# Ecocardiograma 3D/4D

## Quando e para quem...

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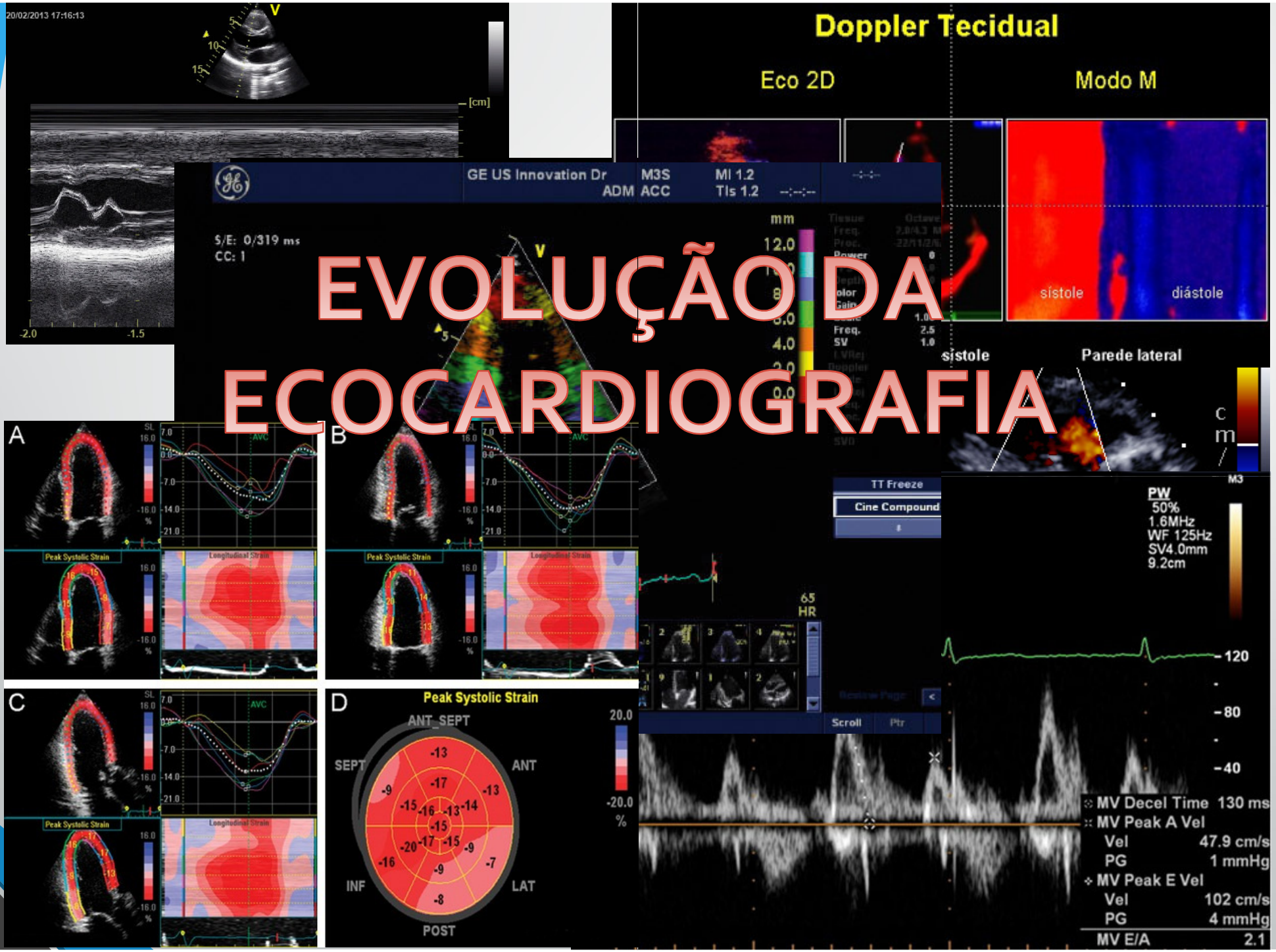
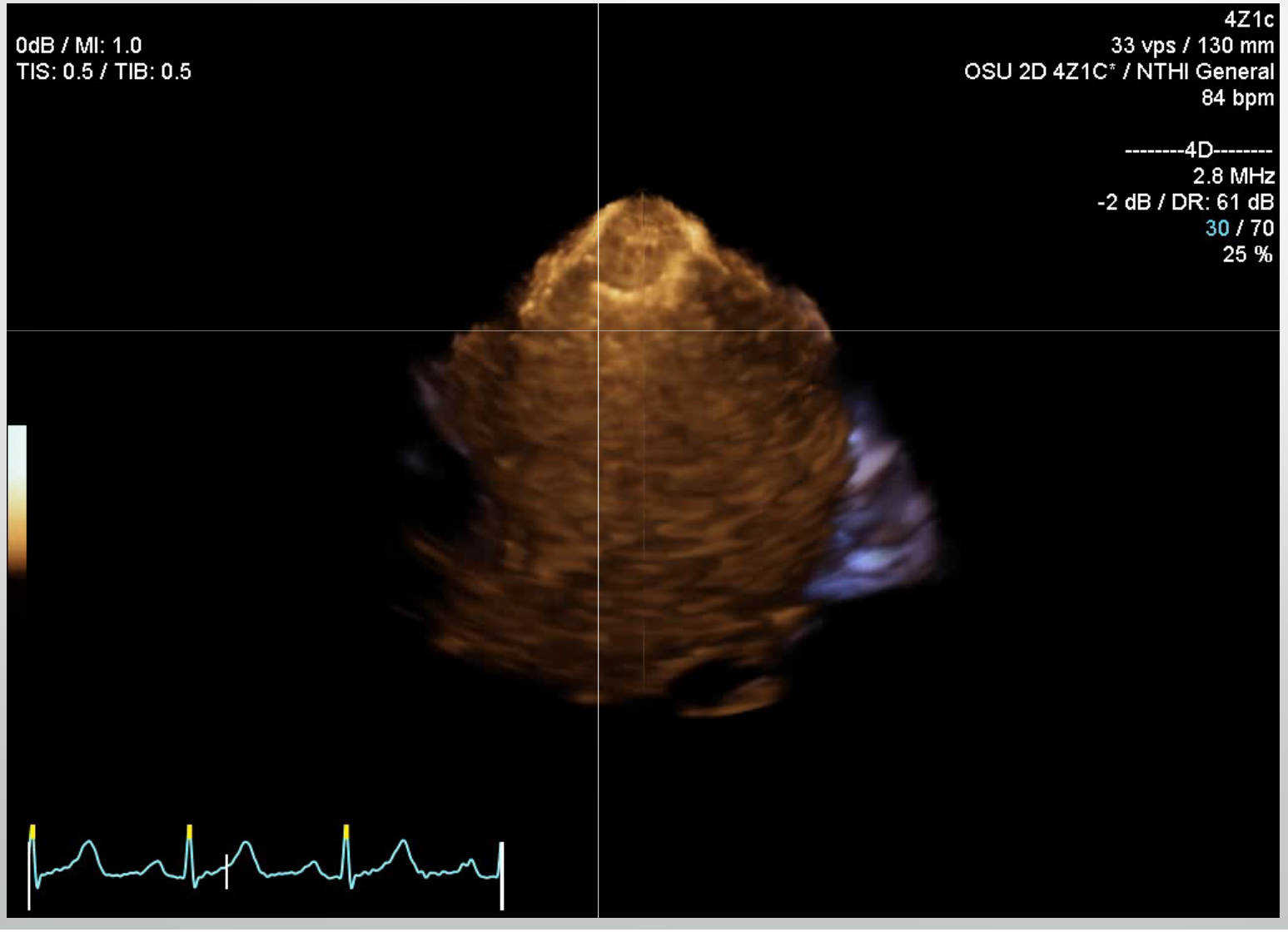
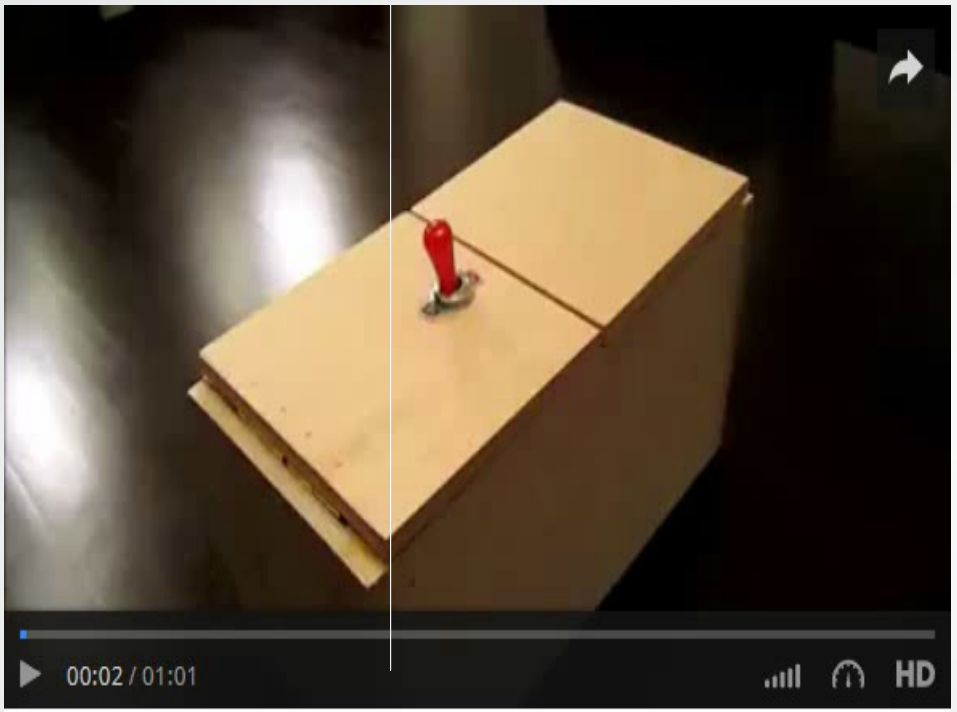



# EVOLUÇÃO DA ECOCARDIOGRAFIA

# EVOLUÇÃO DA ECOCARDIOGRAFIA






Inúmeras tecnologias foram desenvolvidas ao longo dos anos, muitas se tornaram rotina, muitas foram esquecidas, outras nem saíram do plano da pesquisa...

