

Introduction à l'Echo 3D

DIU TUSAR Février 2026

Dr Manon Canevet – Anesthésie Réanimation
CTCV CHU Nantes

7.0 Hz
9.2 cm
3D Zoom
20 / 30
% 59 / 35
C 50 / 34
Gen
PRES 1

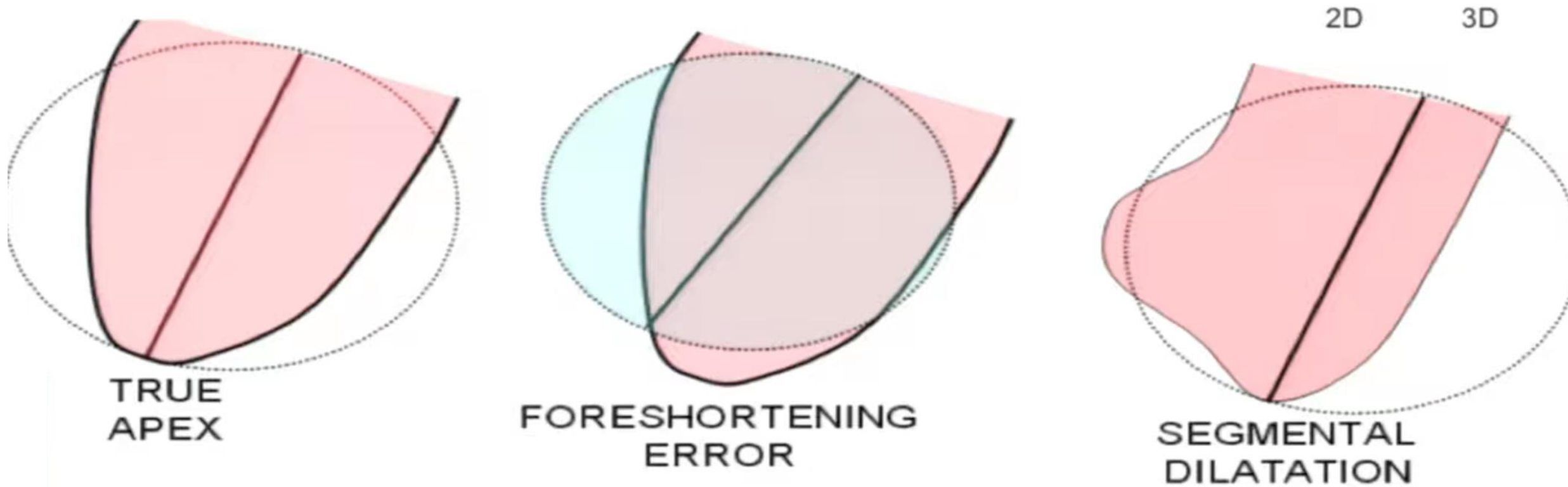


20 / 30
% 59 / 35
C 50 / 34
Gen
PRES 1

Pourquoi faire de l'écho 3D?

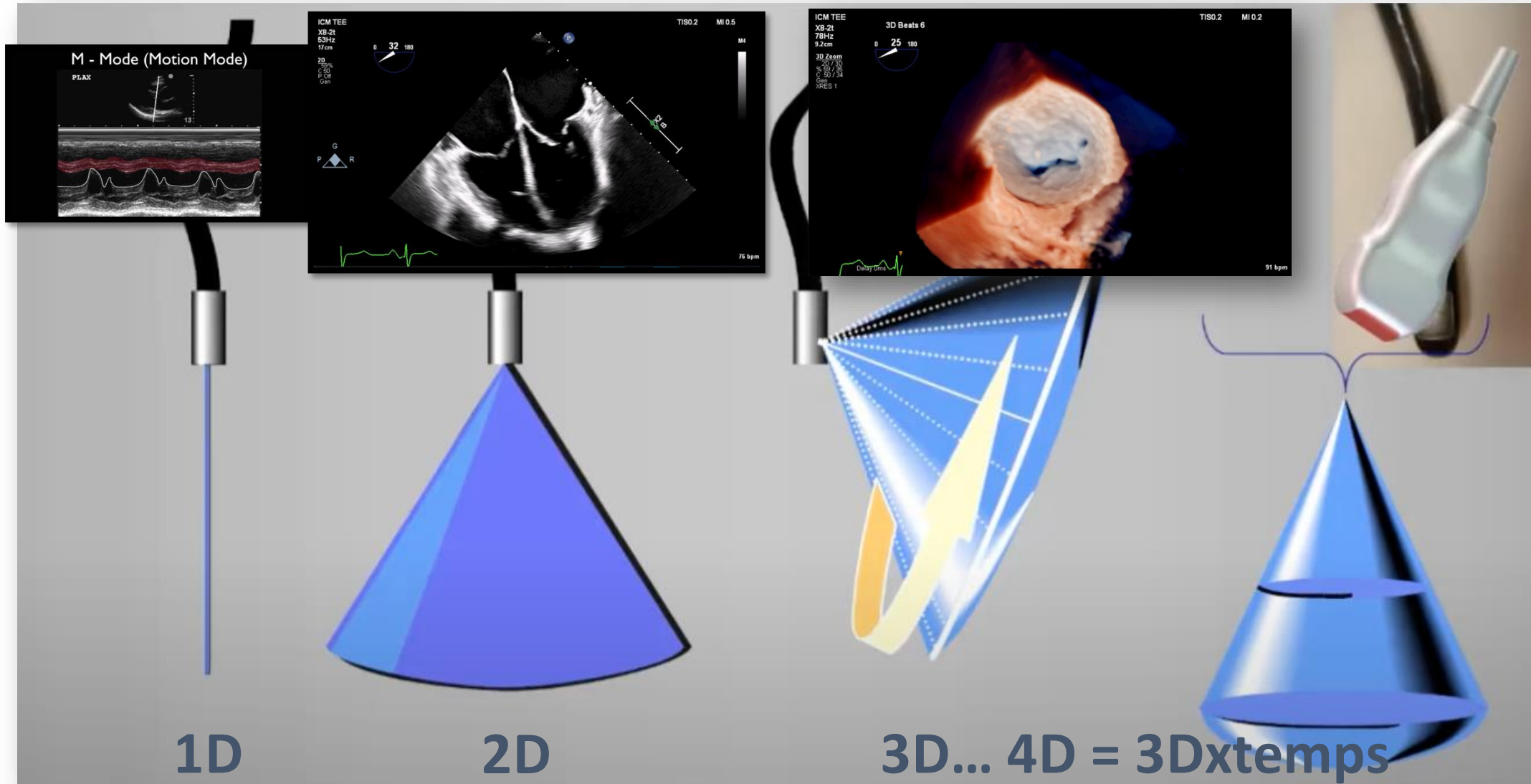
- Evaluation des volumes et de la masse des cavités cardiaques
- Evaluation du mouvement régional de la paroi du ventricule gauche (VG) et la quantification de la dysynchronie systolique
- Présentation de vues réalistes des valves cardiaques
- Evaluation volumétrique des lésions régurgitantes et des shunts avec l'imagerie Doppler couleur 3DE
- Evaluation de l'imagerie de stress 3DE
- Échoguidage des procédures percutanées

Pourquoi faire de l'écho 3D?

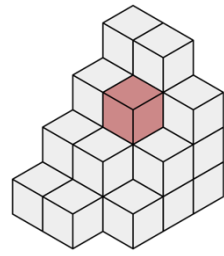


Mor-Avi V, Lang RM et al., *Circulation* 2004. 110: 1814-1818.

1D À 4D



Principe de la 3D



- Acquisition automatisée et sérielle d'images biplan
 - Bras motorisé en ETT ou robotisation de la rotation du plan en ETO avec intégration du positionnement de chaque plan dans l'espace analysé

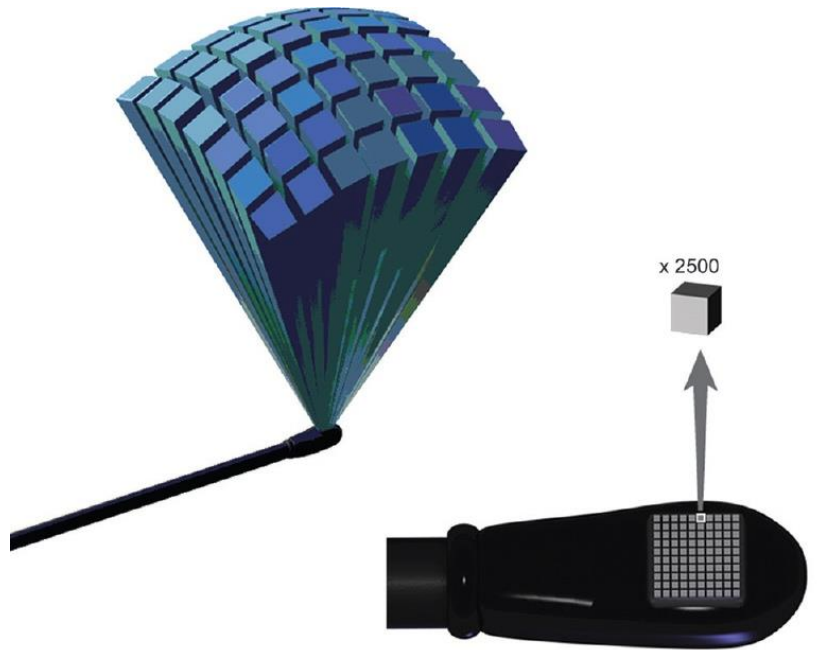
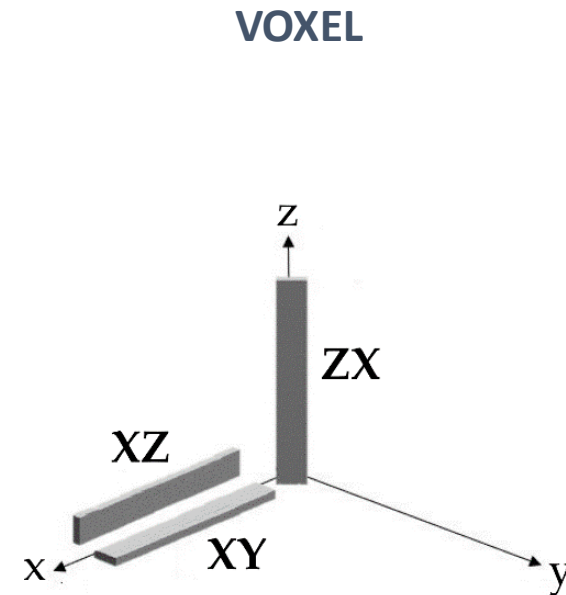
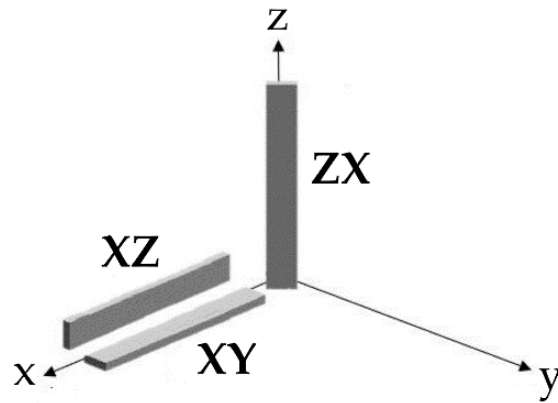


Image courtesy of Michael Corrin



Résolution

- Axiale = 0.5 mm >> latérale = 2,5 mm > élévation = 3 mm



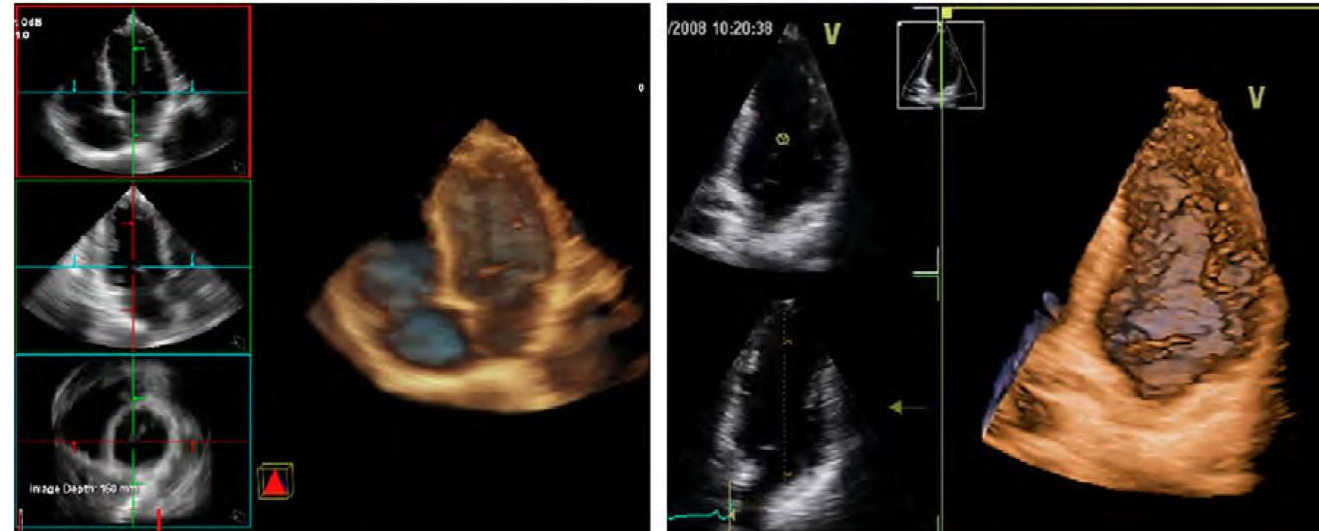
= peut générer des voxels anisotropiques

! Un changement de plan d'étude peut résulter en une différence d'aspect 3D sur une même structure

3D en temps réel ou à battements multiples

3D en temps réel

3DE en temps réel ou en direct fait référence à l'acquisition de plusieurs ensembles de données pyramidales par seconde au cours d'un seul battement de cœur.



