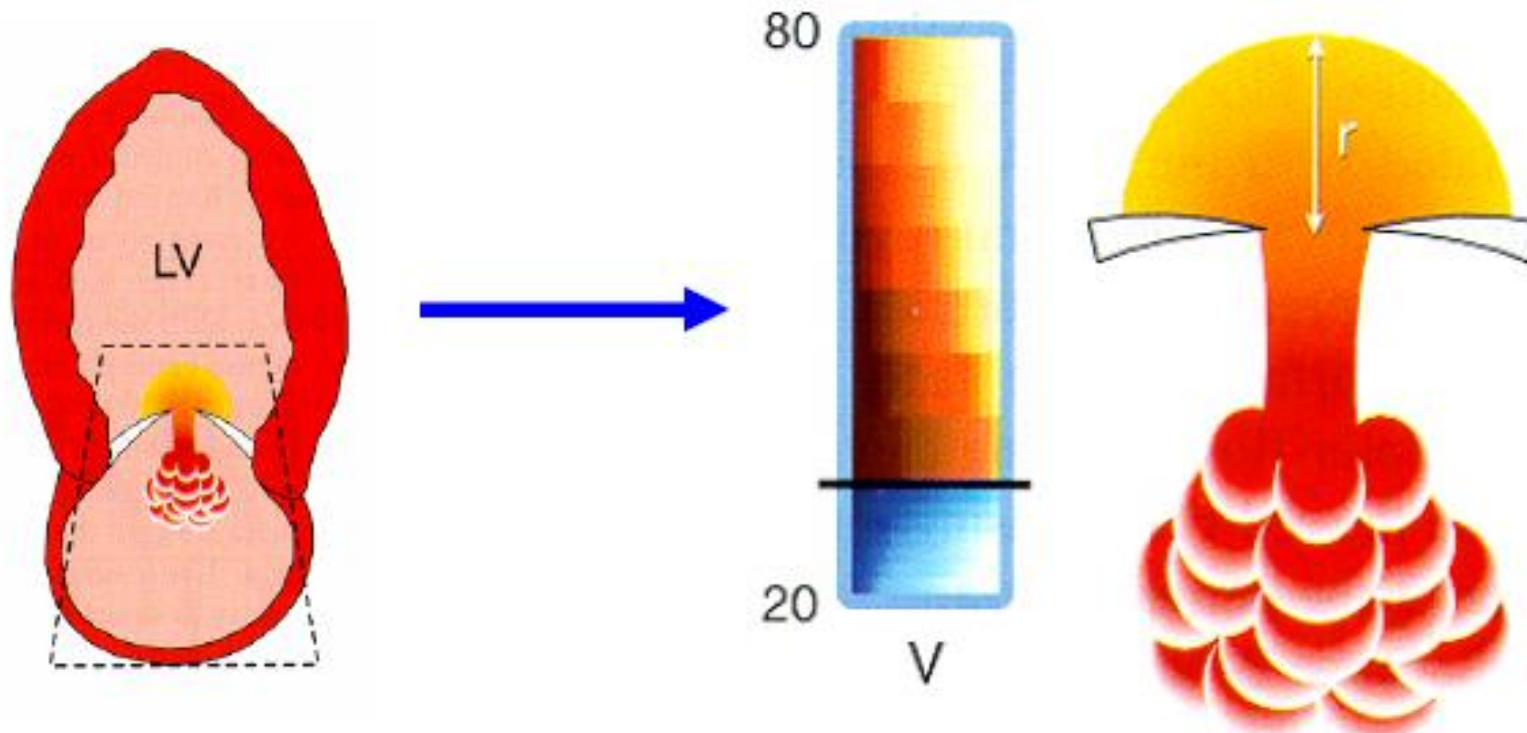
$$Q_R: 2 \pi r^2 \times Val \text{ (en ml/s)}$$