**Portanto: não basta ser bonito, tem que ser útil!**

GUIDELINES AND STANDARDS

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

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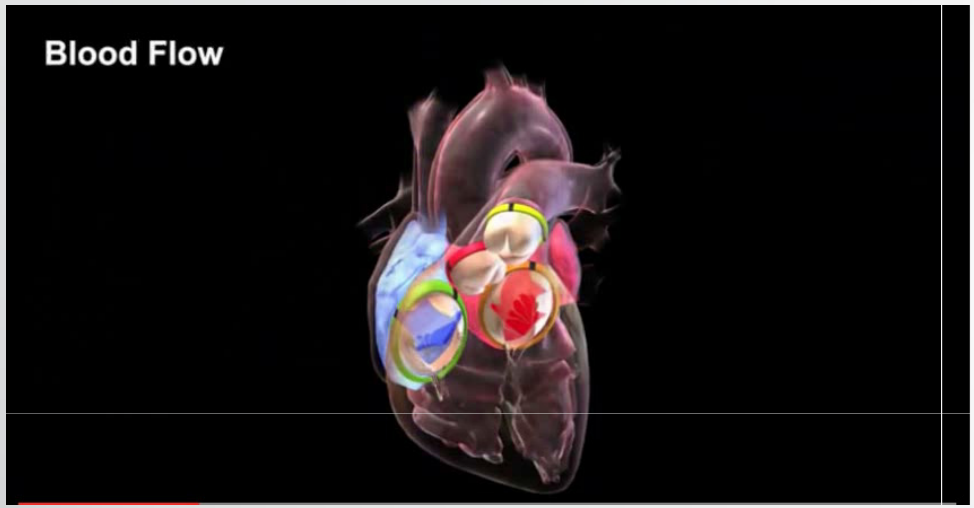
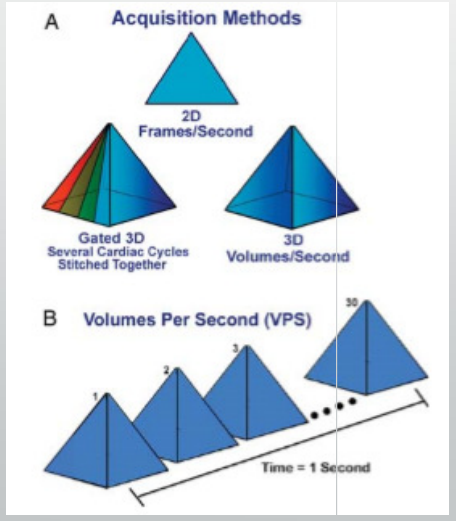
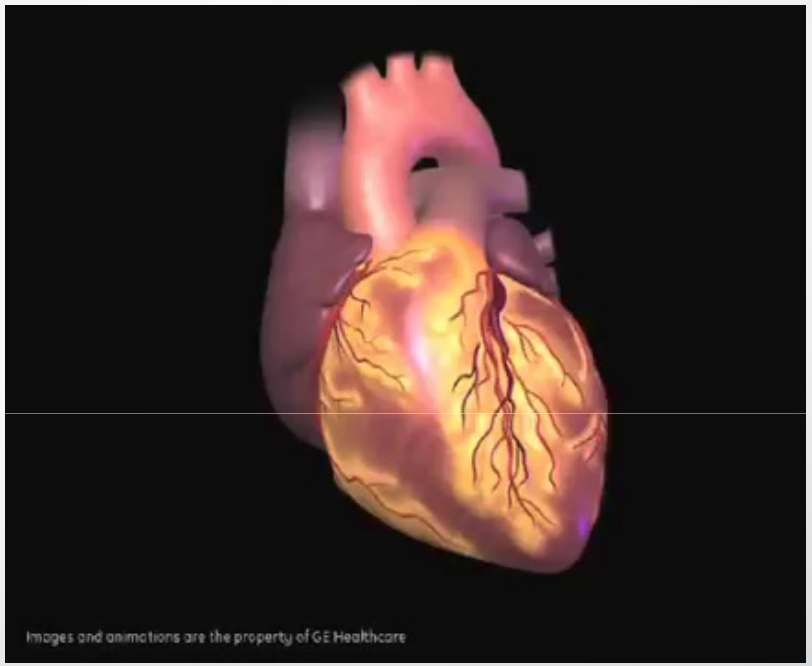
(J Am Soc Echocardiogr 2012;25:3-46.)

# AQUISIÇÃO DAS IMAGENS




2D



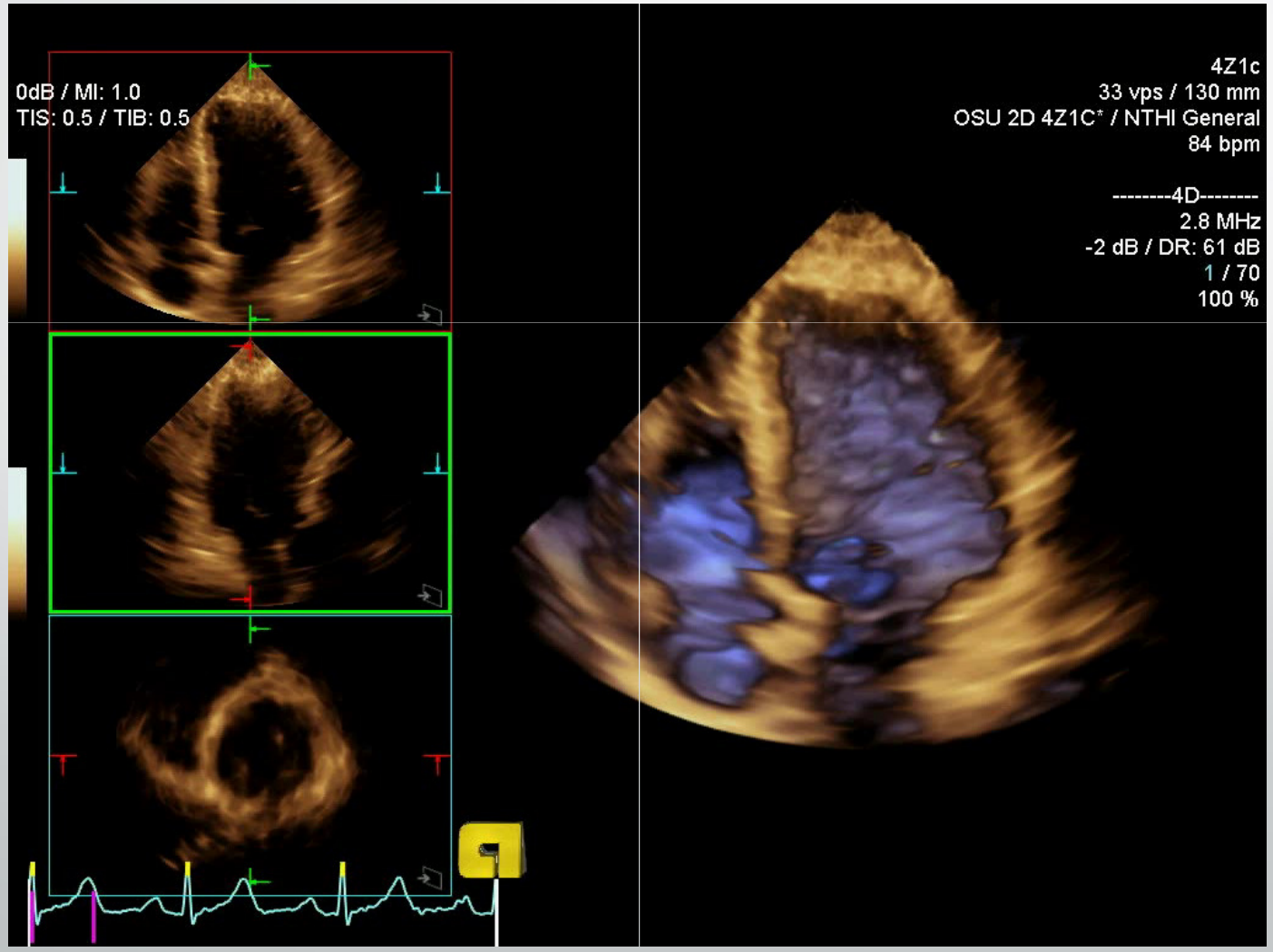

3D

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

| | Recommended for Clinical Practice | Promising Clinical Studies | Areas of Active Research | Unstudied |
|---|---|---|---|---|
| **Left Ventricle Functional Assessment** | | | | |
| Volume | ✔ | | | |
| Shape | | | ✔ | |
| Ejection Fraction | ✔ | | | |
| Dyssynchrony | | | ✔ | |
| Mass | | ✔ | | |
| **Right Ventricle Functional Assessment** | | | | |
| Volume | | ✔ | | |
| Shape | | | | ✔ |
| Ejection Fraction | | ✔ | | |
| **Left Atrial Assessment** | | | | |
| Volume | | | ✔ | |
| **Right Atrial Assessment** | | | | |
| Volume | | | | ✔ |

| | Recommended for Clinical Practice | Promising Clinical Studies | Areas of Active Research | Unstudied |
|---|---|---|---|---|
| **Mitral Valve Assessment** | | | | |
| Anatomy | ✔ | | | |
| Stenosis | ✔ | | | |
| Regurgitation | | | ✔ | |
| **Tricuspid Valve Assessment** | | | | |
| Anatomy | | | | ✔ |
| Stenosis | | | | ✔ |
| Regurgitation | | | | ✔ |
| **Pulmonic Valve Assessment** | | | | |
| Anatomy | | | | ✔ |
| Stenosis | | | | ✔ |
| Regurgitation | | | | ✔ |
| **Aortic Valve Assessment** | | | | |
| Anatomy | | ✔ | | |
| Stenosis | | ✔ | | |
| Regurgitation | | | | ✔ |
| **Infective Endocarditis** | | | | ✔ |
| **Prosthetic Valves** | | | ✔ | |
| **Guidance of Transcatheter Procedures*** | ✔ | | | |

# Avaliação de câmaras cardíacas



- Necropsy data in sheep indicate that whereas M-mode overestimates LV mass by 10% ± 21%, 2DE underestimates it by 19% ± 9%. RT3DE has the least percent error of 8% ± 7% compared with other modalities and, hence, provides the closest estimate of LV mass.


- Qin JX, Jones M, Travaglini A, et al. The accuracy of left ventricular mass determined by real-time three-dimensional echocardiography in chronic animal and clinical studies: a comparison with postmortem examination and magnetic resonance imaging. J Am Soc Echocardiogr 2005;18:1037–43.