Avantages = en cas de mouvements respiratoires ou de trouble du rythme

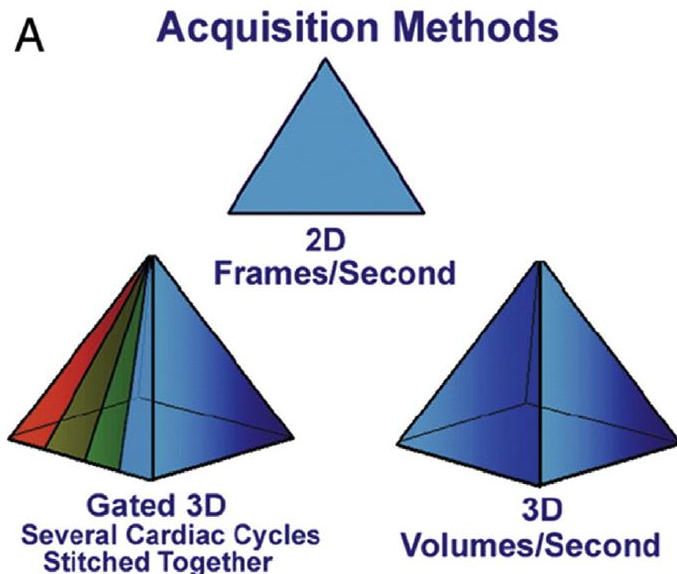
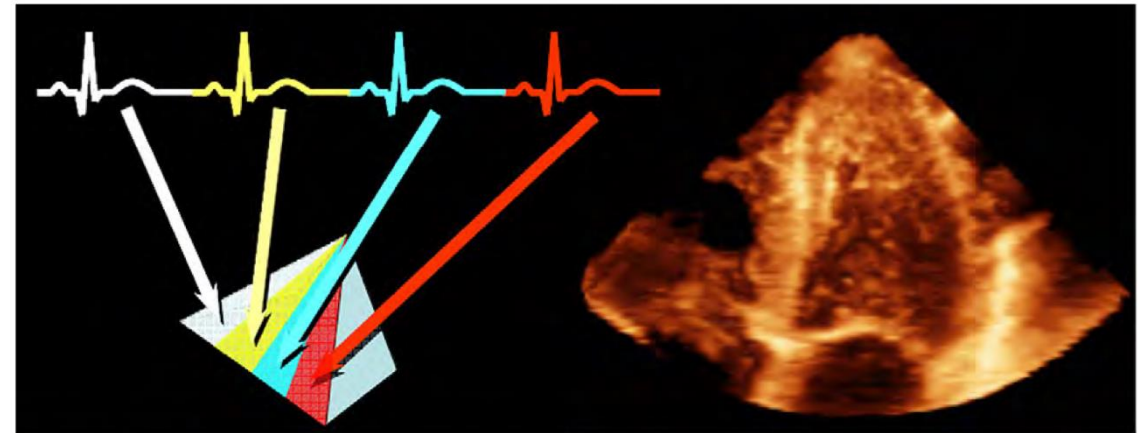
Inconvénient = mauvaise résolution spatiale et temporelle

3D en temps réel ou à battements multiples

3D à battements multiples

volumes étroits d'informations sur plusieurs battements cardiaques

Avantages = augmente résolution spatiale et temporelle

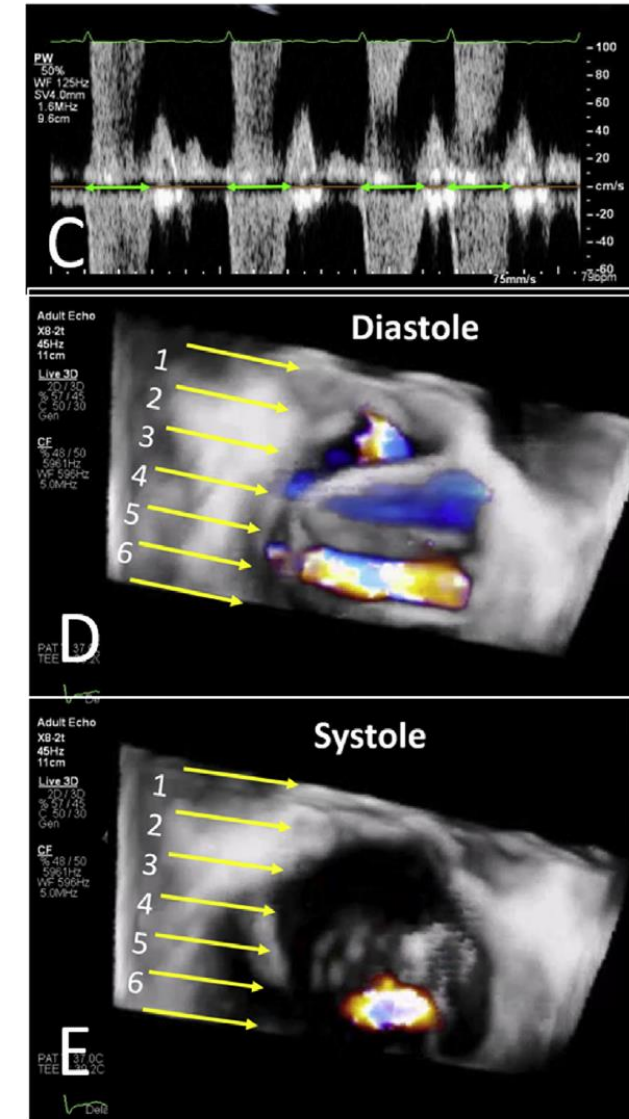
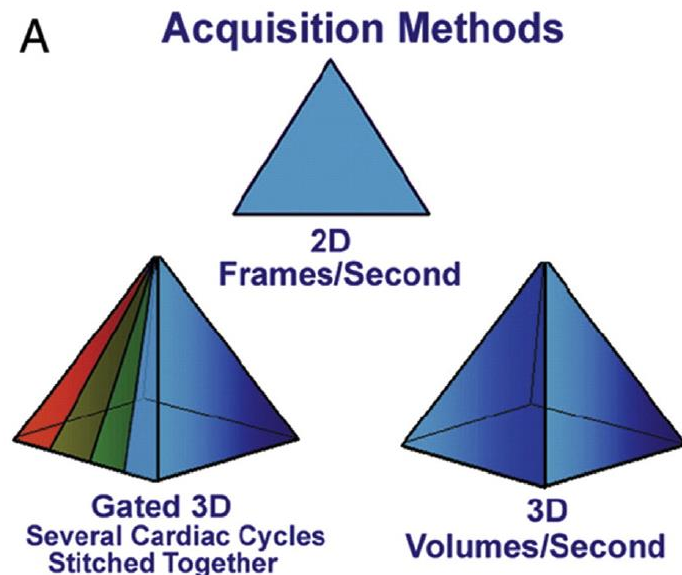


3D en temps réel ou à battements multiples

3D à battements multiples

volumes étroits d'informations sur plusieurs battements cardiaques

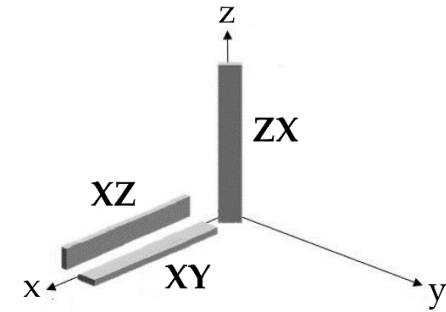
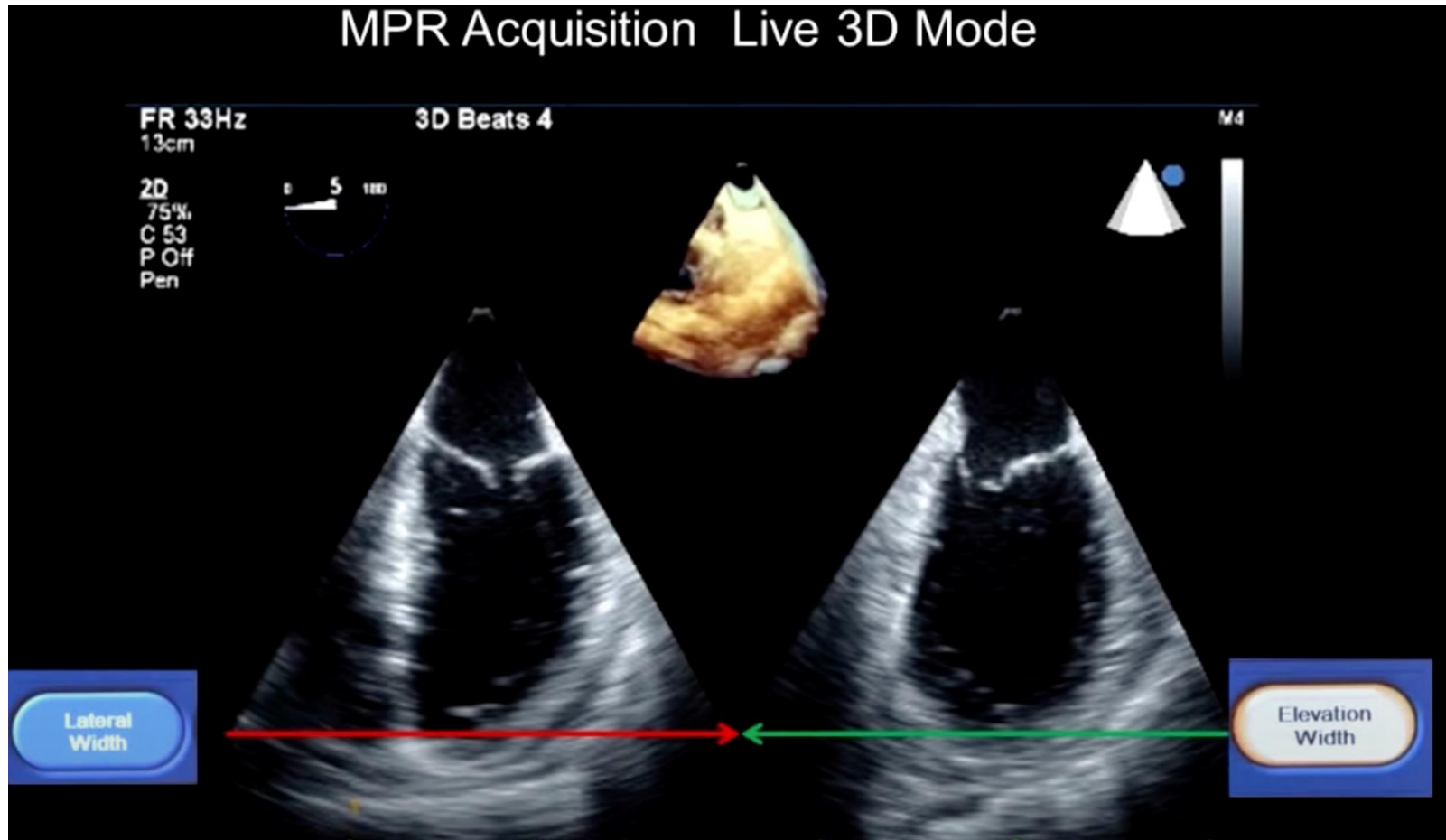
Avantages = augmente résolution spatiale et temporelle