$$SOR: Q_R / Vmax \text{ (en cm}^2\text{)}$$



Quantification: PISA

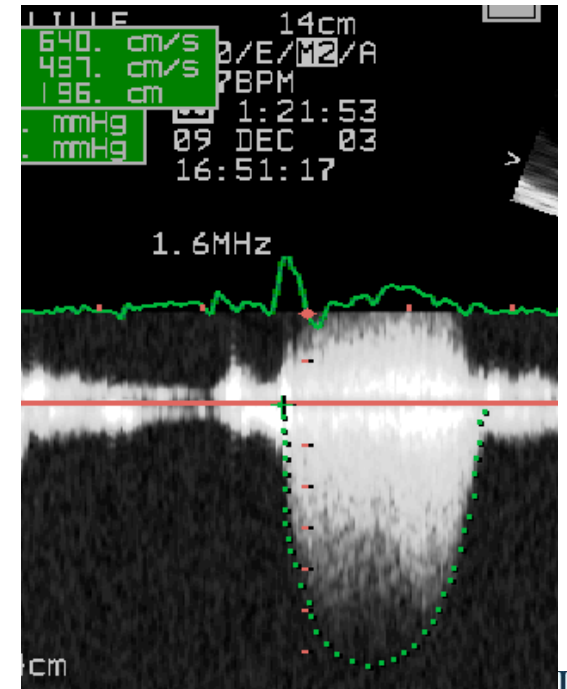
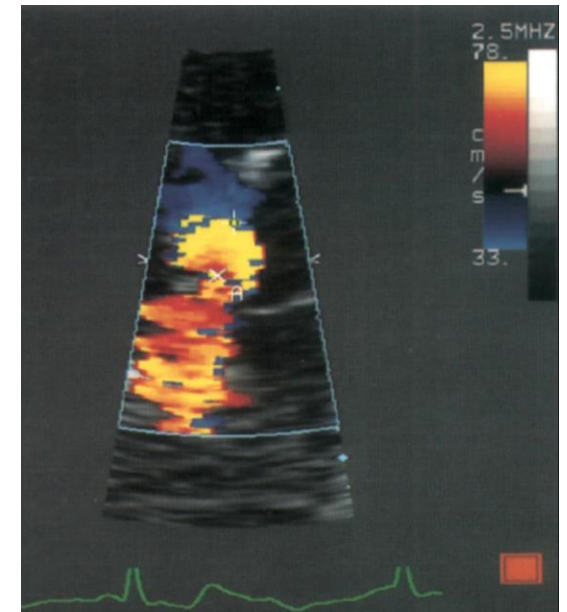
Mesure du rayon de l'hémisphère entre l'orifice régurgitant (plan des valves) et le 1^{er} aliasing (transition jaune-orangé au bleu)



Quantification: PISA

Vol IM: $SOR \times VTI \text{ IM (en ml)}$

Freg %: $\text{Vol IM} / (\text{Vol IM} + \text{Vol Ao})$



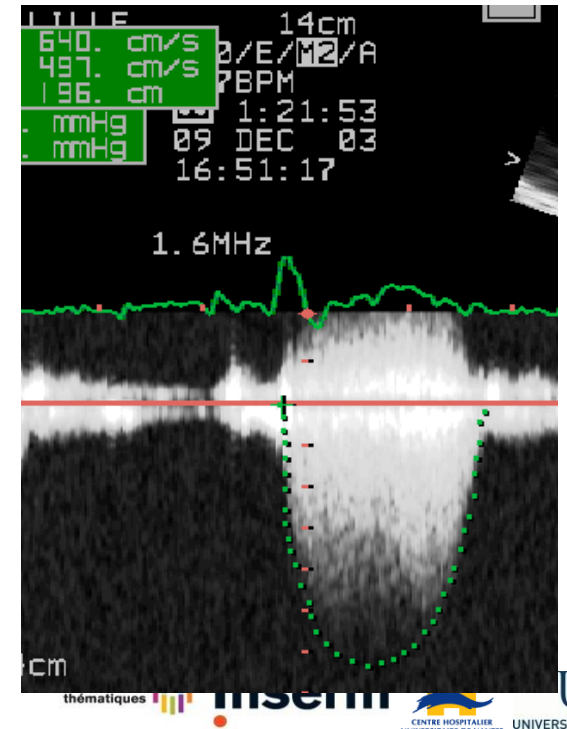
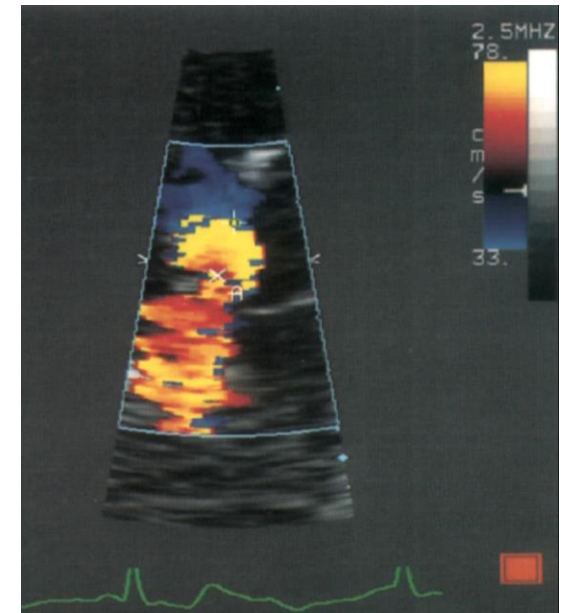
Quantification: PISA