**Table 1.** *Comparison of left ventricular volume between 2D/3D echocardiography and cardiac magnetic resonance*

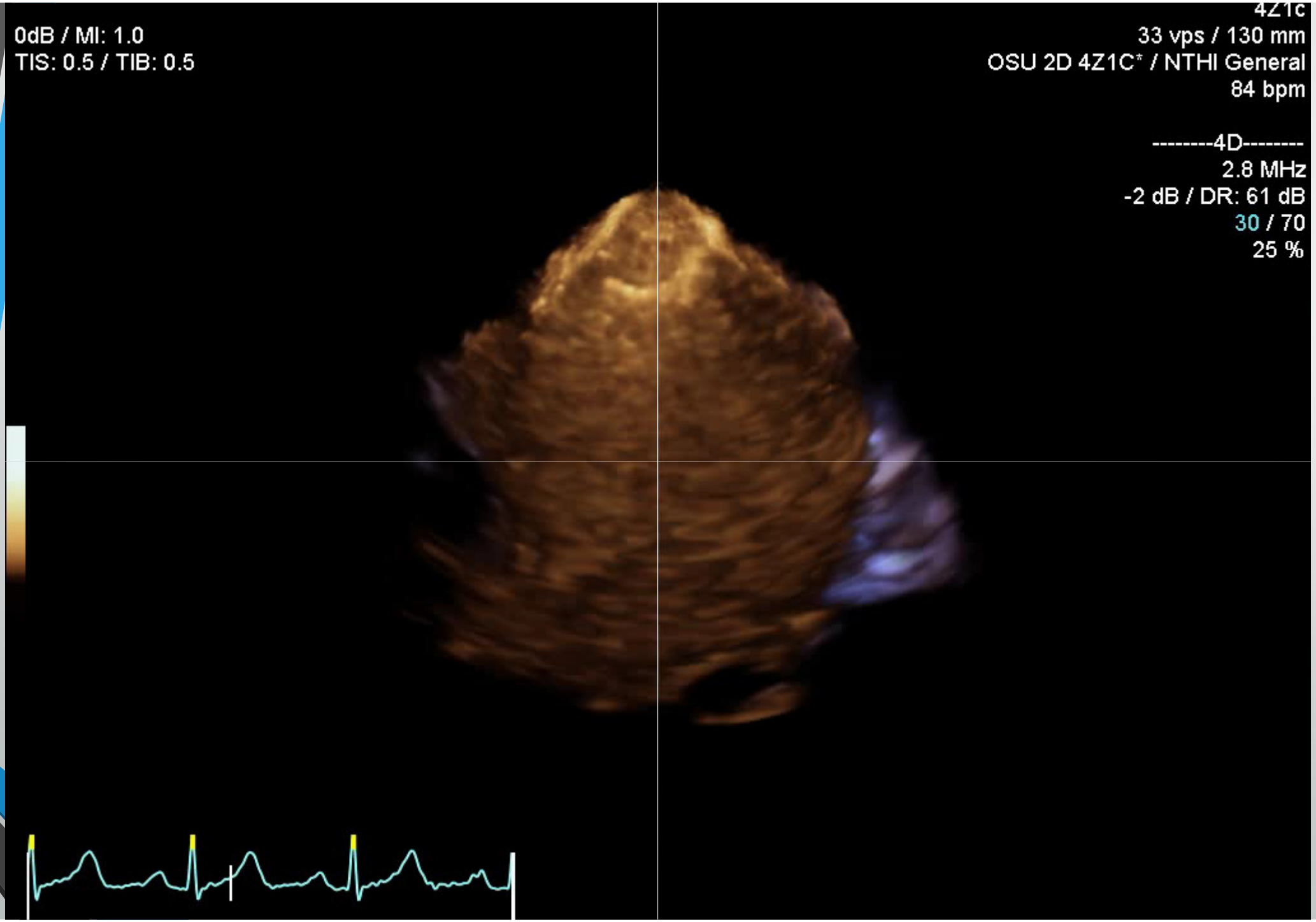
| Studies | Subjects | *n* | 3DE vs. CMR | | | | | | 2DE vs. CMR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | EDV (ml)* | p | ESV (ml)* | p | EF (%)* | p | EDV (ml)* | p | ESV (ml)* | p | EF (%)* | p |
| Jenkins et al., *JACC* 2004 | Mixed patients | 50 | -4 ± 29 | 0.31 | -3 ± 18 | 0.23 | 0 ± 7 | 0.74 | -54 ± 33 | < 0.01 | -28 ± 28 | < 0.01 | -1 ± 13 | 0.76 |
| Caiani et al., *JASE* 2005 | Mixed patients | 46 | -4.1 ± 30 | ns | -3.5 ± 34 | ns | -0.8 ± 14 | ns | -23.1 ± 86 | < 0.001 | -18.7 ± 60 | < 0.001 | 3.7 ± 16 | < 0.001 |
| Jacobs et al., *Eur Heart J* 2006 | Mixed patients | 50 | -14 ± 17 | < 0.05 | -6.5 ± 16 | < 0.05 | -1 ± 6.4 | 0.27 | -23 ± 29 | < 0.05 | -15 ± 24 | < 0.05 | 0.8 ± 8.5 | 0.57 |
| Greupner et al., *JACC* 2012 | Mixed patients | 36 | -18.3 ± 0.7 | 0.004 | -13 ± 13.5 | 0.005 | 2.7 ± 1.2 | ns | -25.8 ± 6 | < 0.001 | -14.3 ± 18.2 | 0.002 | 0.7 ± 1.3 | ns |

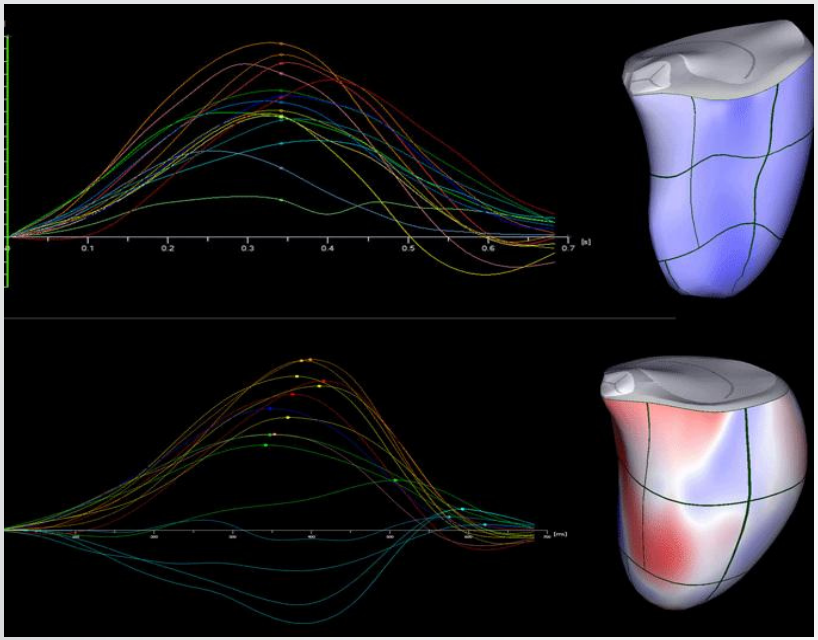
CMR, cardiac magnetic resonance; EDV, end-diastolic volume; EF, ejection fraction; ESV, end-systolic volume; ns, not significant; 2D, two-dimensional; 2DE, two-dimensional echocardiography; 3D, three-dimensional; 3DE, three-dimensional echocardiography.
* Mean difference between 3DE or 2DE, and MRI.

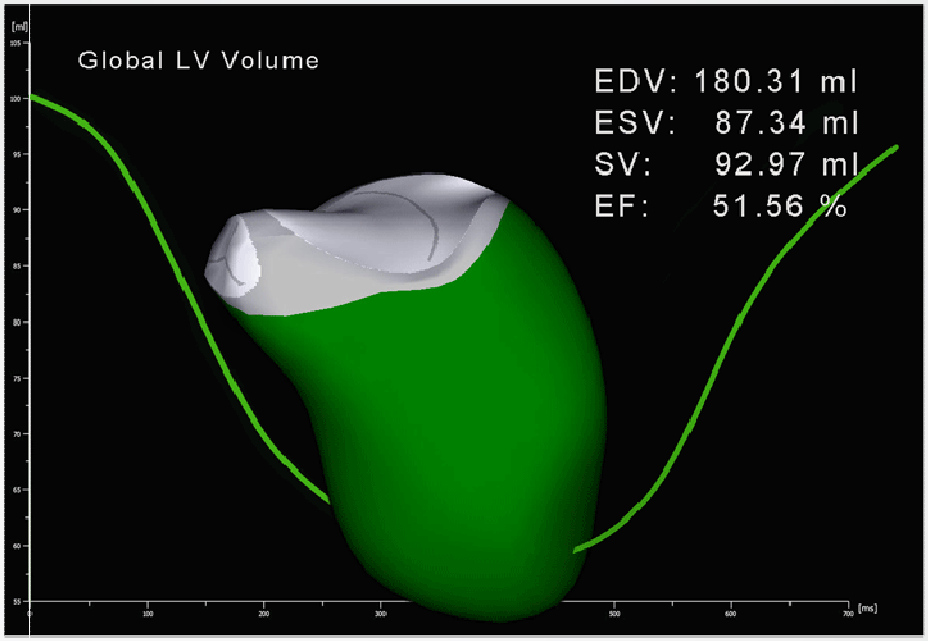
**Table 2.** Comparison of left ventricular mass between 2D/3D echocardiography and cardiac magnetic resonance

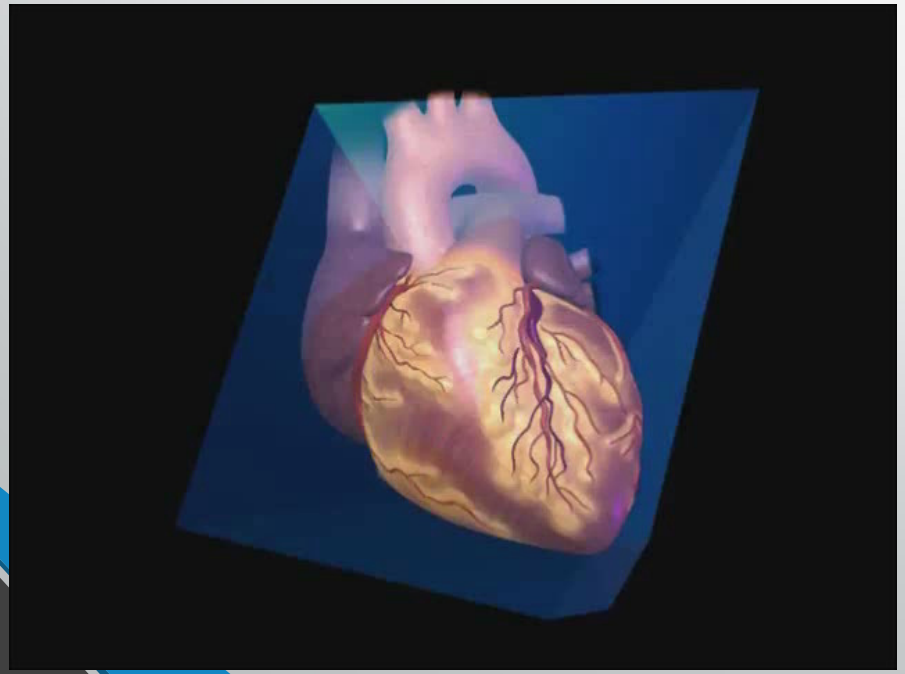
| Studies | Subjects | *n* | 3DE vs. CMR* | | | 2DE vs. CMR* | | |
|---|---|---|---|---|---|---|---|---|
| | | | Bias | LOA | *r* | Bias | LOA | *r* |
| Qin et al., *Echocardiogr* 2000 | Mixed | 19 | -9 | 66 | 0.97 | | | |
| Jenkins et al., *JACC* 2004 | Mixed | 50 | 0 | 76 | 0.87 | 16 | 114 | 0.85 |
| Mor-Avi et al., *Circulation* 2004 | Mixed | 21 | -4 | 34 | 0.90 | -39 | 58 | 0.79 |
| Oe et al., *Am J Cardiol* 2005 | LV hypertrophy | 20 | -14.1 | 58.2 | 0.94 | -10.7 | 167.4 | 0.70 |
| Caiani et al., *Heart* 2006 | Mixed | 46 | -2.1 | 23 | 0.96 | -34.9 | 49.6 | 0.79 |
| Takeuchi et al., *JASE* 2008 | Mixed | 55 | -1 | 6 | 0.95 | | | |
| Mizukoshi et al., *JASE* 2016 | Mixed | 57 | -4.8 | 27.7 | 0.96 | | | |