Patient en FA

Plusieurs étapes

- Etape 1 = définir la zone d'intérêt





Mauvaise qualité
d'image 2D

=

Mauvaise qualité
d'image 3D +++

Plusieurs étapes

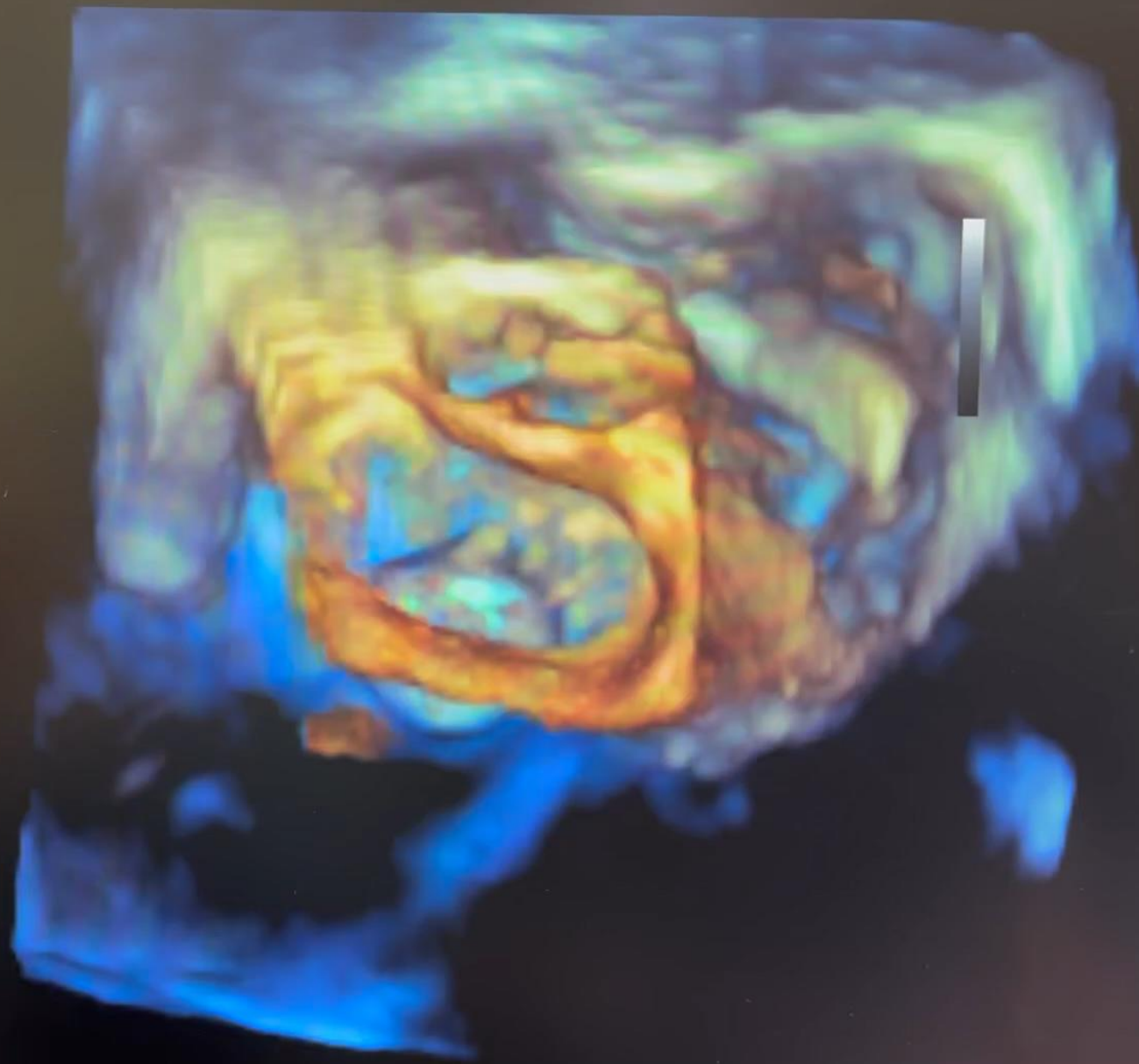
- Etape 2 = Acquisition du volume dynamique
 - Visualisation du volume cardiaque en temps réel

ZOOM 3D





al



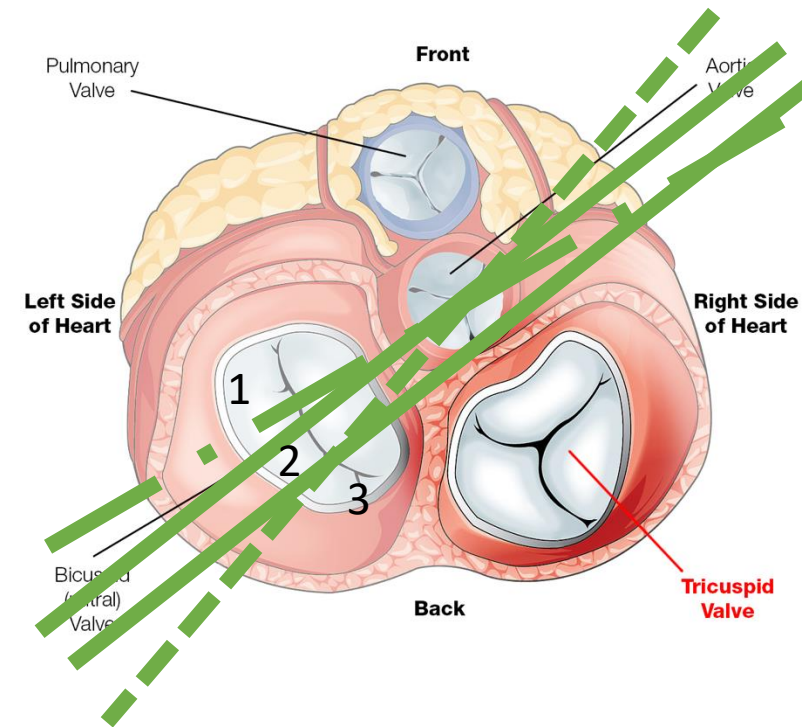
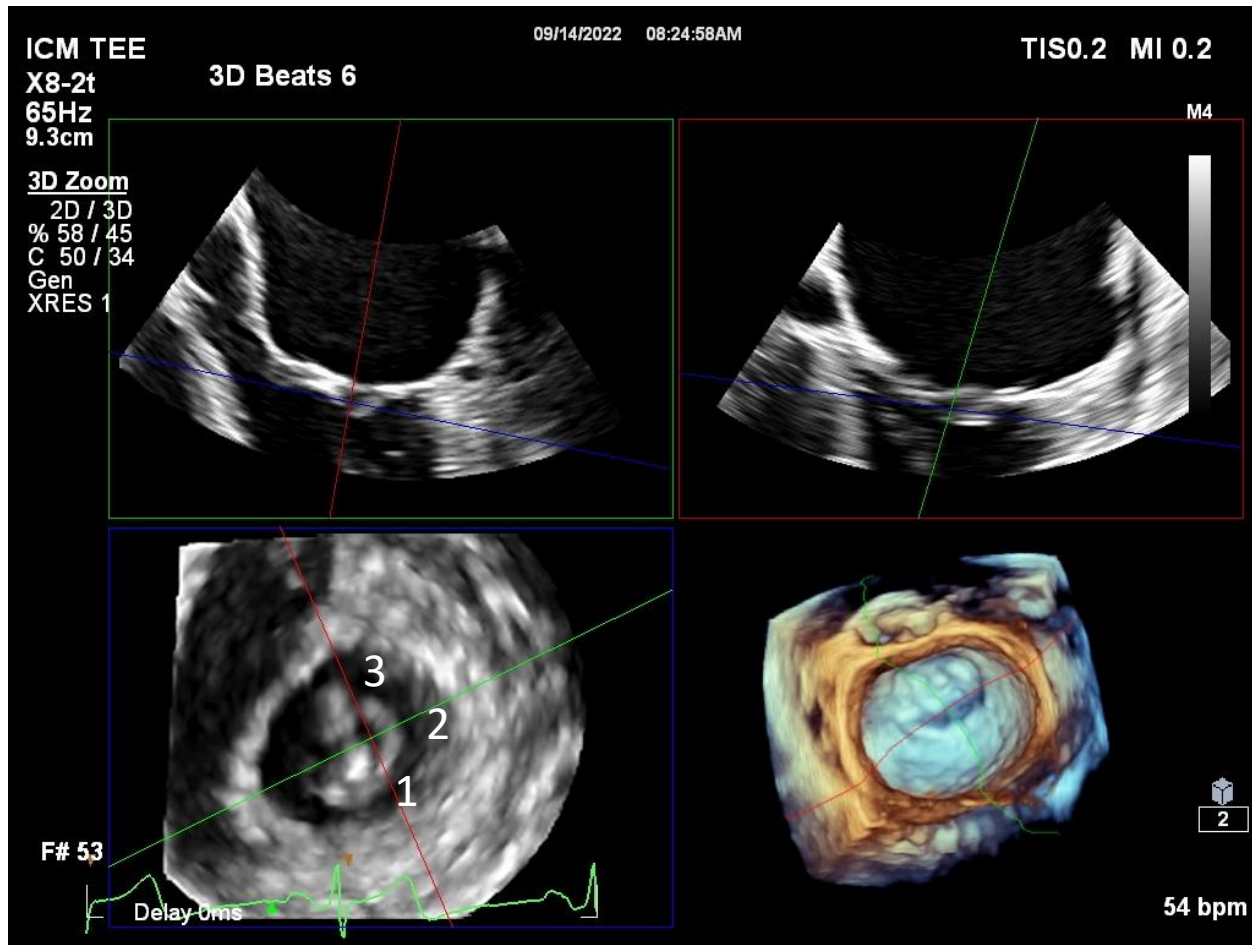
4200RPM

37.0C
39.4C

Plusieurs étapes

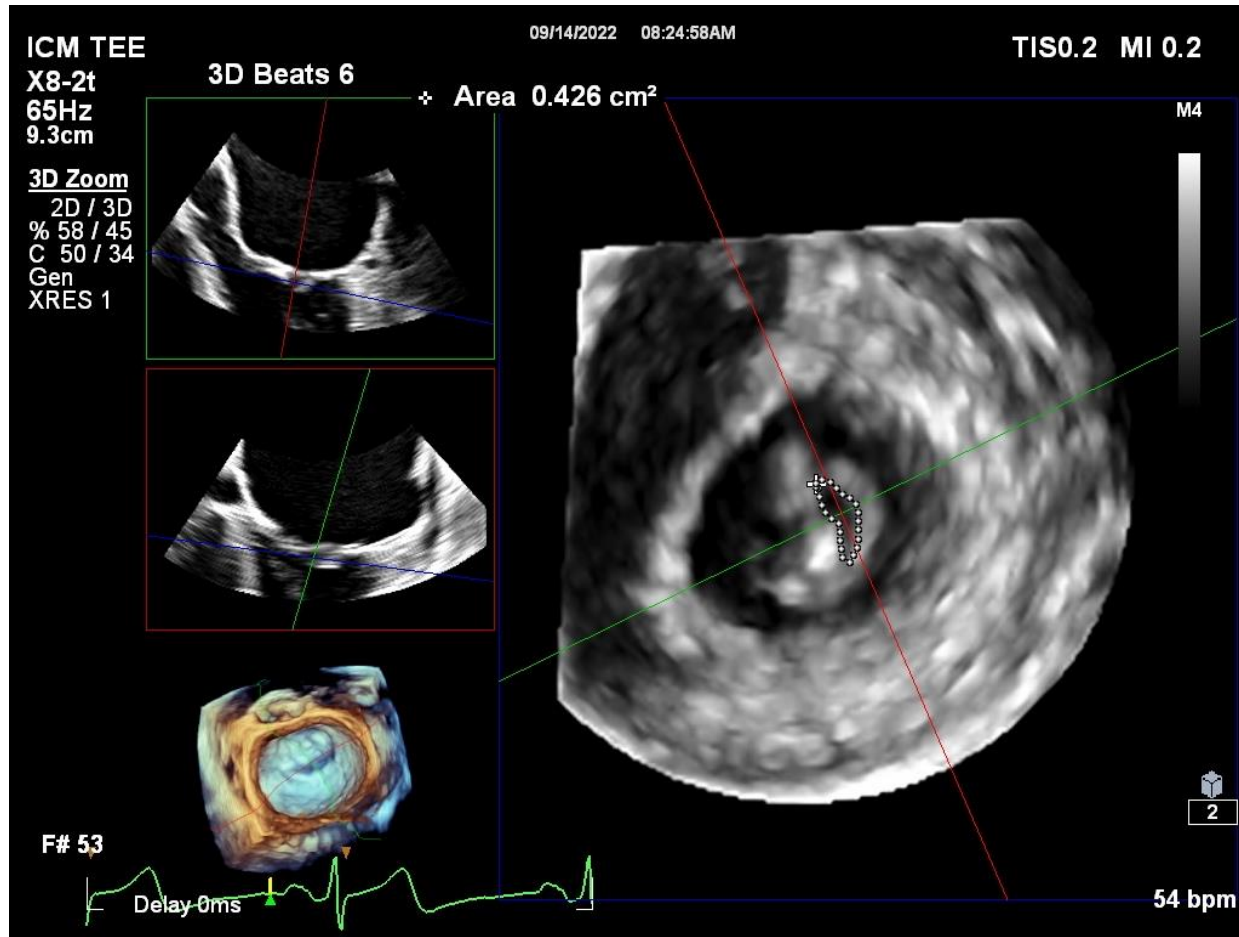
- Etape 3 = navigation dans le volume cardiaque

120-140° ETO



Plusieurs étapes

- Etape 3 = navigation dans le volume cardiaque



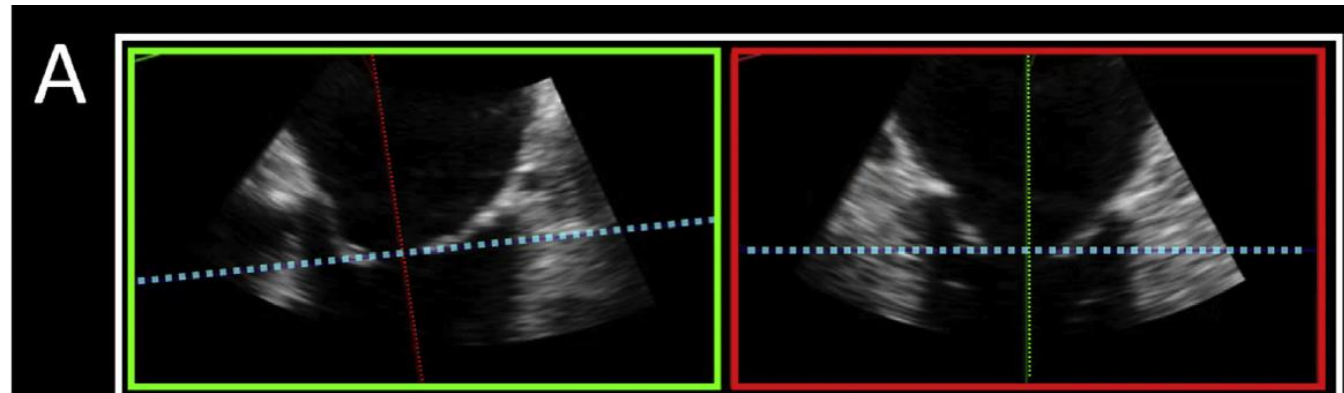
Mesures = Ne pas mesurer directement sur la 3D!