Méthode simplifiée:

PRF à 40 cm/s $\Rightarrow 2 \pi \times Val = 250$

$V_{max} IM \approx 500 \text{ cm/s}$

SOR: $r^2/2$ (en cm^2)



Quantification

- S'assurer que l'IM est holosystolique
- Mesure en mésosystole
- Régler correctement la PRF (base 20-40 cm/s)
- Attention au phénomène de confinement
- Se méfier des fuites étendues sur la zone de coaptation

.21TT :0.7

RADIO TMC

GAIN 75 COMP 45

6HZ16cm

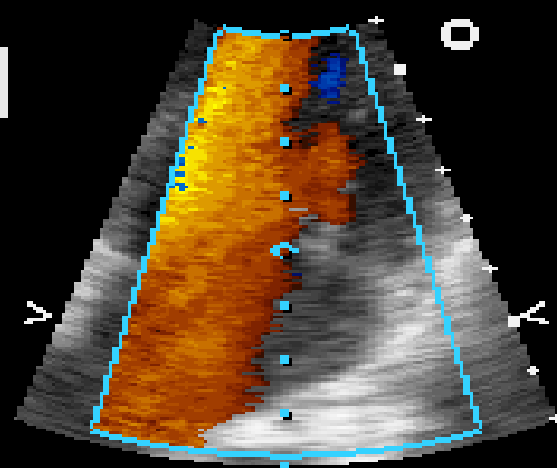
1/2/F/M2/A

75BPM

1:43:53

11 MAI 05

11:55:15

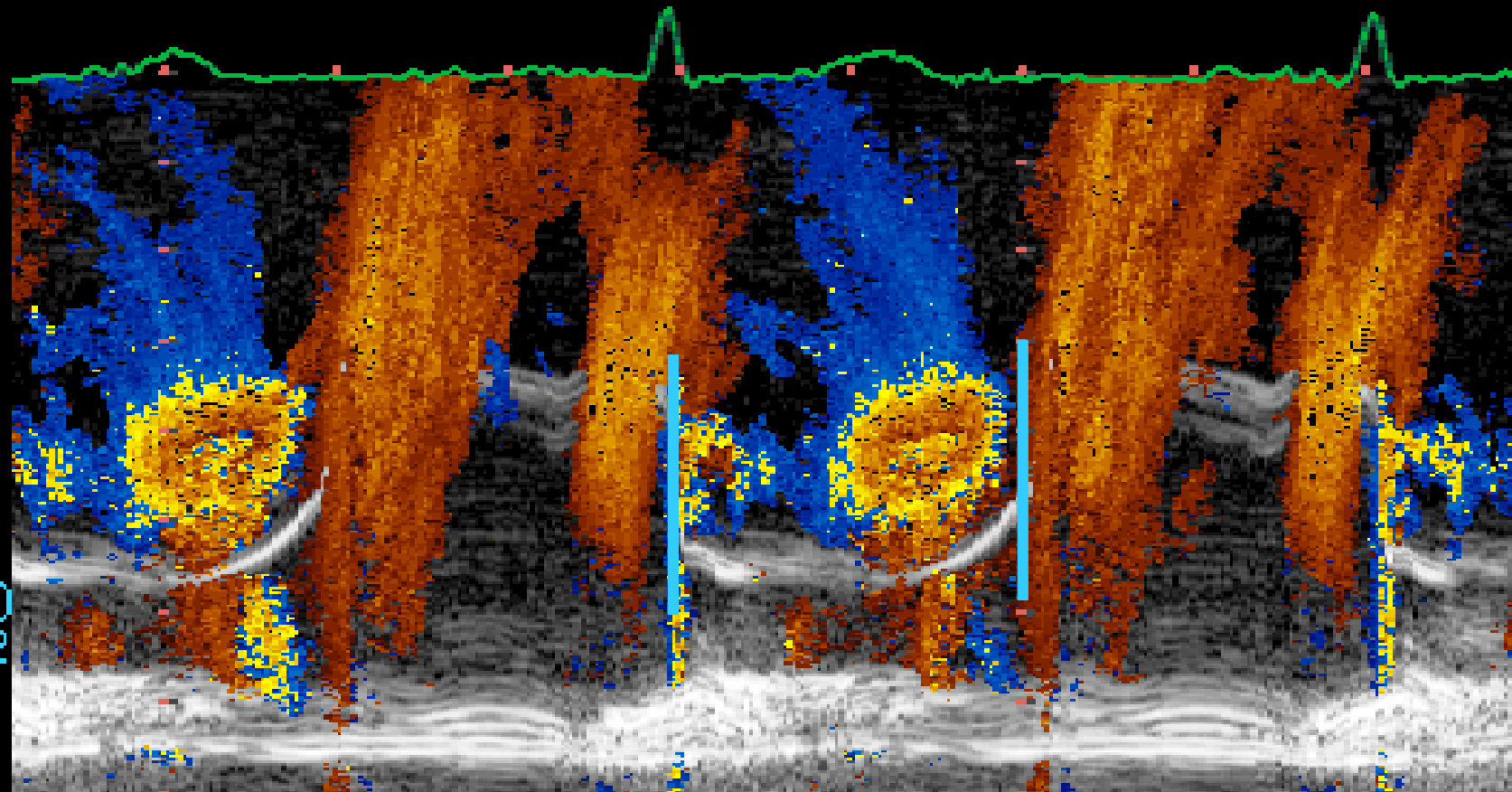


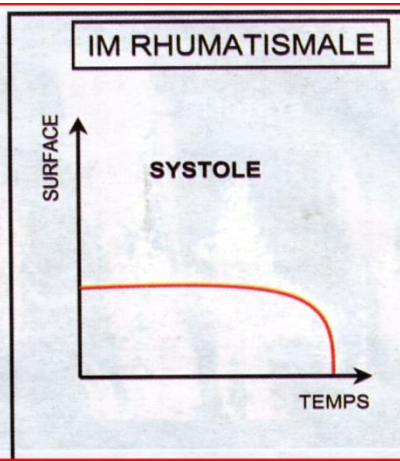
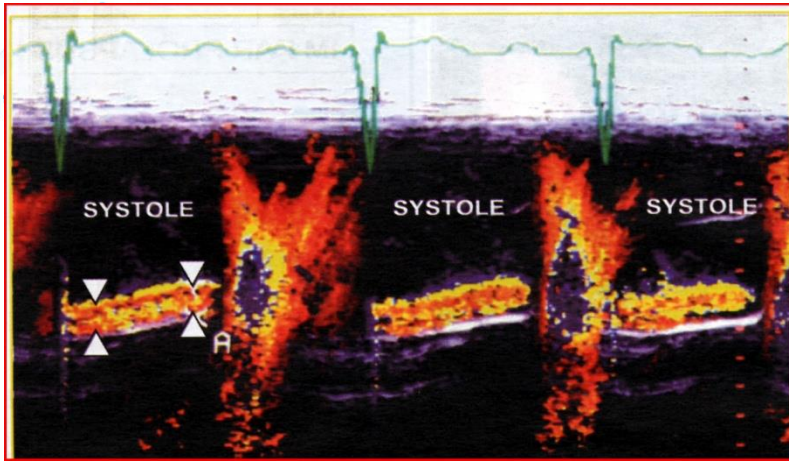
3.0MHz