LOA, limits of agreement. * Bias and LOA are given in grams. Abbreviations are in Table 1.


0dB / MI: 1.0
TIS: 0.5 / TIB: 0.5
4Z1c
33 vps / 130 mm
OSU 2D 4Z1C* / NTHI General
84 bpm
--------4D--------
2.8 MHz
-2 dB / DR: 61 dB
30 / 70
25 %




Global LV Volume
EDV: 180.31 ml
ESV: 87.34 ml
SV: 92.97 ml
EF: 51.56 %



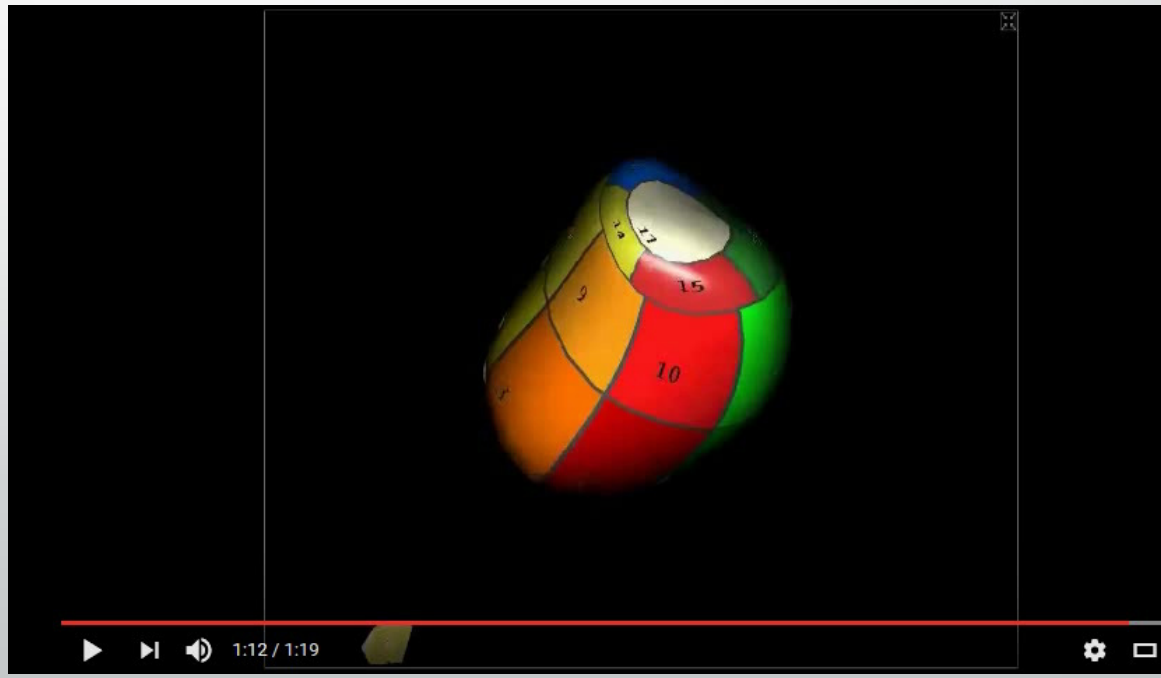
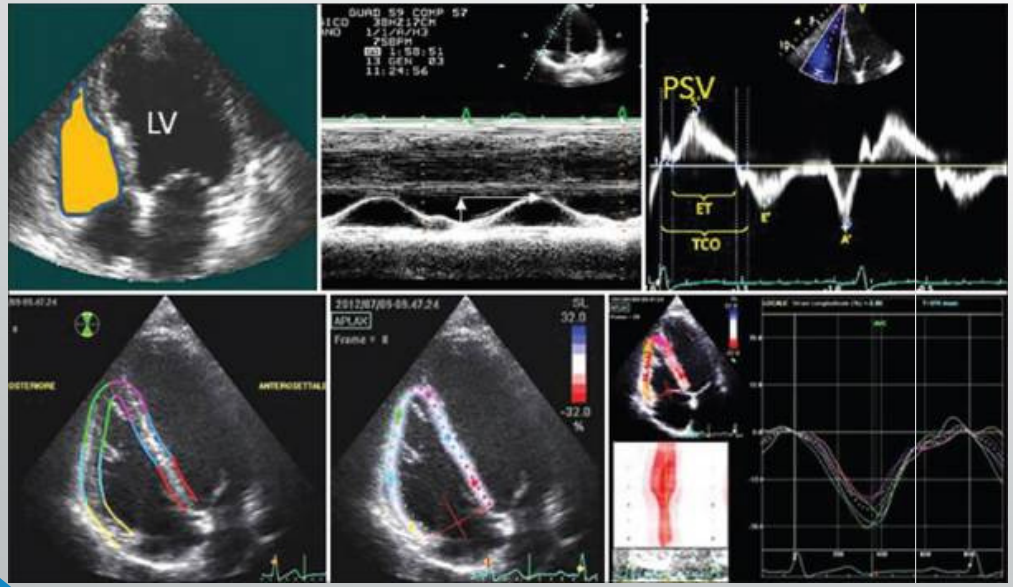

1:12 / 1:19

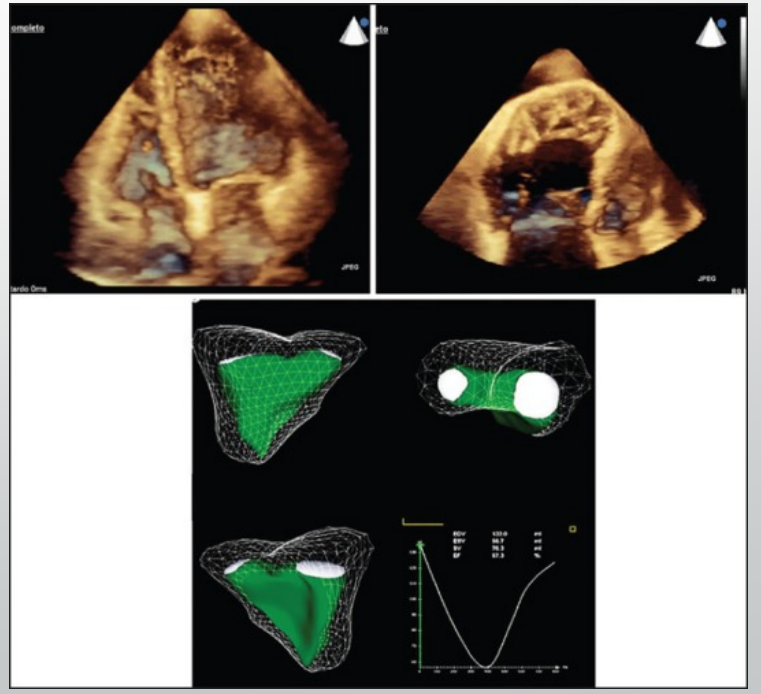
**Table 3.** Comparison of right ventricular volume between 3D echocardiography and cardiac magnetic resonance