- peut être hors axe comparativement à une mesure dans le plan 2D
- l'épaisseur augmentée de l'image 3D peut accentuer artificiellement la taille de la structure et empêche une délimitation nette et précise de celle-ci, altérant la précision de la mesure
- une approche en 3 étapes doit être réalisée pour mesurer une structure +++

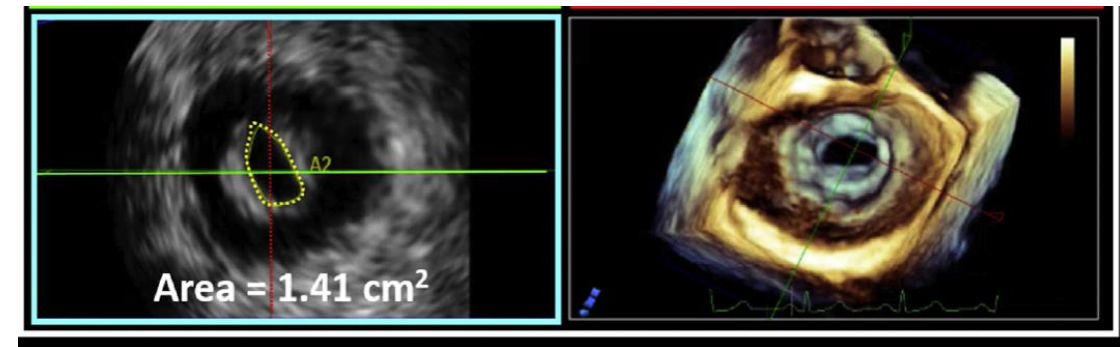
Mesure : ex d'approche en 3 étapes

MVA 3D

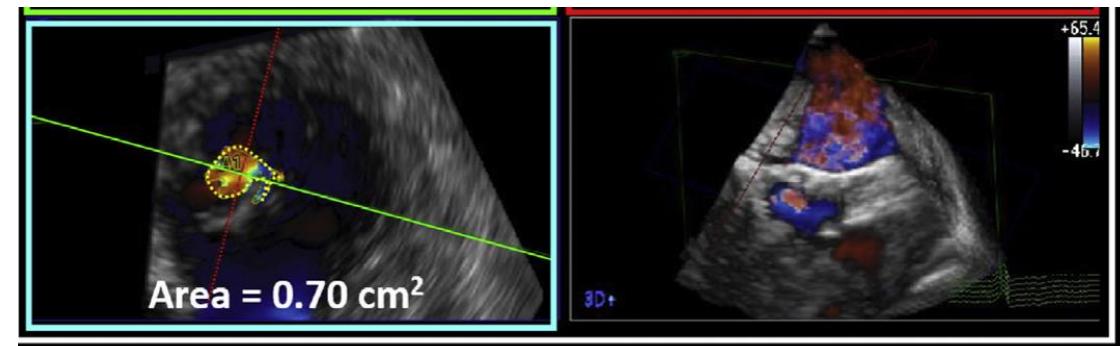
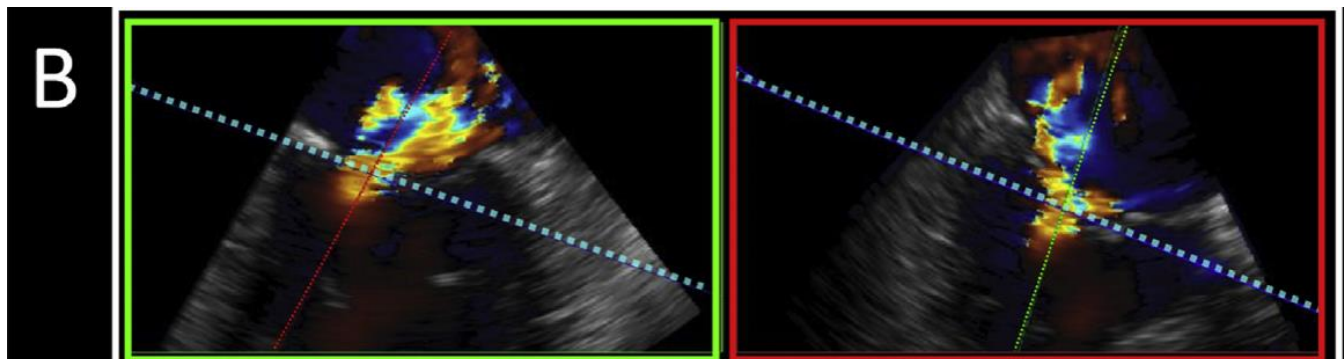
Etape 1 et 2