77

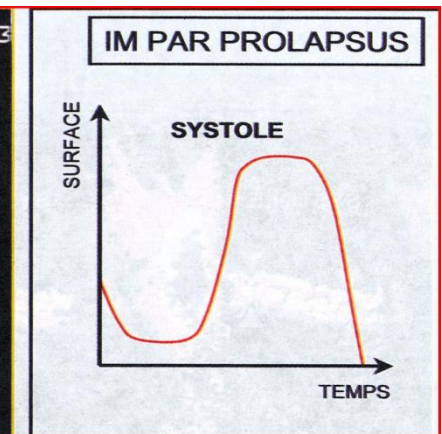
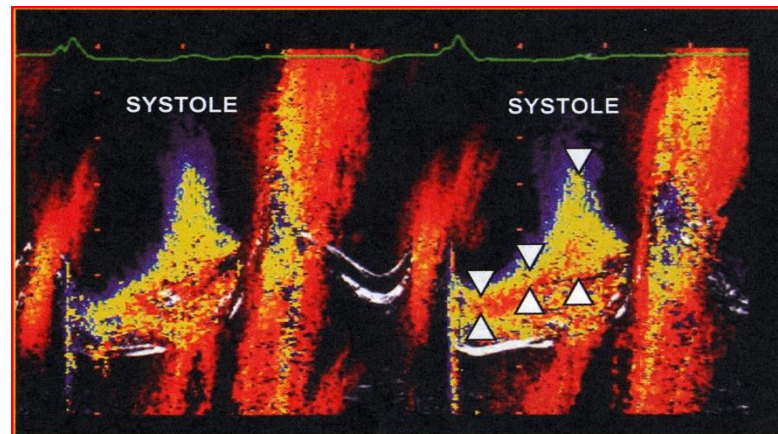
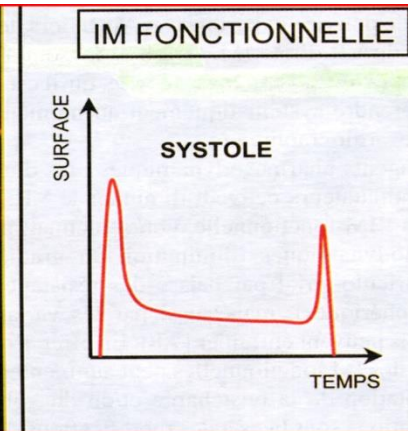
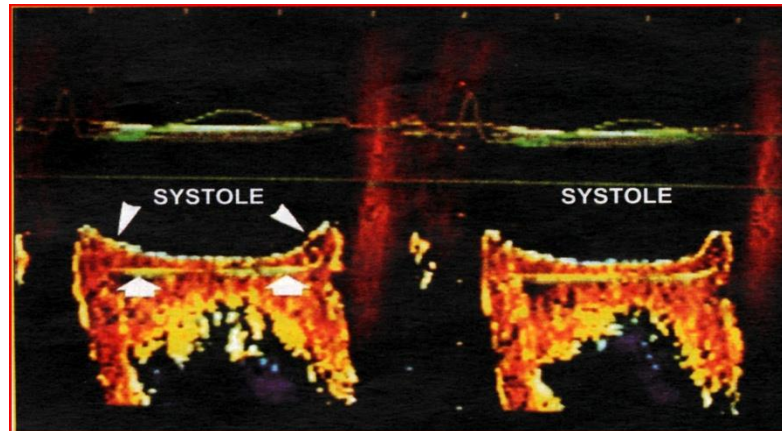
0
m
s