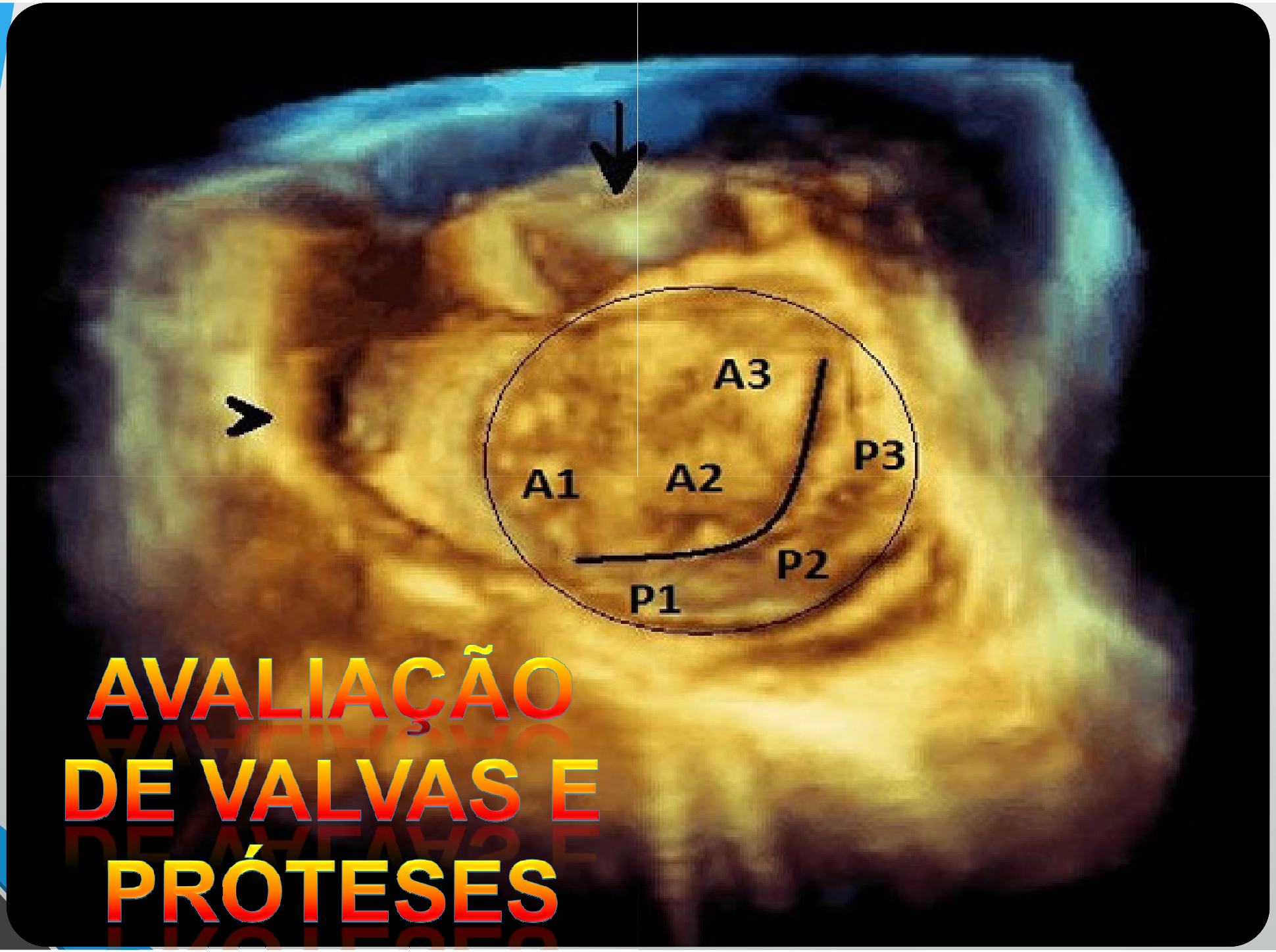
| Studies | Subjects | *n* | EDV (ml)* | ESV (ml) | EF (%) | Feasibility (%) |
|---|---|---|---|---|---|---|
| Jenkins et al., *Chest* 2007 | AMI | 50 | -3 ± 10 | -4 ± 7 | 2 ± 4 | 100 |
| Grapsa et al., *Eur J Echocardiogr* 2010 | PAH | 60 | -4 (-11, 4) | 0 (-6, 6) | -1 (-3, 0) | 100 |
| Sugeng et al., *JACC Imaging* 2010 | Mixed | 28 | -14 (-28, 0) | -9 (-19, 1) | -2 (-4, 0) | 93 |
| van der Zwaan et al., *JASE* 2010 | CHD | 50 | -34 (-43, -25) | -11 (-19, 3) | -4 (-6, -2) | 81 |
| Leibundgut et al., *JASE* 2010 | Mixed | 88 | -10 (-15, -6) | -5 (-8, -1) | 0 (-2, 1) | 88 |
| Medvedofsky et al., *JASE* 2015 | Mixed | 147 | -11 ± 20 | -0.3 ± 15 | -3 ± 8 | 89 |

AMI, acute myocardial infarction; CHD, congenital heart disease; EDV, end-diastolic volume; EF, ejection fraction; ESV, end-systolic volume; PAH, pulmonary arterial hypertension.

* Mean difference between 3DE and MRI, with mean ± SD, with 95% confidence interval.