Etape 3



VCA 3D



ICM TEE

X8-2t

78Hz

9.2cm

3D Zoom

2D / 3D

% 59 / 35

C 50 / 34

Gen

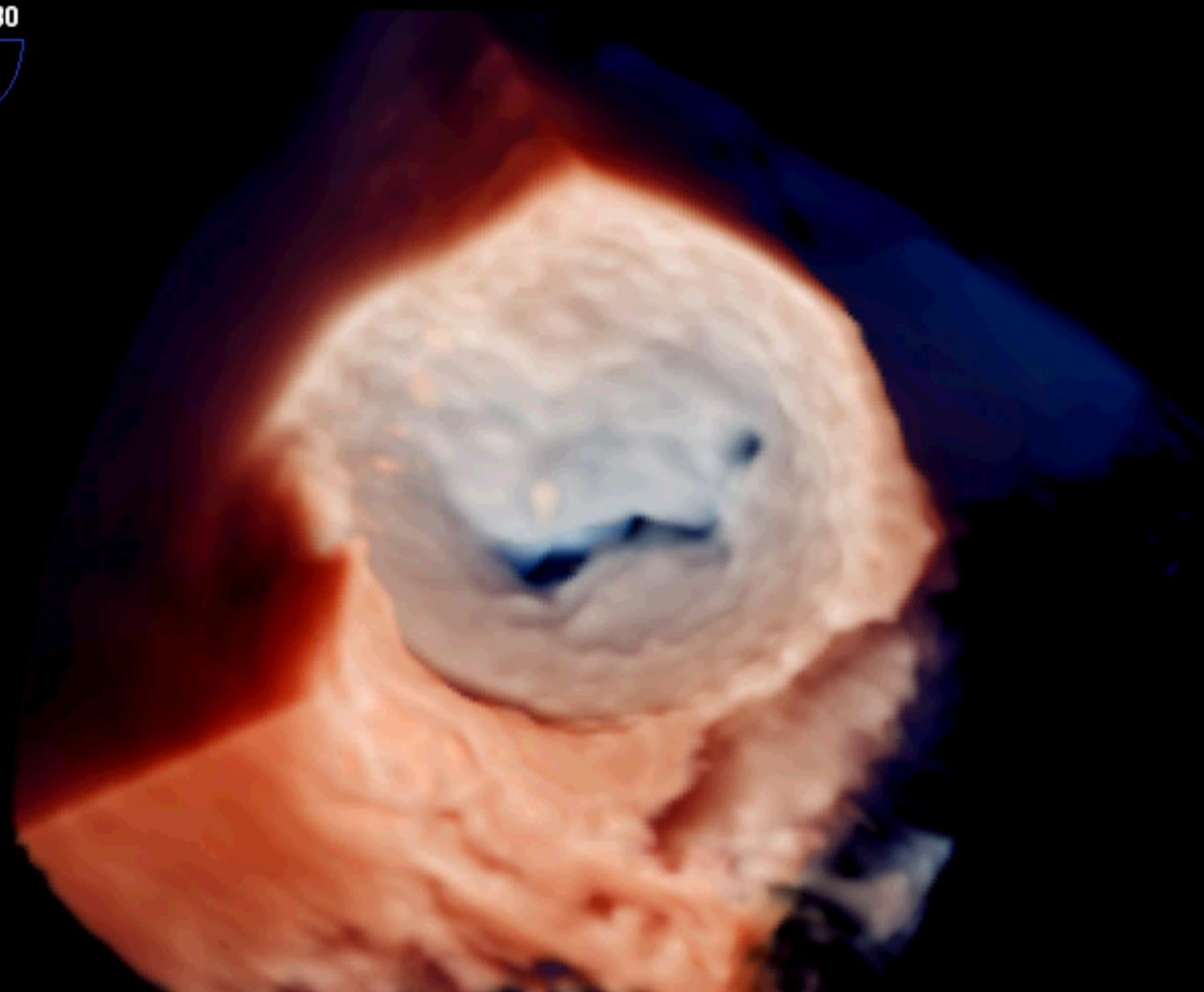
XRES 1

3D Beats 6



TIS0.2

MI 0.2



91 bpm

ICM TEE

X8-2t

78Hz

9.2cm

3D Zoom

2D / 3D

% 59 / 0

C 50 / 34

Gen

XRES 1

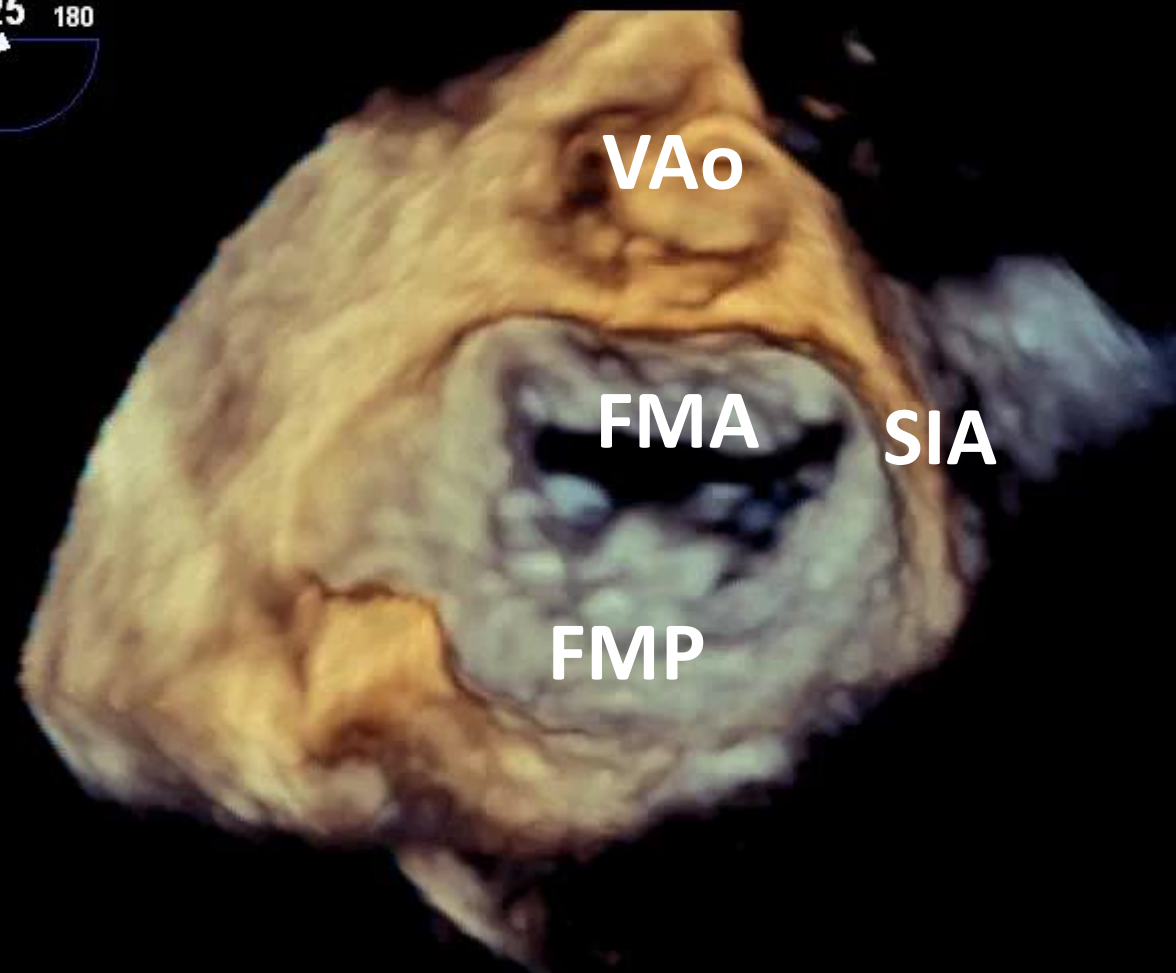
3D Beats 6

0 25 180



TIS0.2

MI 0.2



Delay 0ms

91 bpm

ICM TEE

X8-2t

17Hz

10cm

Full Volume

2D / 3D

% 57 / 34

C 50 / 34

Gen

XRES 1

3D Beats 1



TIS0.2

MI 0.3

SIA

NC

G

D

VP

83 bpm

ICM TEE

X8-2t

17Hz

9.1cm

Full Volume

2D / 3D

% 56 / 28

C 50 / 34

Gen

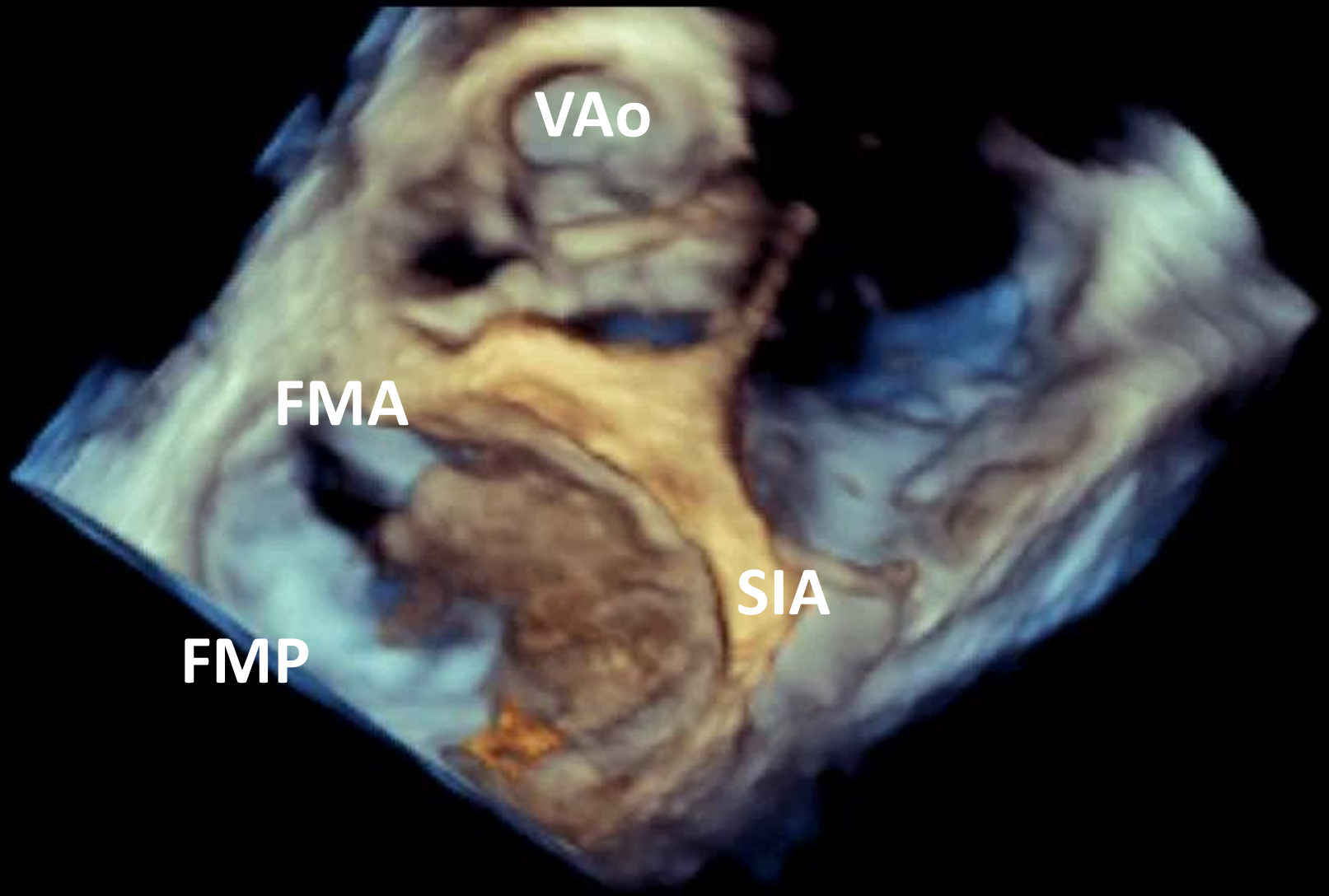
XRES 1

3D Beats 1



TIS0.2

MI 0.3



56 bpm

ICM TEE

X8-2t

34Hz

9.1cm

3D Zoom

2D / 3D

% 66 / 62

C 50 / 34

Gen

XRES 1

CF

% 48 / 50

6998Hz

WF 699Hz

4.4MHz

3D Beats 6



TIS0.5

MI 0.3

M4M4

+60.7



Delay 0ms

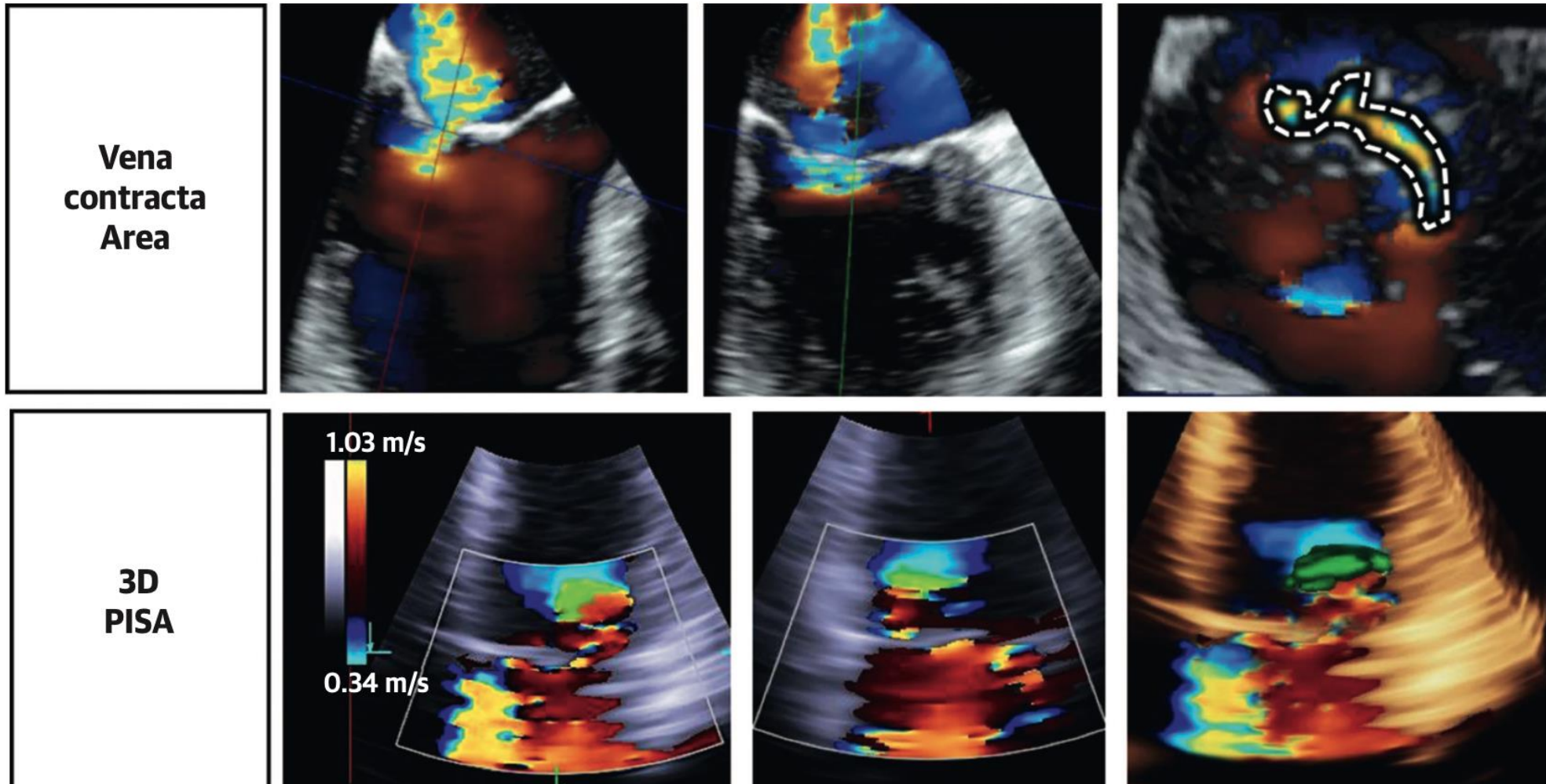
46 bpm

Quelles applications ?



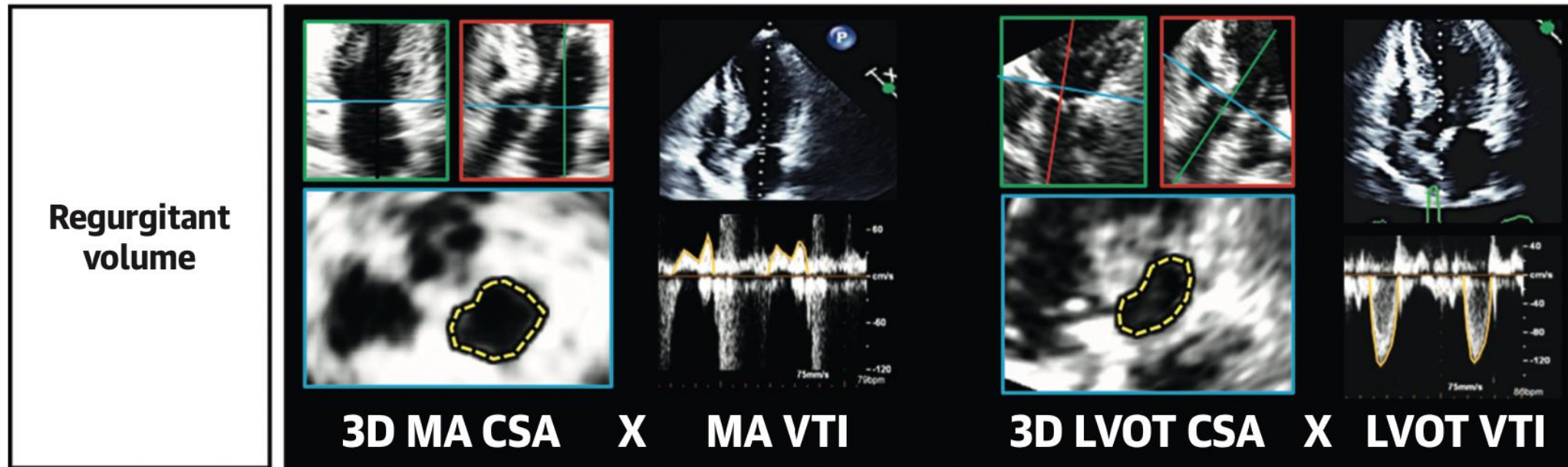
Quelles applications ?

- Quantification 3D de la régurgitation mitrale



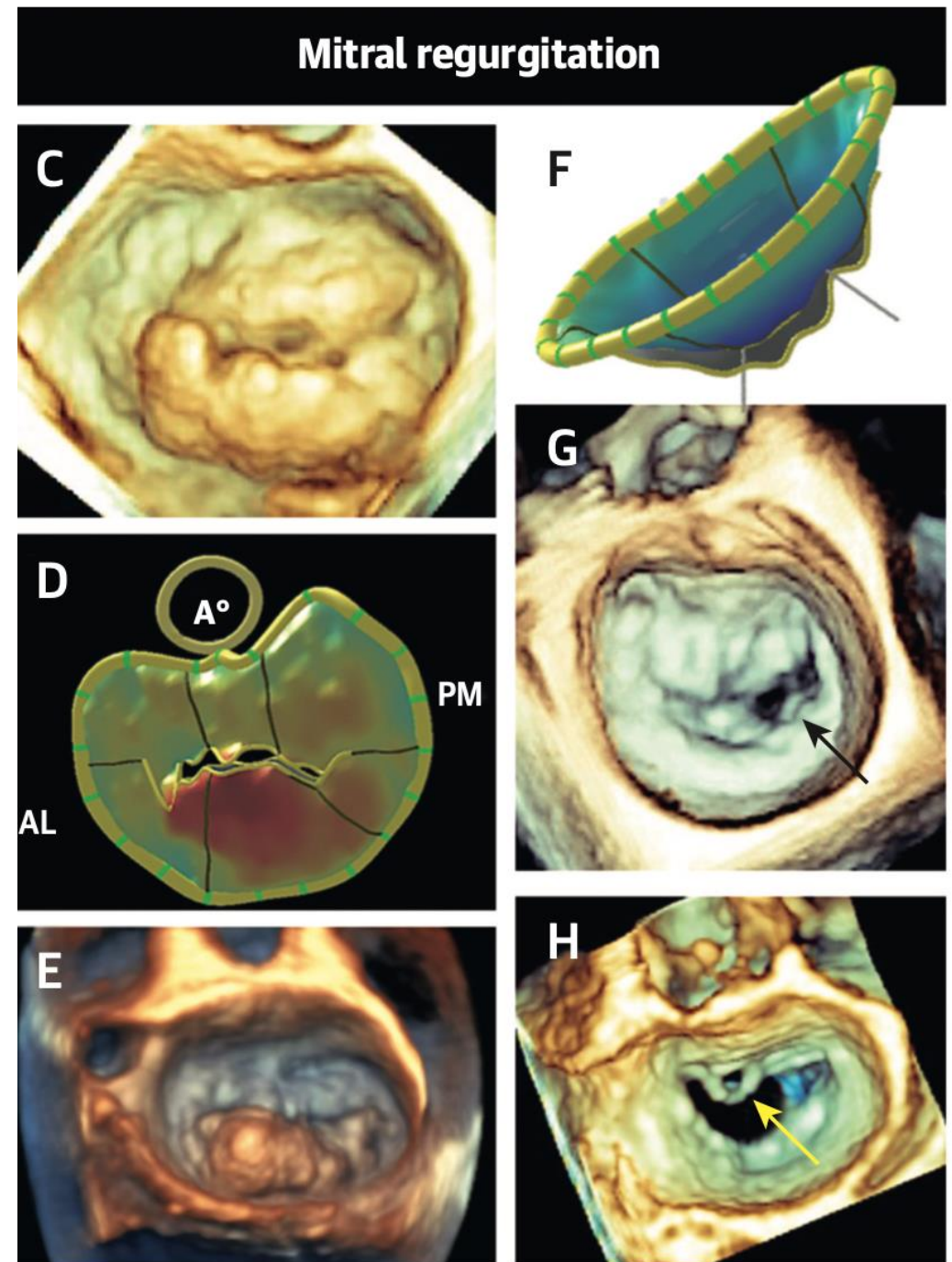
Quelles applications ?