33



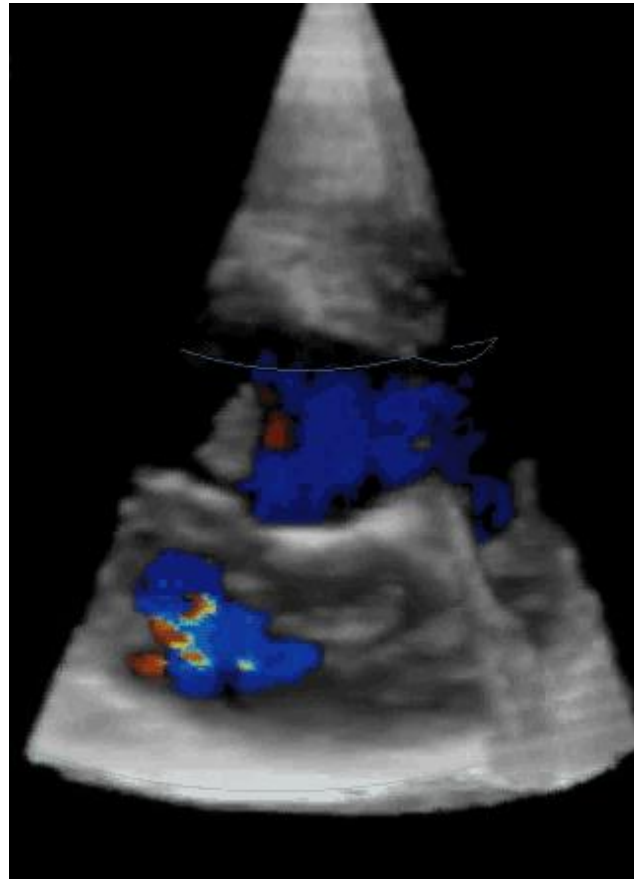


Mesure de la PISA en mésosystole



Quantification

Echocardiographie 3D temps-réel



Quantification: Doppler pulsé

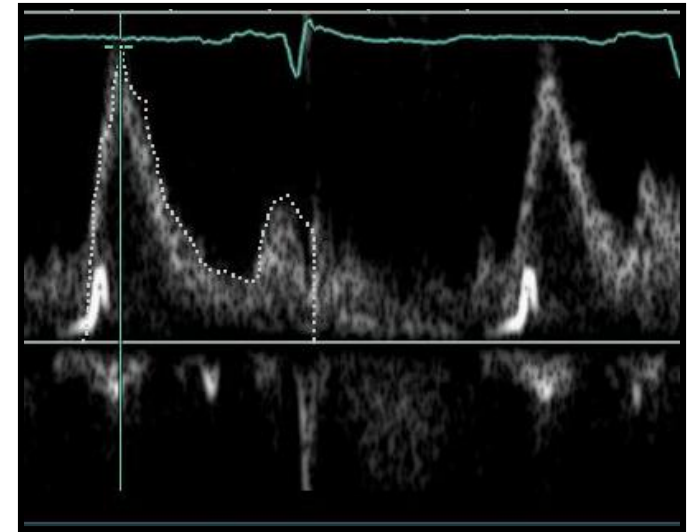
Mesure de l 'anneau mitral en 2 plans
orthogonaux (D1, D2)

(PSGA et A2Cav en diastole)

VTI mitral à l 'anneau en doppler pulsé

Vol Mitral: $\pi (D1 \times D2)/4 VTI_M$

Vol IM: Vol Mitral-Vol Ao



Quantification

IM grade 3		IM sévère IM grade 4
SOR	0,3 cm ²	0,4 cm ²
Vol Reg	45 ml	60 ml
FReg	40%	50%