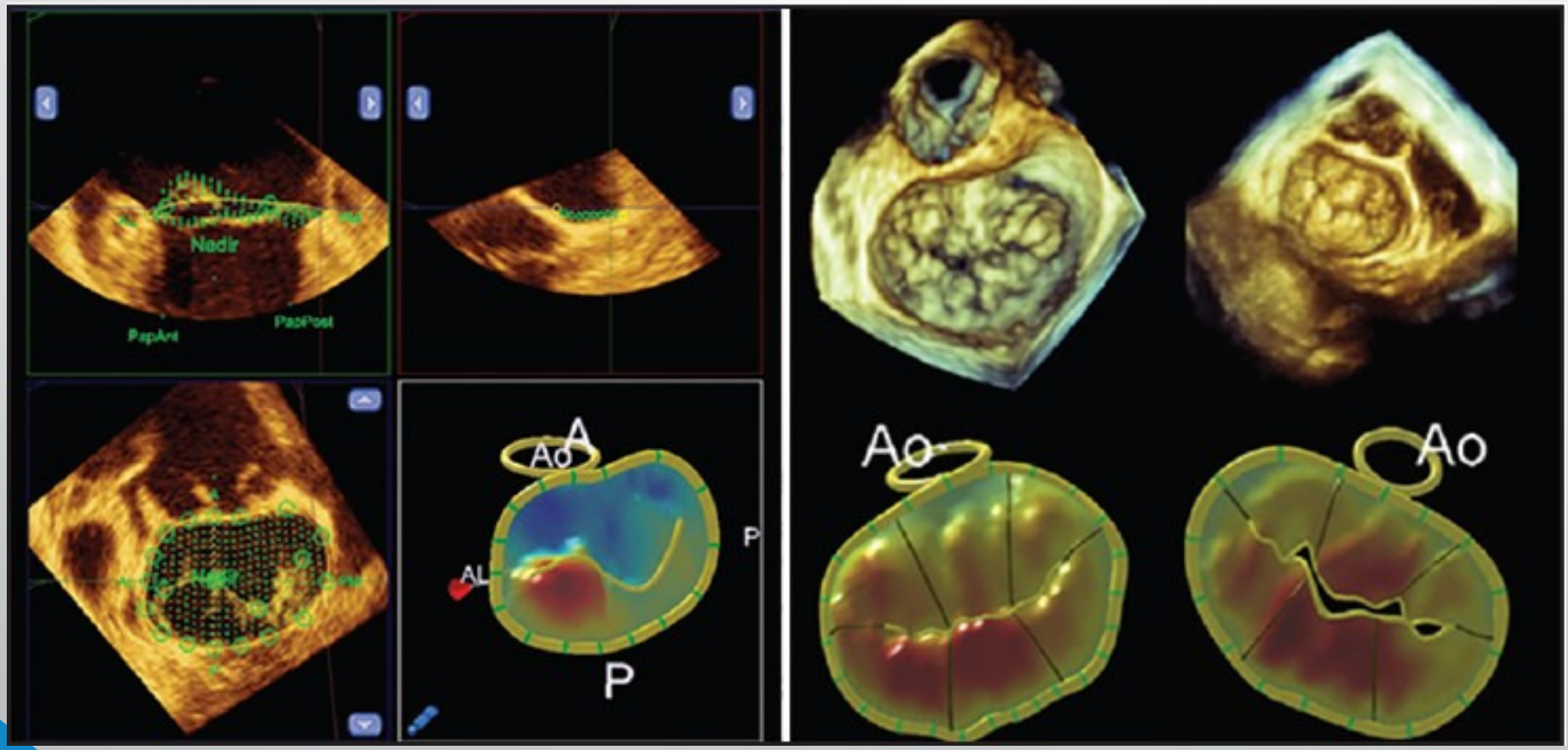






# AVALIAÇÃO DE VALVAS E PRÓTESES

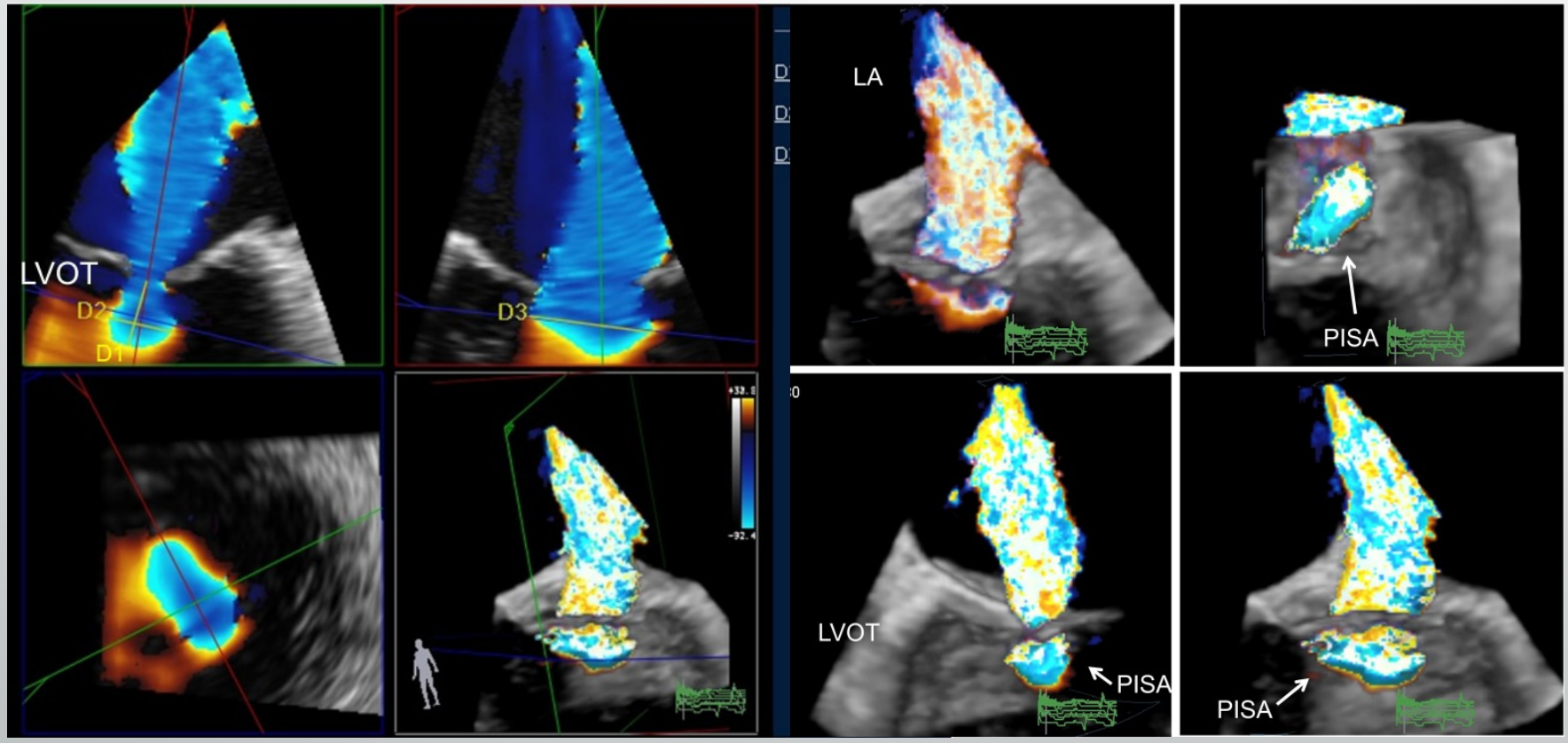
# Valva Mitral

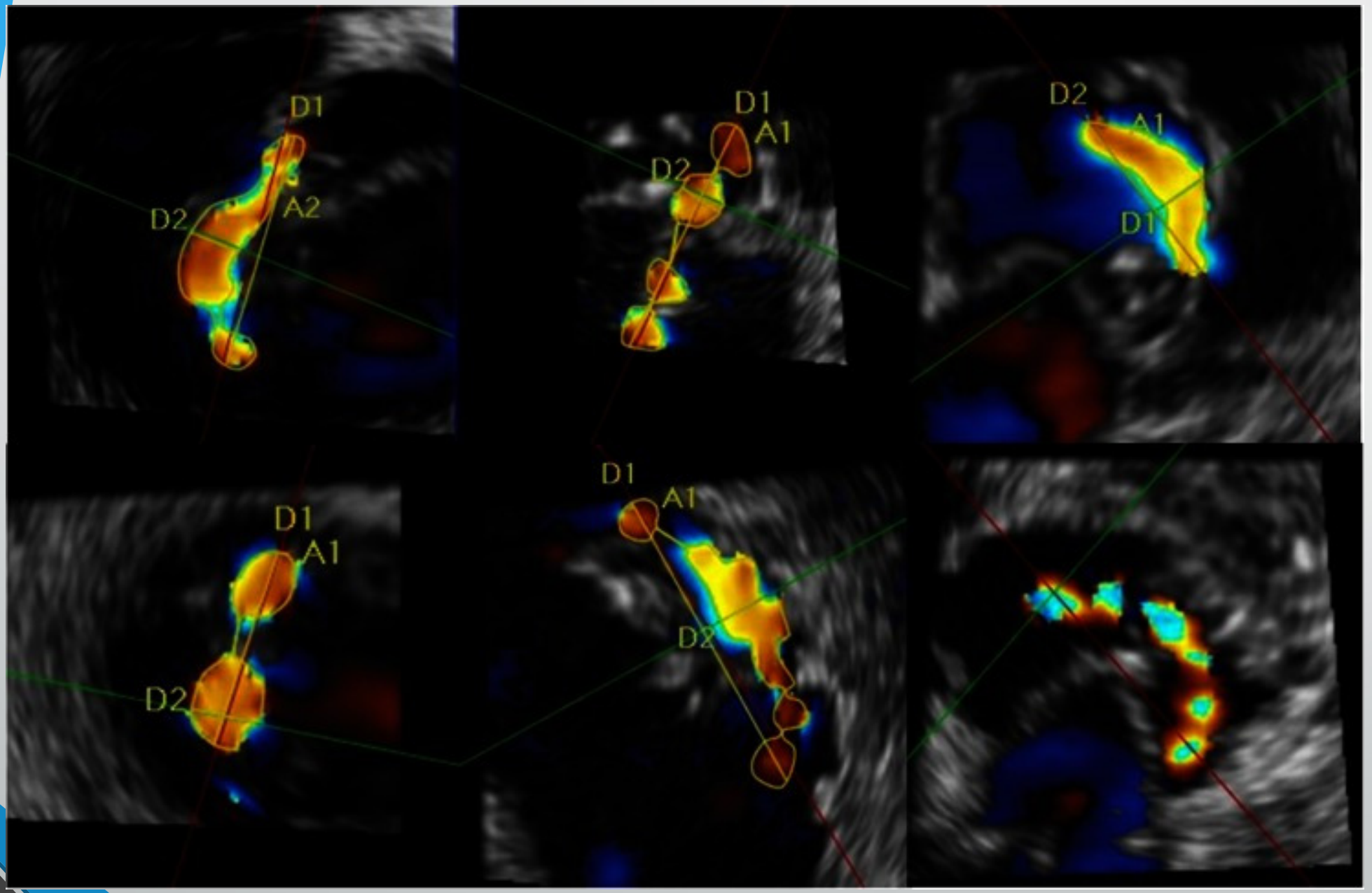
Avaliação anatômica



# Valva Mitral

Avaliação funcional

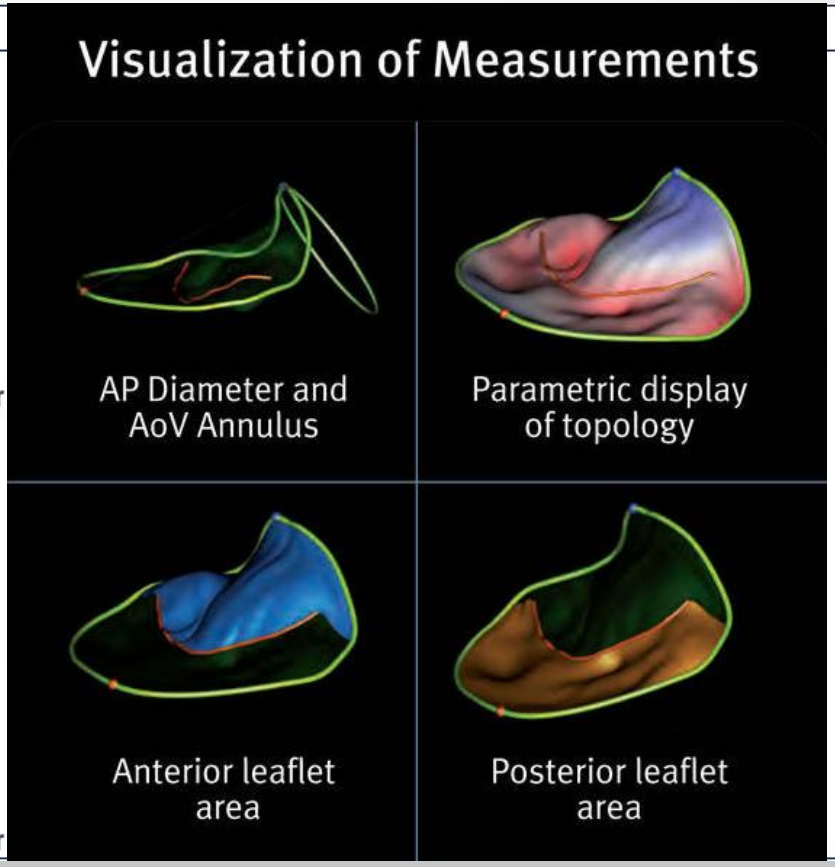



D1
A2
D2
D1
A1
D2
D2
A1
D1
D1
A1
D2
D1
A1
D2

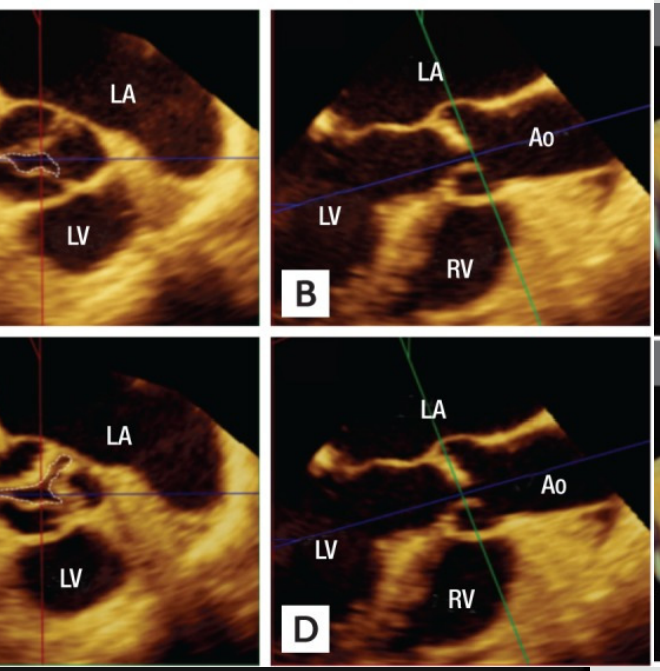
# Valva Mitral

Conduta:

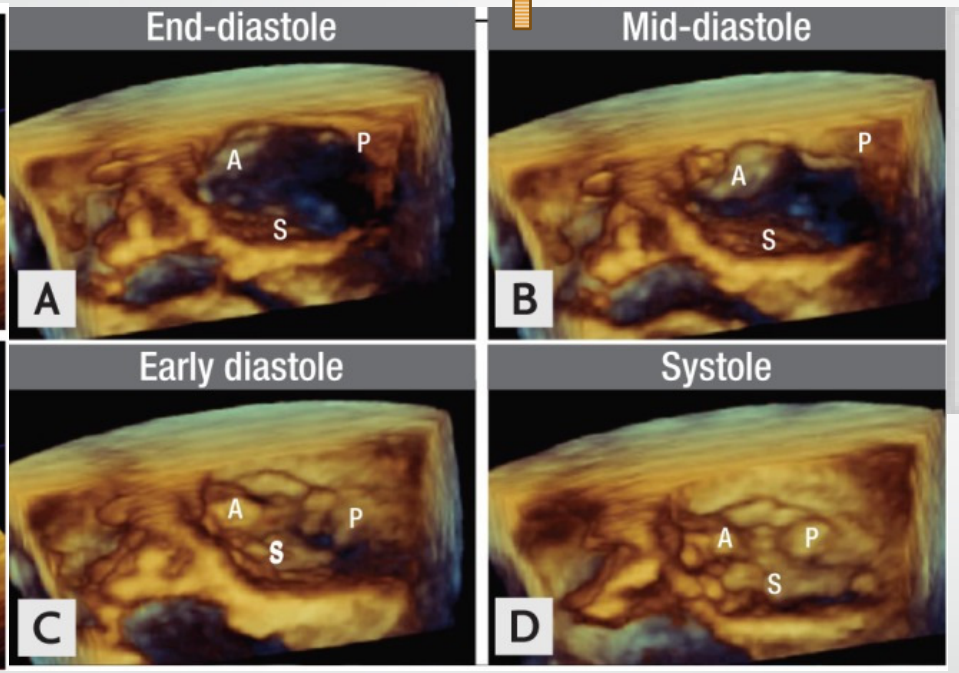

| Areas of application | Advantages of 3D echo over 2D |
|---|---|
| Diagnosis | Precise anatomic localization of prolapsing mitral valve segments |
| | Accurate segmental analysis of mitral valve prolapse in complex lesions |
| | Easy interpretation of 3D images with their true-life *en face* display of the mitral valve |
| | Quantitative analysis of mitral apparatus geometry |
| | Enhanced quantification of MR |
| Surgical Implications | Preoperative assessment of the feasibility and durability of MV repair |
| | Improved planning of surgical strategy |
| | Definition of changes in mitral annulus morphology and dynamic after annuloplasty |
| Percutaneous Repair Implications | Refined patient selection and identification of echocardiographic predictors associated with complex procedures |
| | Advanced procedural guidance with the precise spatial definition of the clip arms orientation |
| | More reliable assessment of clip attachment to the mitral leaflets |
| | Evaluation of immediate procedural results on mitral annulus morphology |
| | Measurement of left cardiac chamber reverse remodeling after repair |