- Quantification 3D de la régurgitation mitrale



Quelles applications ?

- Préciser la pathologie mitrale
- Modélisation anneau et dimension



X8-2t

28Hz

7.4cm

Ватем. 3D 6

Volume total

2D / 3D

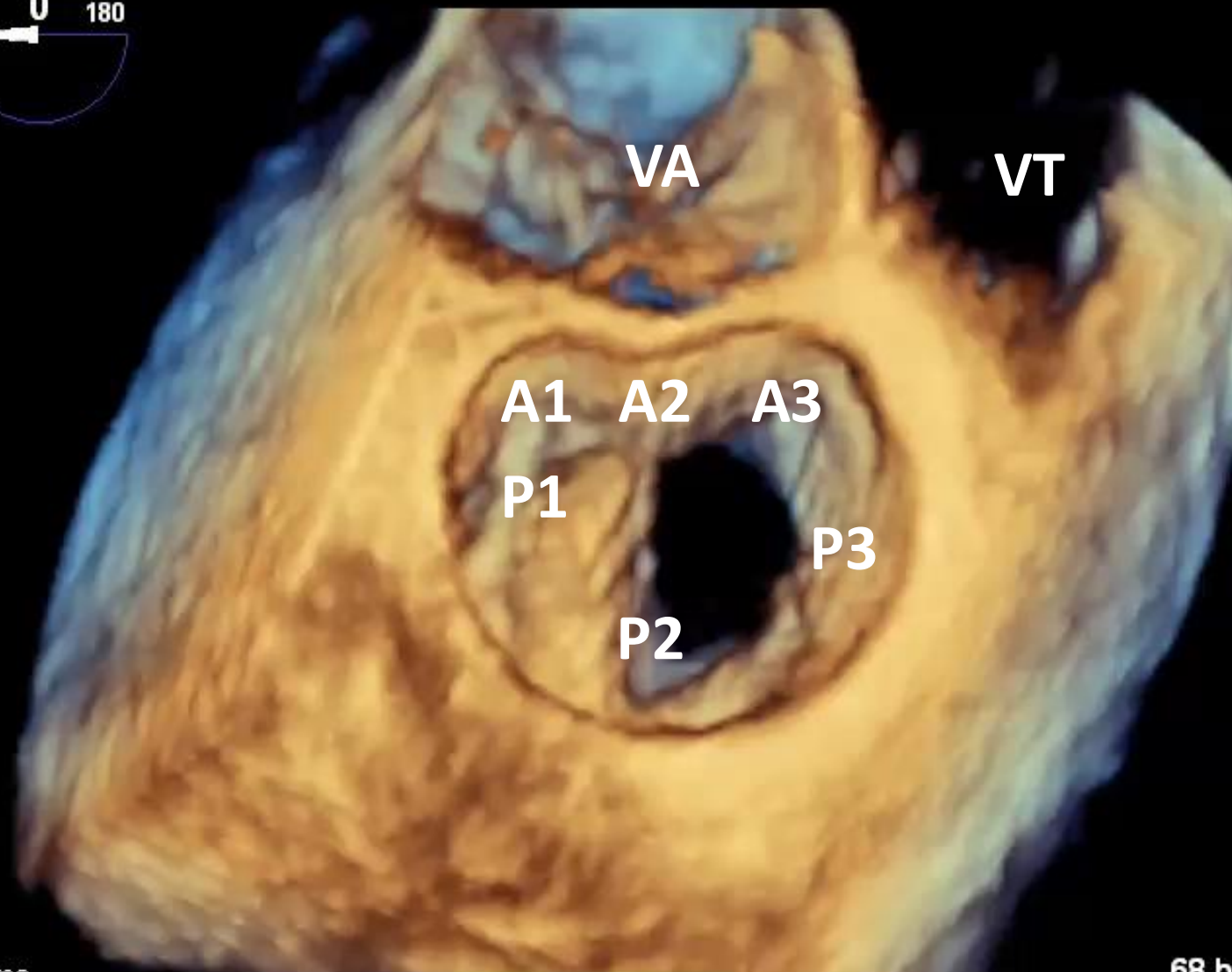
% 65 / 2

C 53 / 30

Gén

XRES ON

0 0 180

PAT T: 37.0C
TEE T: 38.5C

Délai 0ms

68 bpm

X8-2t

28Hz

7.4cm

Ватем. 3D 6

Volume total

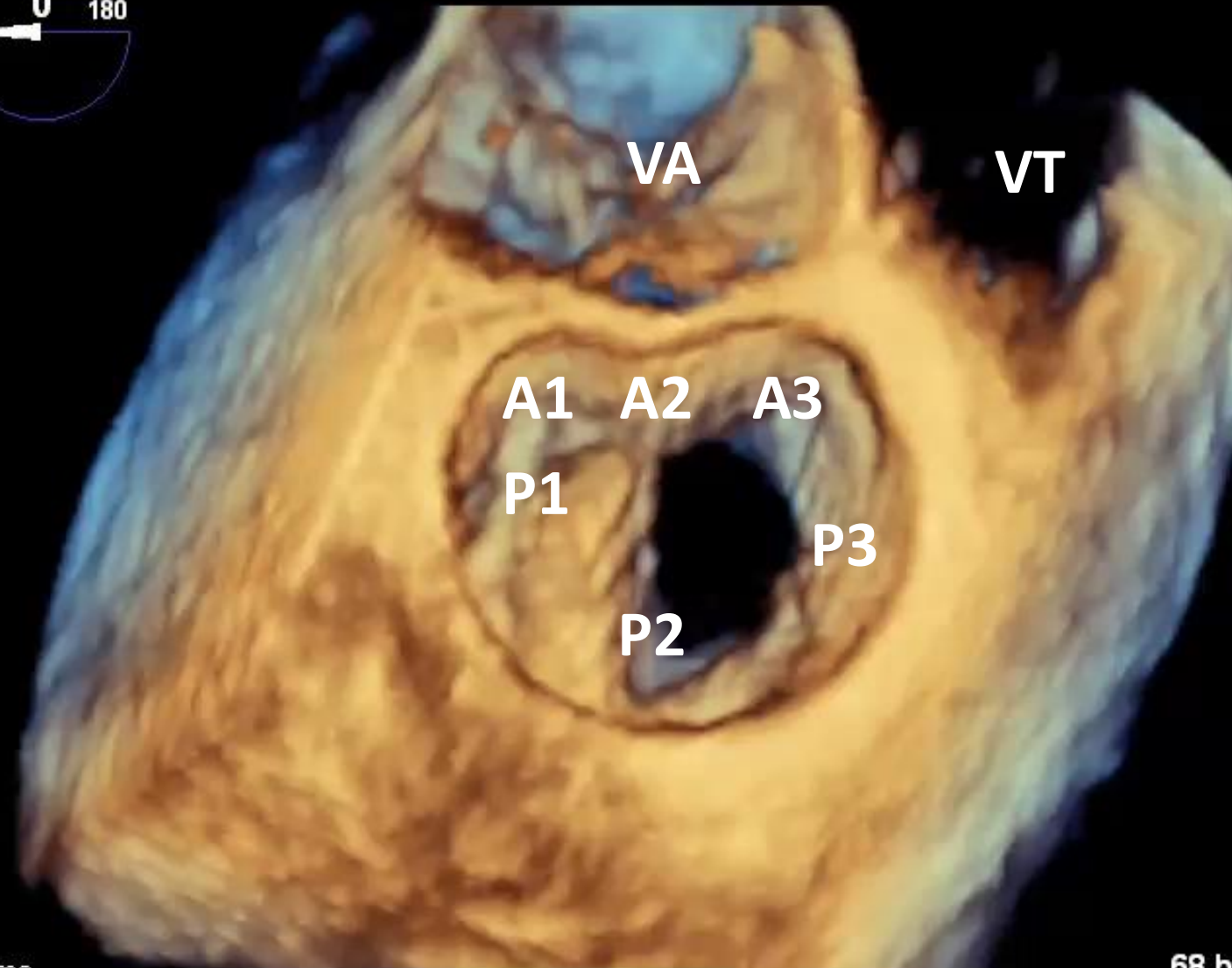
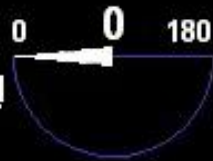
2D / 3D

% 65 / 2

C 53 / 30

Gén

XRES ON

PAT T: 37.0C
TEE T: 38.5C

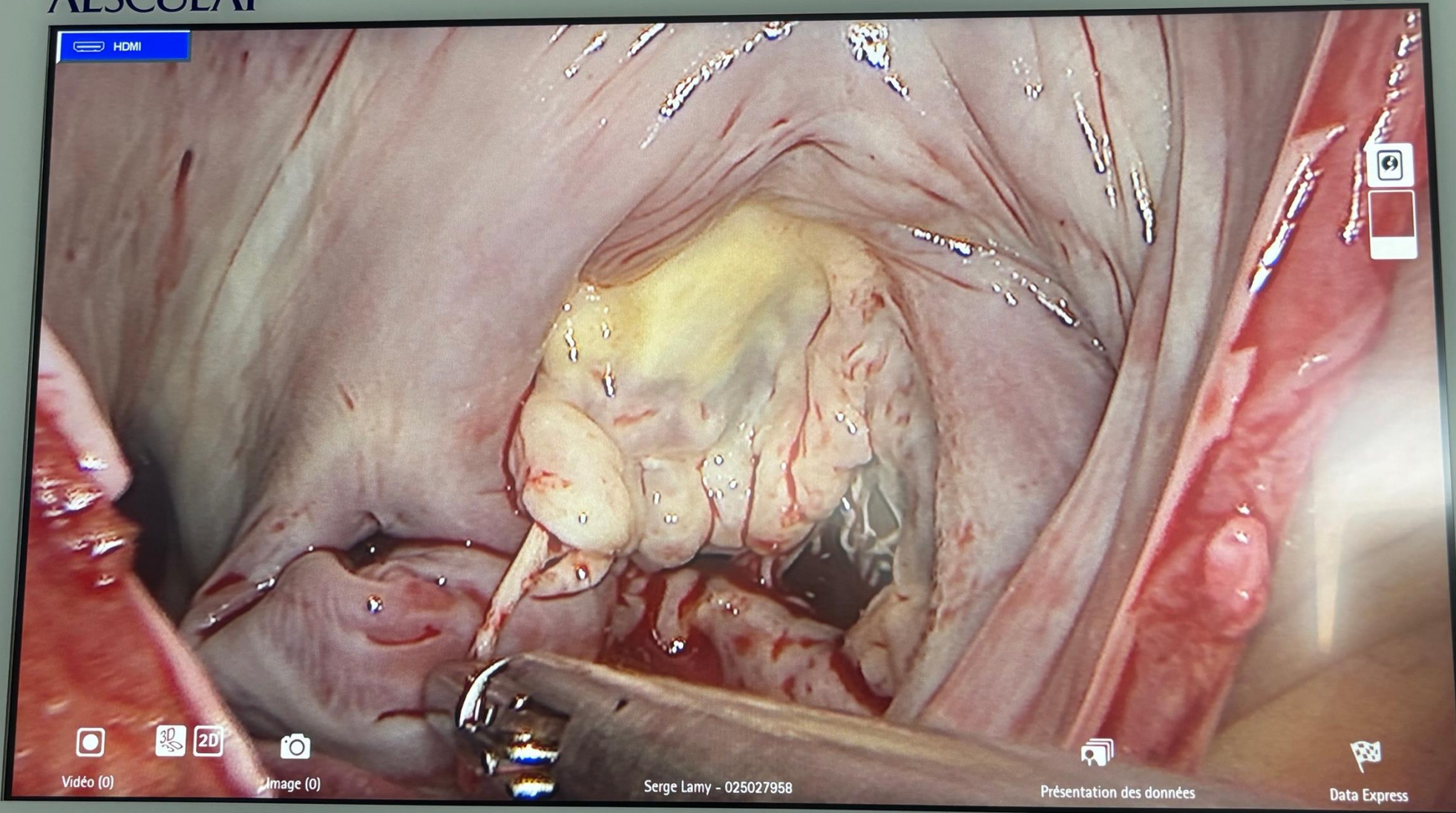
Délai 0ms

68 bpm

AESCULAP®

FULL HD

HDMI



Vidéo (0)

Image (0)