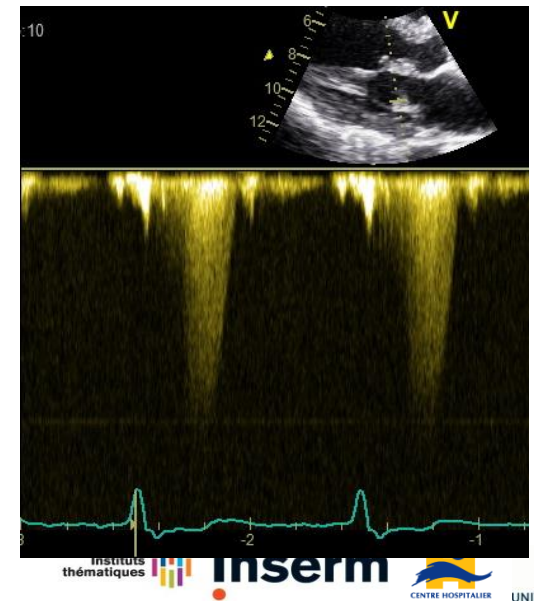
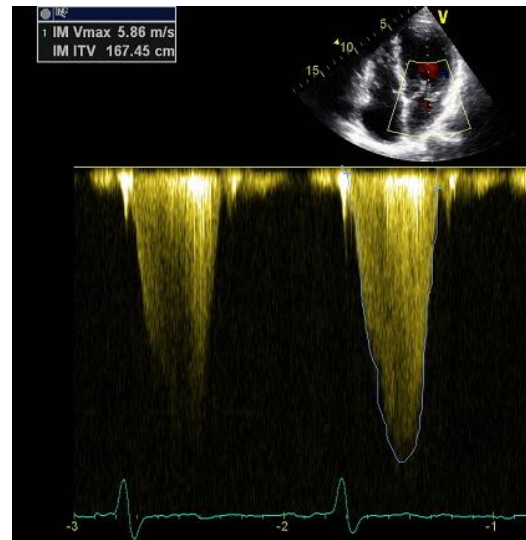
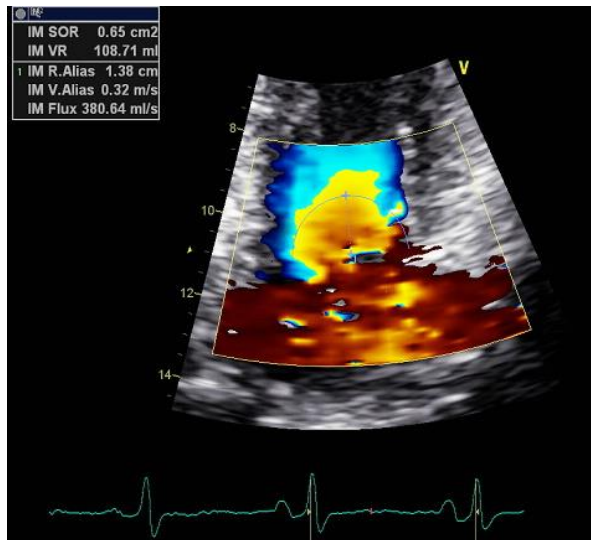
Quantification: Cas clinique

Mécanisme: rupture de cordage, éversion de la valve:
IM sévère

Veines pulmonaires: reflux holosystolique

PISA: SOR 0.65 cm², Vol Reg 110 mL

Vol Ejection VG - VES ch de chasse: 150-87 = 63 mL



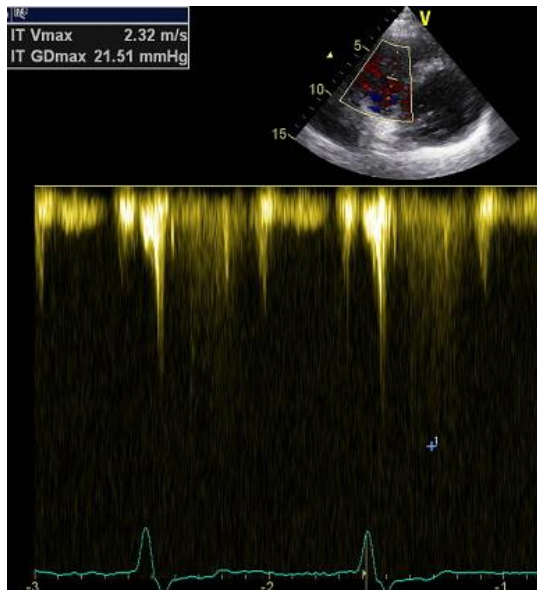
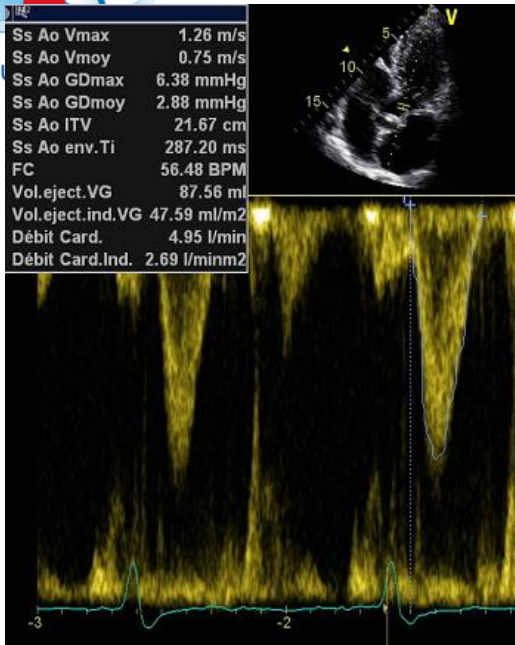
Quantification: Conclusion