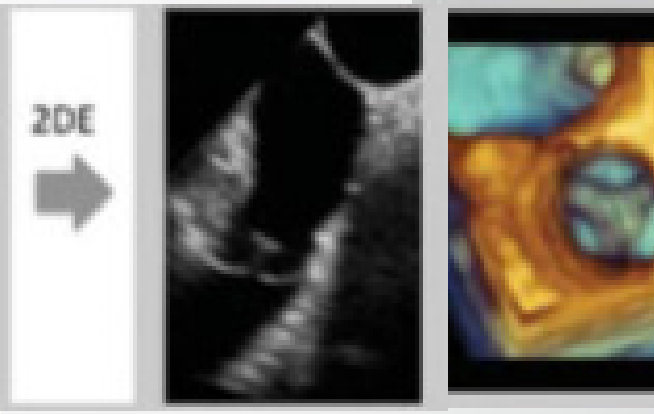
# Valva Aórtica

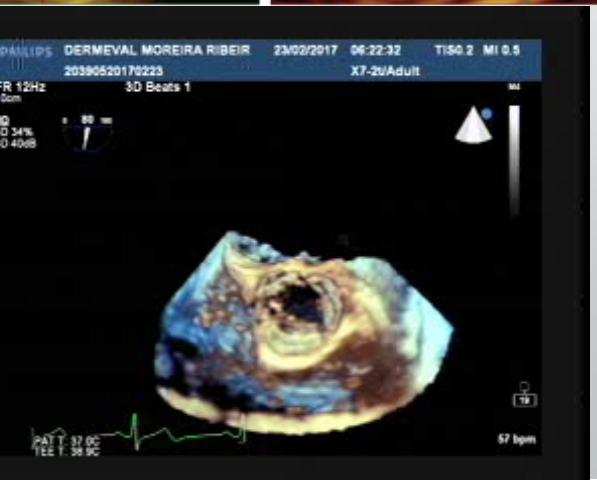


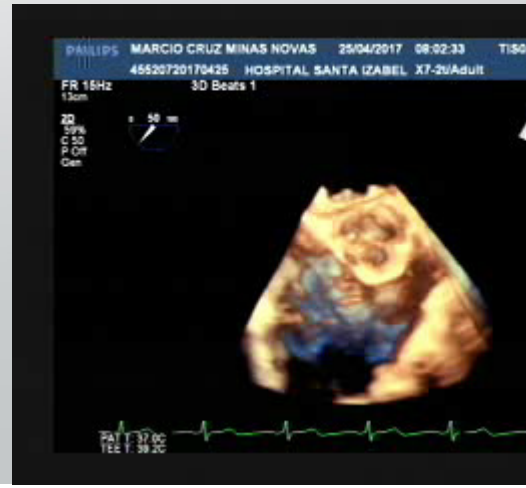

# Valva Tricúspide



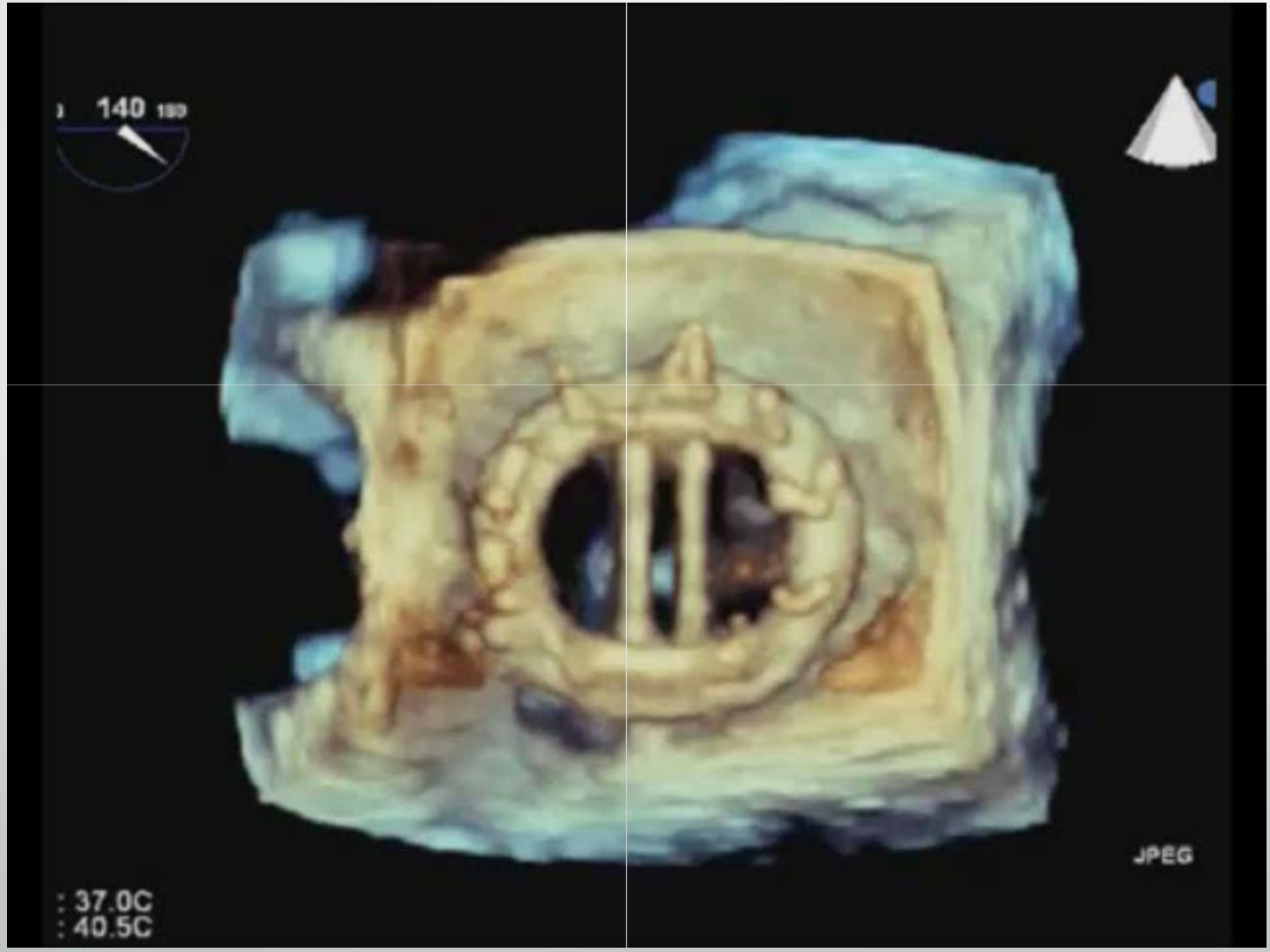

# Valva Pulmonar

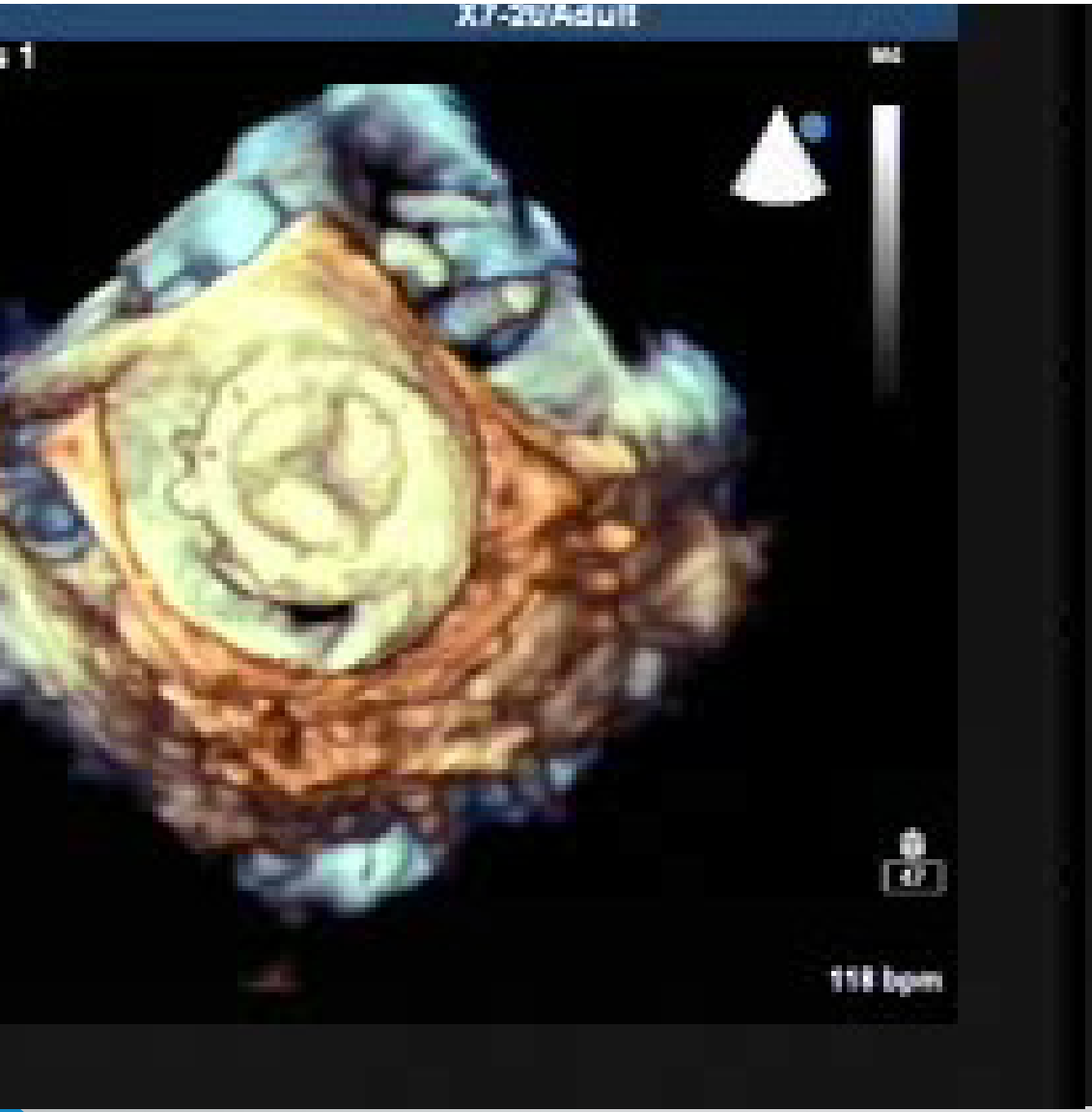


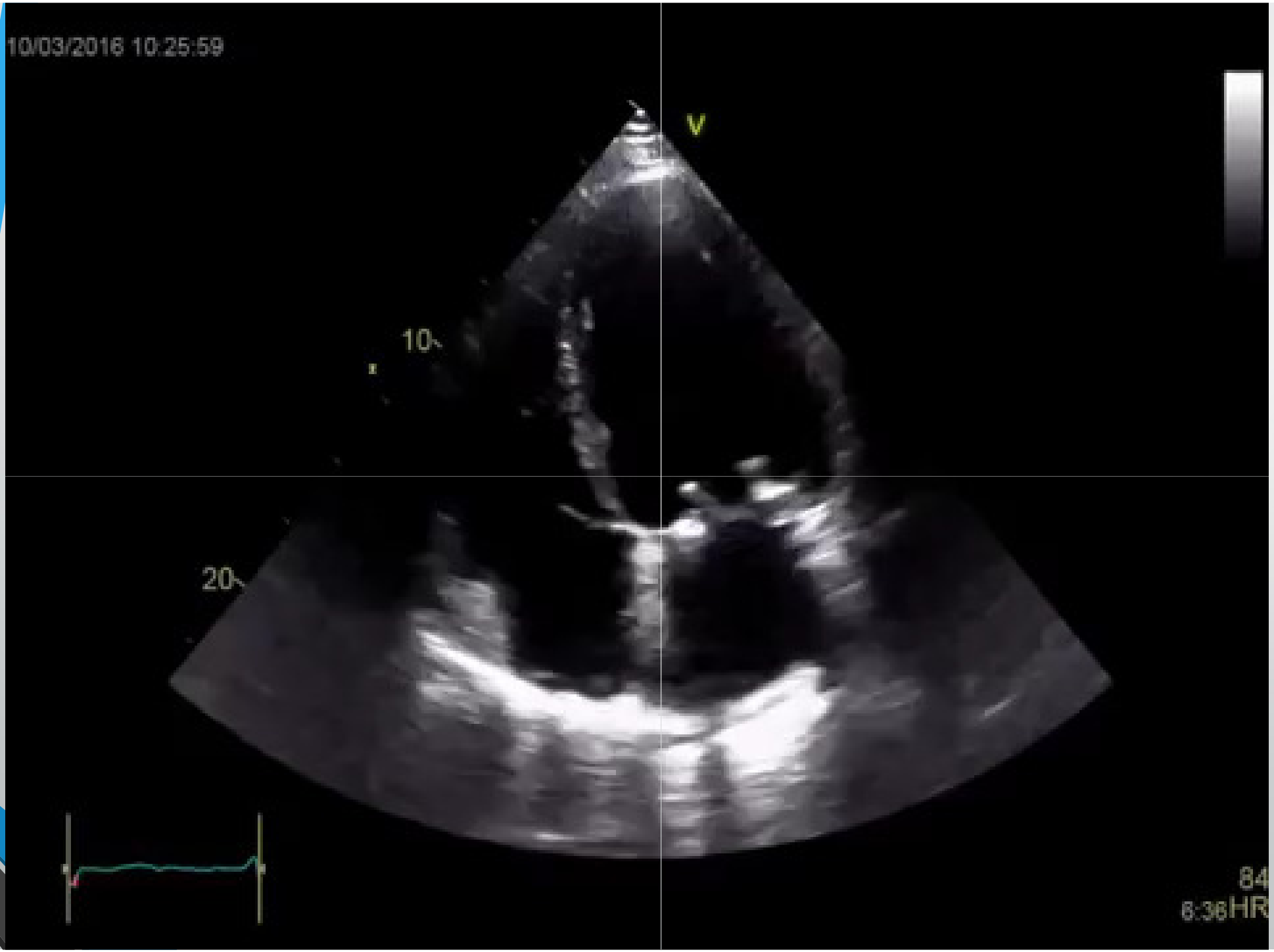



# AVALIAÇÃO DE PRÓTESES






# Avaliação de Leak