Serge Lamy - 025027958

Présentation des données

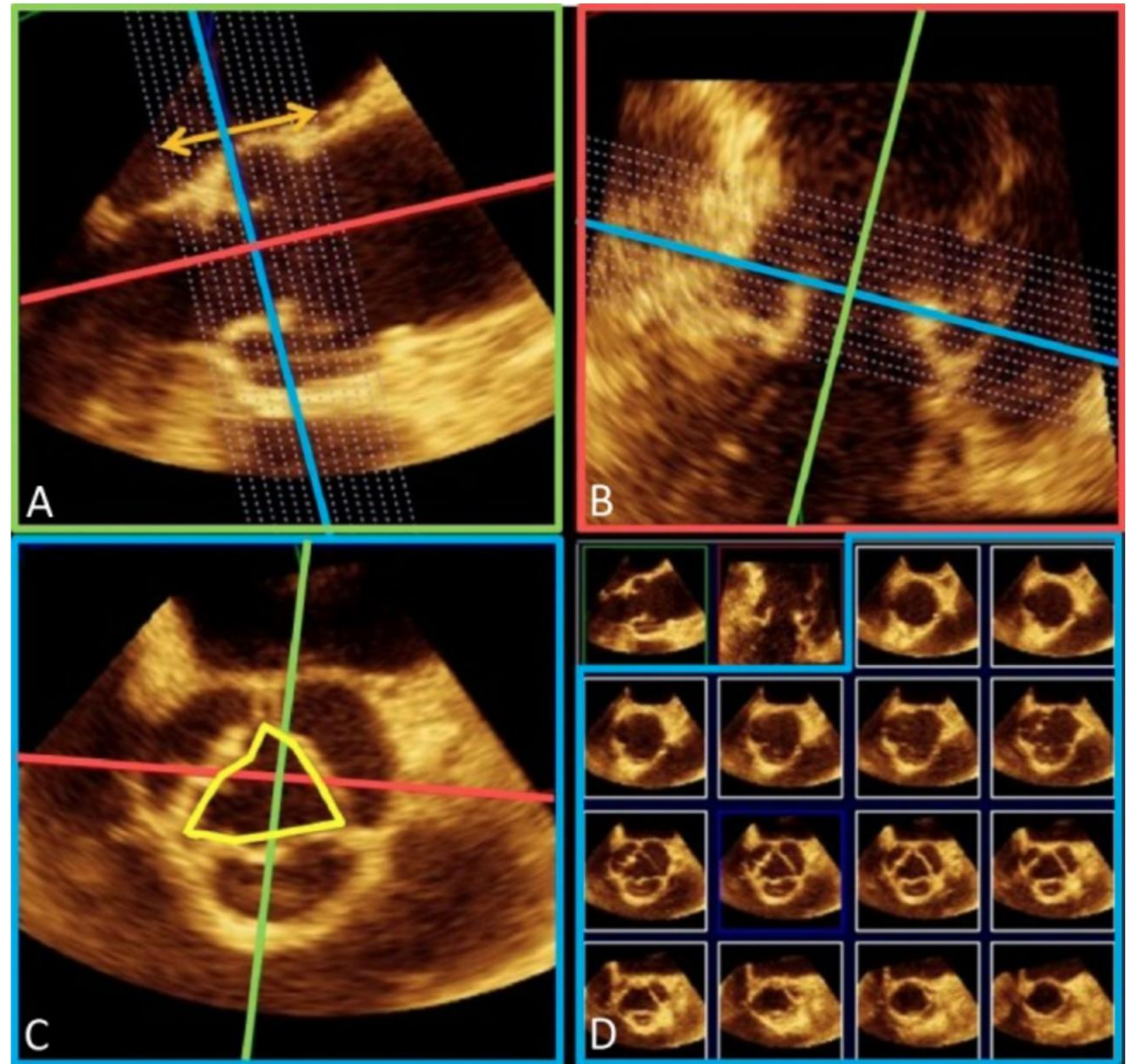
Data Express

CHU DE NANTES
23/11077
INVENTAIRE



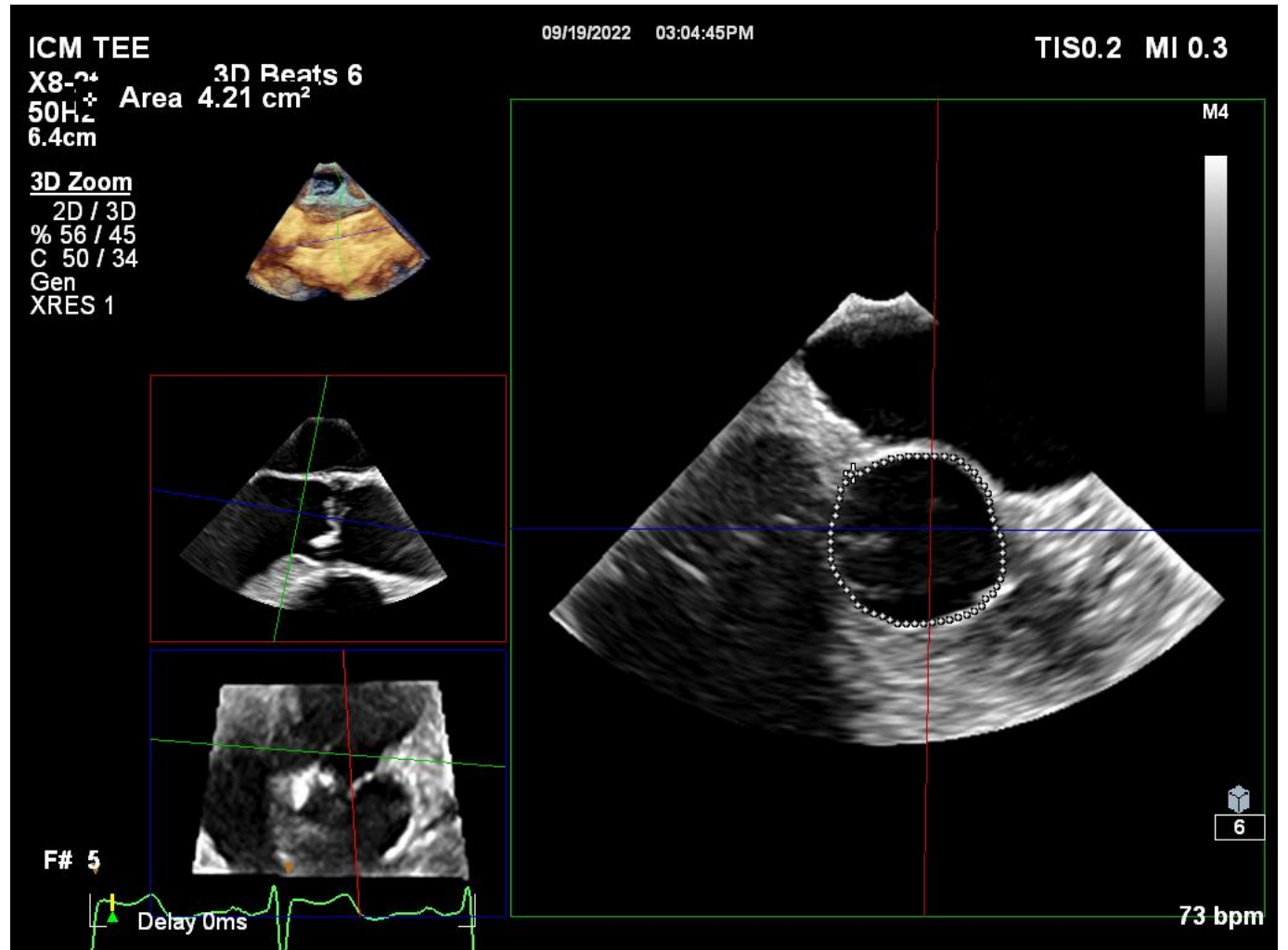
Quelles applications ?

- Surface valvulaire aortique 3D



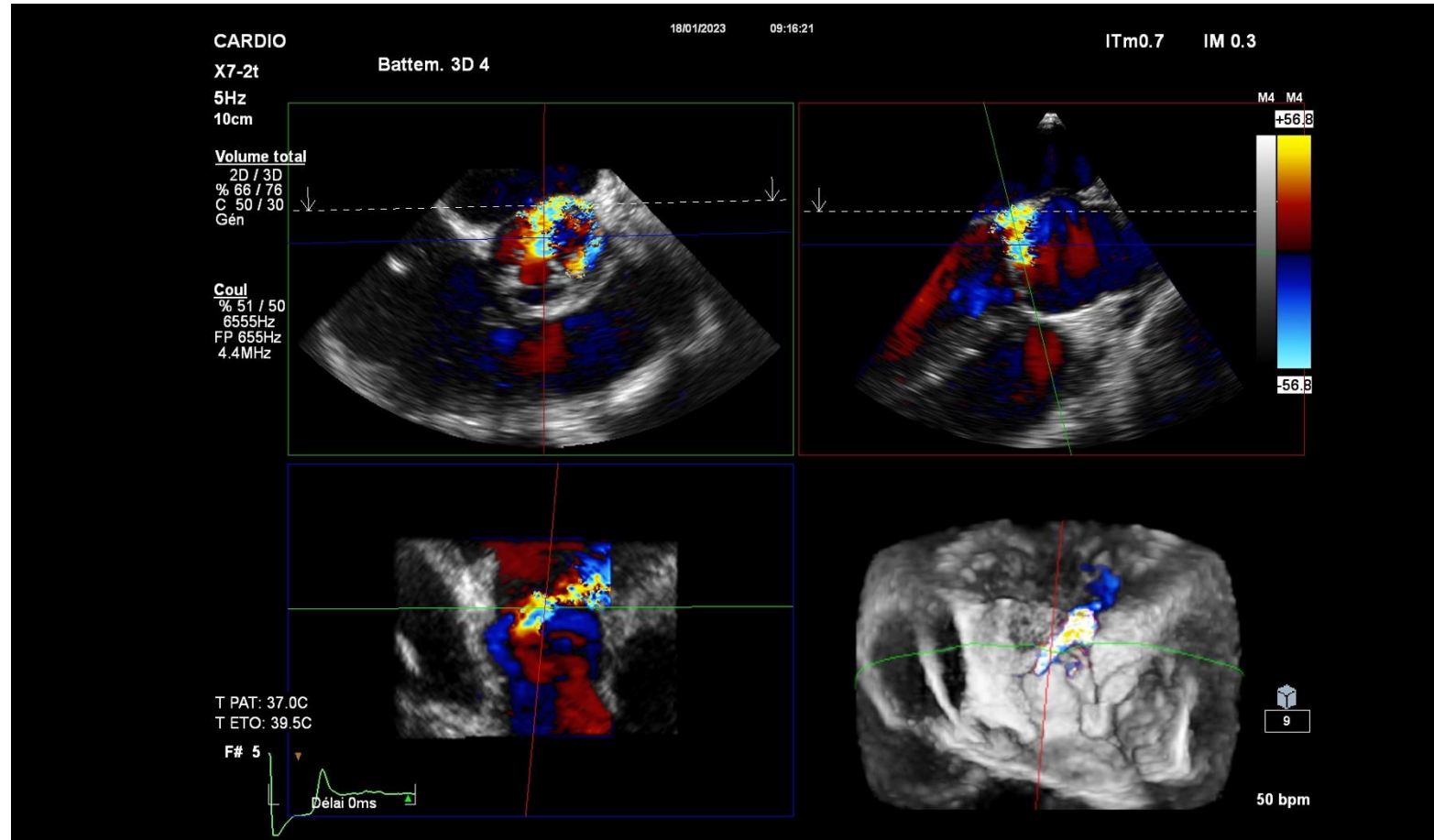
Quelles applications ?

- Surface valvulaire aortique 3D
- Mesure de l'anneau



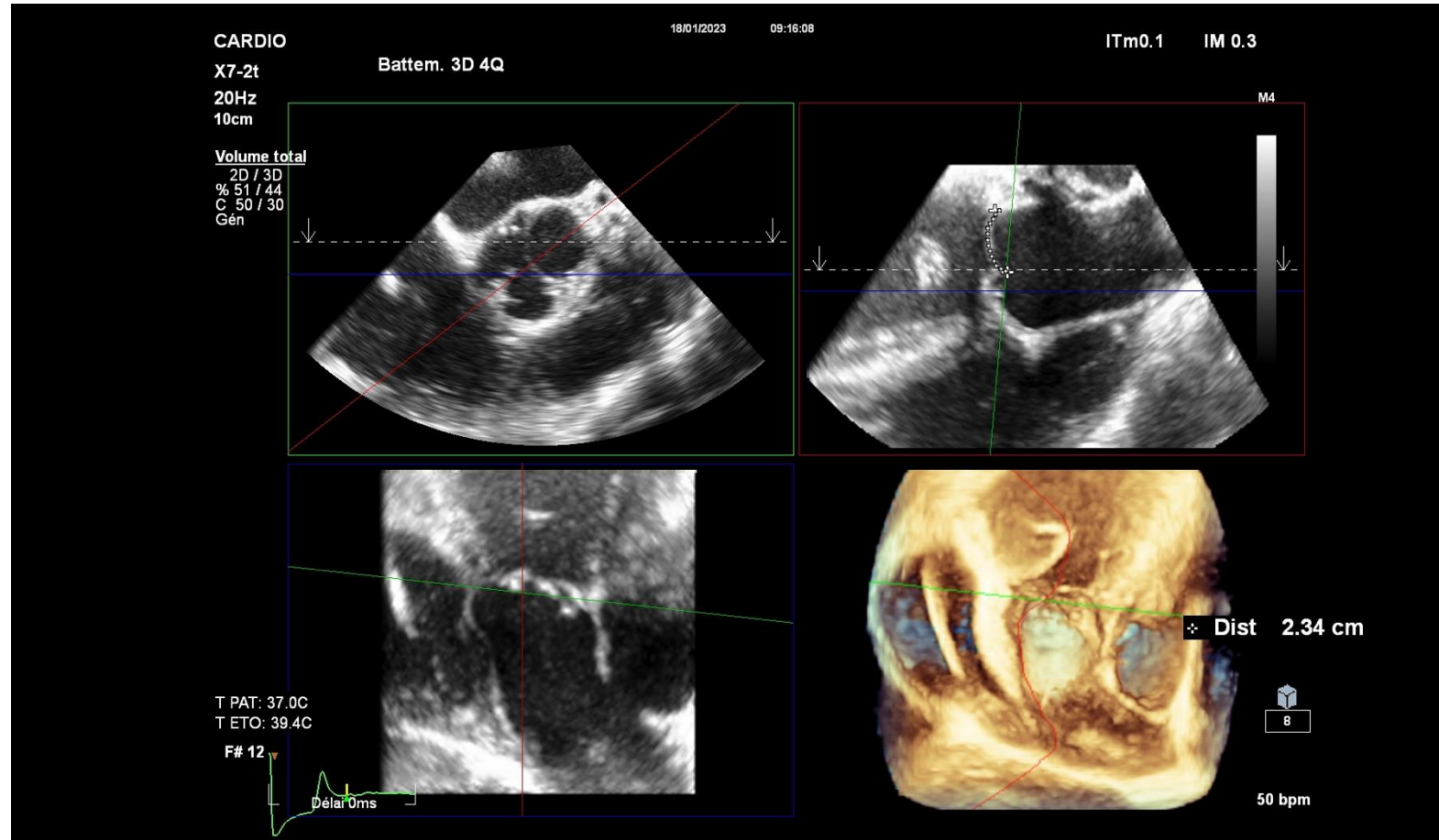
Quelles applications ?