- Critères de retentissement: VG, OG, PAPS, Flux V pulmonaire
- Mécanisme: Flail +++
- Critères volumétriques:
 - PISA +++
 - Equation de continuité
 - Volumes VG-Débit Ch de Chasse

Retentissement à l'effort

Echo d'effort:

- Arrêt pour fatigue Minfs (Asympto)
- Capacité fonctionnelle: 90% théor.
- PAPs 63 + 15 mmHg



The END

Effet de la Chirurgie

- Améliore la symptomatologie
- Améliore la survie
- Réparation > Remplacement
- Taux de réopération: $\approx$ identique 1-2%/an

Réparabilité

- ◆ **Forme anatomique:**
 - Prolapsus postérieur +++
- ◆ **Taux de plastie: 50 à 80% des IM**
 - Lille 1995-2006: 256 patients, 76% plastie (80% prolapsus, 27% autres étiologies organiques)
 - Mayo Clinic: > 90%
- ◆ **Durabilité:**
 - Récidive: 2,4% à 1 an

Guidelines IM

Indication chirurgicale IM sévère

Niveau

Patient Symptomatique, FE VG $> 30\%$ et DTS VG < 55 mm

I B

Patients asymptomatiques :

-Dysfonction VG (DTS ≥ 40 mm [ACC/AHA] / ≥ 45 mm [ESC]) ou FE $\leq 60\%$,
ou chir pour une autre indication

I C

-FA de novo ou HTAP de repos > 50 mmHg

IIa C

- Flail leaflet, Haute probabilité de plastie, faible risque, DTS ≥ 40 mm
[ESC] ou < 40 mm [ACC/AHA]

IIa C

FE VG $< 30\%$ ou DTS > 55 mm résistant au TT médical, réparation +/-
possible, et peu de comorbidités

IIa- IIb C

Patients asympt, FE normale, plastie réalisable, faible risque Chir et

IIb C

-Haute probabilité de plastie, bas risque chir, si Dilatation OG ≥ 60
ml/m² ou HTAP d'effort ≥ 60 mmHg [ESC]

IIb C

Suivi: Guidelines of Valve Disease

TABLE 3. Stages of progression of VHD

Stage	Definition	Description
A	At risk	Patients with risk factors for development of VHD
B	Progressive	Patients with progressive VHD (mild-to-moderate severity and asymptomatic)
C	Asymptomatic severe	Asymptomatic patients who have the criteria for severe VHD: C1: Asymptomatic patients with severe VHD in whom the left or right ventricle remains compensated C2: Asymptomatic patients with severe VHD with decompensation of the left or right ventricle
D	Symptomatic severe	Patients who have developed symptoms as a result of VHD

VHD, Valvular heart disease.

Suivi: Guidelines of Valve Disease

TABLE 4. Frequency of echocardiograms in asymptomatic patients with VHD and normal left ventricular function

Stage	Valve lesion			
	Aortic stenosis*	Aortic regurgitation	Mitral stenosis	Mitral regurgitation
Progressive (stage B)	Every 3–5 y (mild severity $V_{\max}$ 2.0–2.9 m/s) Every 1–2 y (moderate severity $V_{\max}$ 3.0–3.9 m/s)	Every 3–5 y (mild severity) Every 1–2 y (moderate severity)	Every 3–5 y (MVA >1.5 cm ²)	Every 3–5 y (mild severity) Every 1–2 y (moderate severity)
Severe (stage C)	Every 6–12 mo ($V_{\max} \geq 4$ m/s)	Every 6–12 mo Dilating LV: more frequently	Every 1–2 y (MVA 1.0–1.5 cm ²) Once every year (MVA <1.0 cm ²)	Every 6–12 mo Dilating LV: more frequently

Nishimura R, VHD Guidelines, Circulation 2014