- Surface valvulaire aortique 3D
- Mesure de l'anneau
- Orienter le geste chirurgical

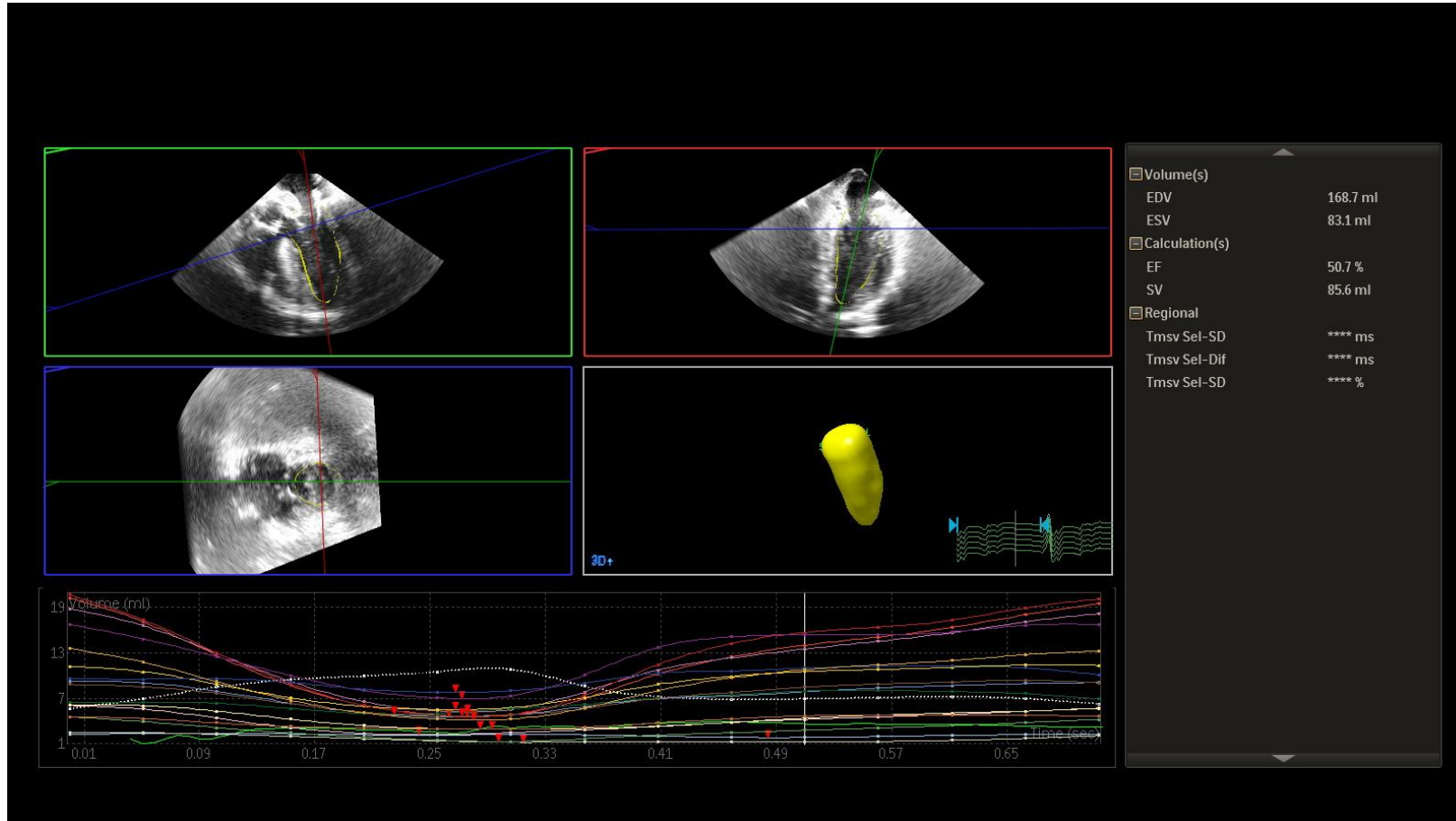


Quelles applications ?

- Surface valvulaire aortique 3D
- Mesure de l'anneau
- Orienter le geste chirurgical

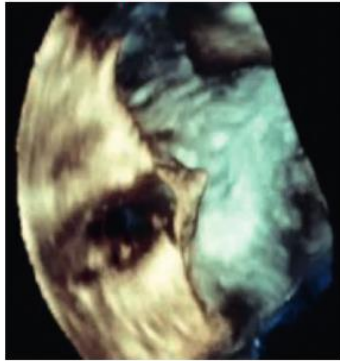


Quelles applications ?

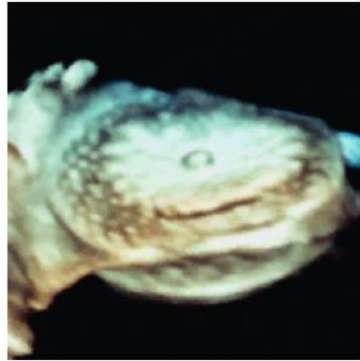


Quelles applications ?

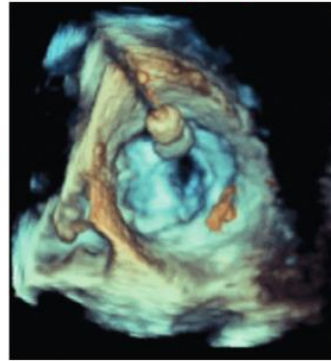
Trans-septal
puncture



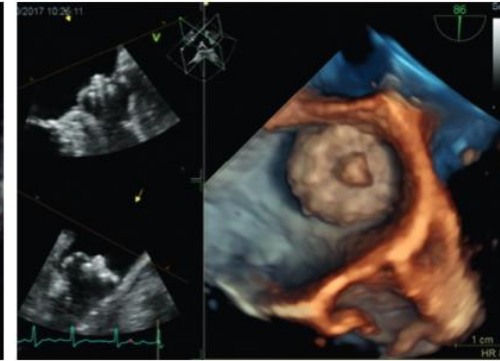
ASD closure



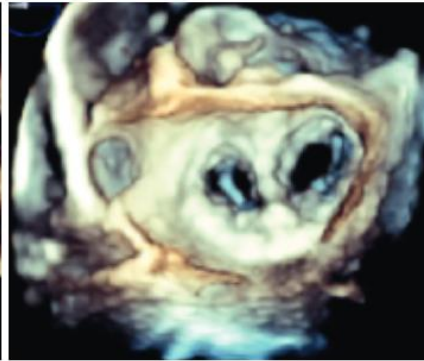
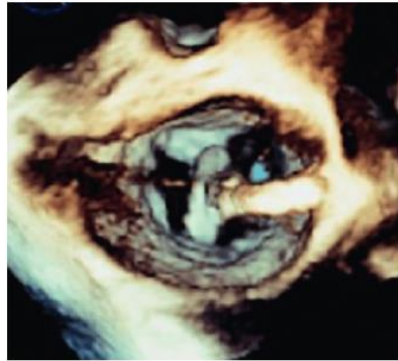
Balloon
valvuloplasty



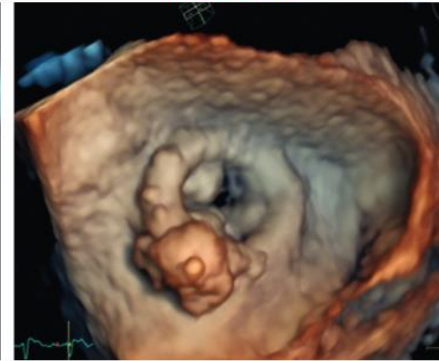
LAA closure with
Watchman device



Mitra-clip

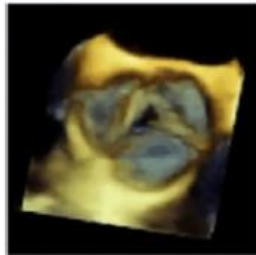


PVL closure



Artéfacts

Table 2 Artifacts of 3D imaging

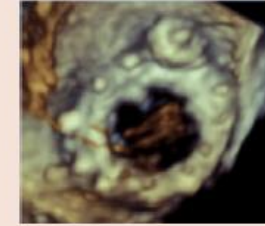
Type of artifact	Mechanism	Impact on images	3D example
Stitching	Incorrect juxtaposition at the interface of sequential subvolumes (because of arrhythmias, breathing, probe/patient motion)	Strong demarcation between subvolumes leading to a “broken” image	 Stitch Lines
Dropout	Poor echocardiographic signal strength due to weak echoes	These artifacts can be misdiagnosed as true holes/perforations	

Artéfacts

Blurring

Indistinct edges of structures due to the assembly of nonisotropic voxels (2° to differences in axial > lateral > elevational resolution)

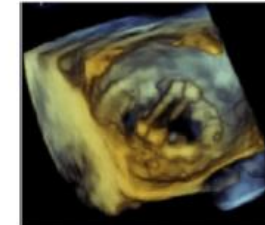
Thin structures (i.e., sutures) appear thicker than they are



Blooming

Metallic structures when intersected by ultrasound produce fringes extending beyond the borders of the metallic devices/catheters

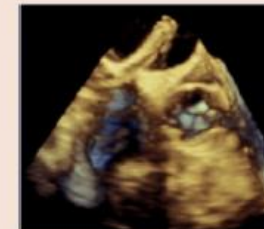
Metallic structures appear with irregular, thick edges



Railroad-shaped

In large catheters with wide lumens, two surfaces are perpendicular to the ultrasound beam, producing strong echoes, while the other two are tangential, producing very weak echoes

Single catheter appears as two linear structures

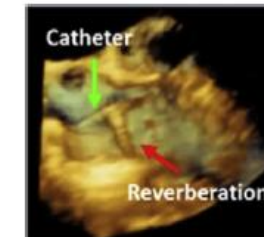


Artéfacts

Reverberations

Multiple reflection of metallic component of catheters

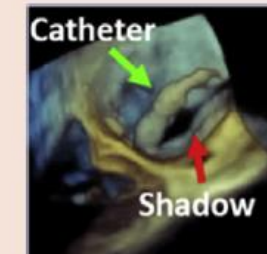
Depending on the perspective and the position of catheter, reverberations may appear to lengthen the catheter



Shadowing

Inability of ultrasound to pass through strong reflecting catheters/devices

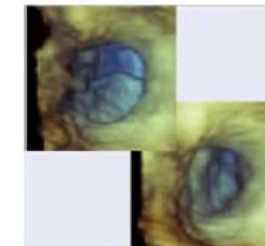
Lack of tissue posterior to catheters/devices that may appear as a “tear” of cardiac structures



Gain

Variation of gain may produce significant variation in the size of structures

Orifices may appear larger or smaller according to gain variation



EAE/ASE Recommendations for Image Acquisition and Display Using Three-Dimensional Echocardiography

Roberto M. Lang, MD, FASE*[‡], Luigi P. Badano, MD, FESC^{†‡}, Wendy Tsang, MD*, David H. Adams, MD*, Eustachio Agricola, MD[†], Thomas Buck, MD, FESC[†], Francesco F. Faletra, MD[†], Andreas Franke, MD, FESC[†], Judy Hung, MD, FASE*, Leopoldo Pérez de Isla, MD, PhD, FESC[†], Otto Kamp, MD, PhD, FESC[†], Jaroslaw D. Kasprzak, MD, FESC[†], Patrizio Lancellotti, MD, PhD, FESC[†], Thomas H. Marwick, MBBS, PhD*, Marti L. McCulloch, RDCS, FASE*, Mark J. Monaghan, PhD, FESC[†], Petros Nihoyannopoulos, MD, FESC[†], Natesa G. Pandian, MD*, Patricia A. Pellikka, MD, FASE*, Mauro Pepi, MD, FESC[†], David A. Roberson, MD, FASE*, Stanton K. Shernan, MD, FASE*, Girish S. Shirali, MBBS, FASE*, Lissa Sugeng, MD*, Folkert J. Ten Cate, MD[†], Mani A. Vannan, MBBS, FASE*, Jose Luis Zamorano, MD, FESC, FASE[†], and William A. Zoghbi, MD, FASE*

En bref

- Technologie d'avenir
- Deviendra le gold standard pour l'évaluation des valves ?
- Hologramme et réalité virtuelle