periprotético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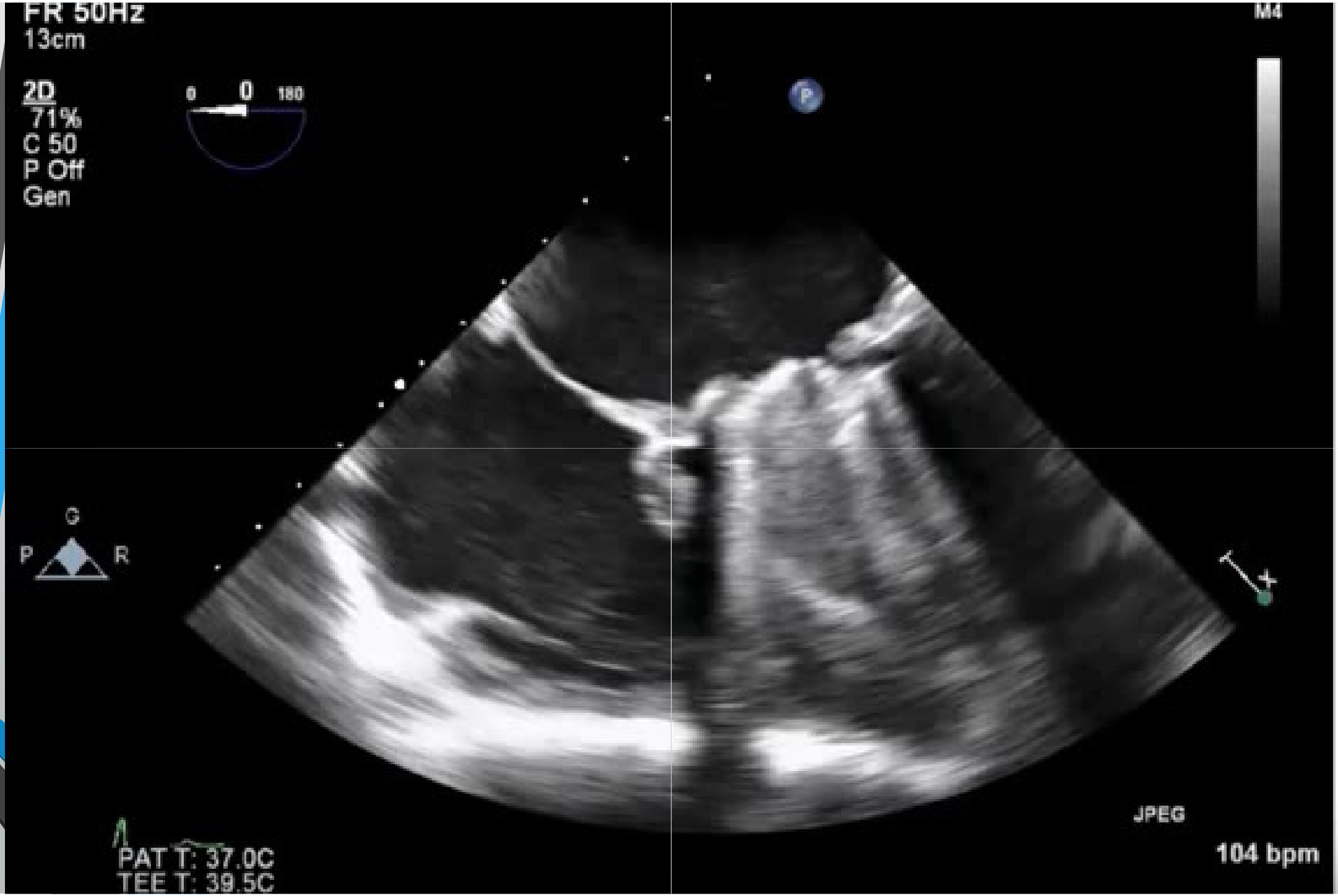
V
10
20
84
6:36HR


FR 50Hz
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2D
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C 50
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Gen
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G
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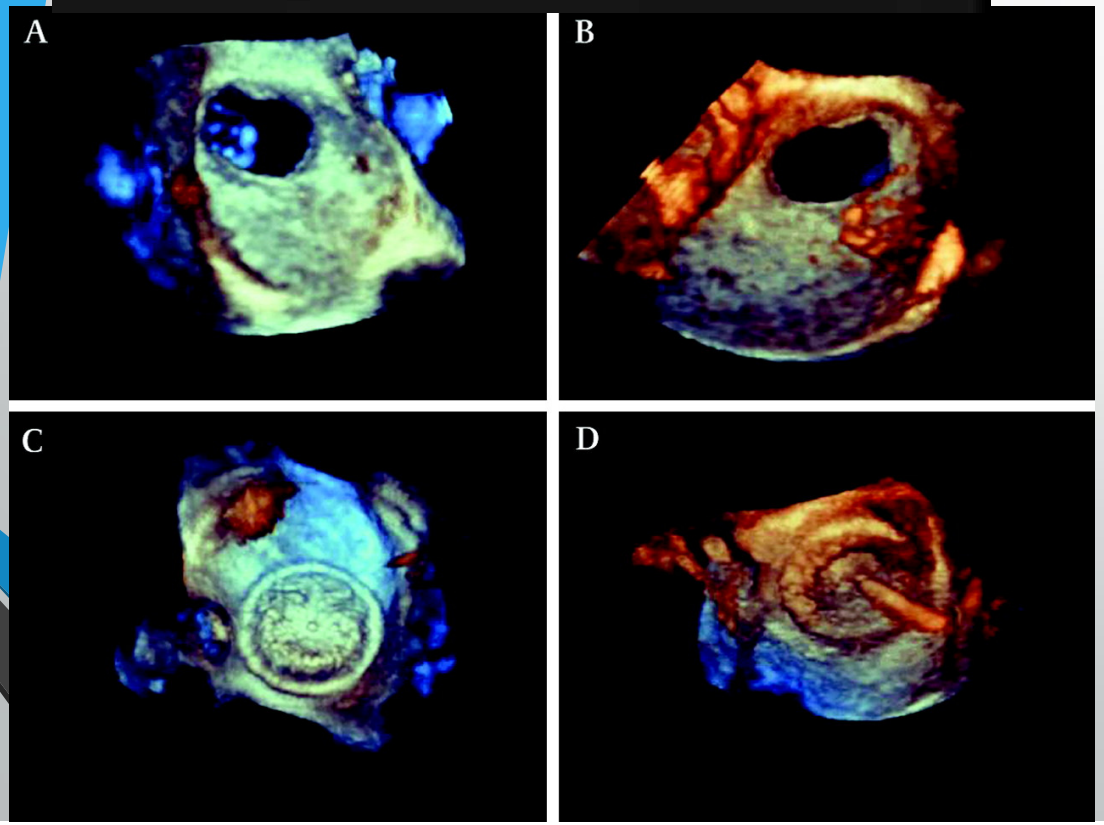
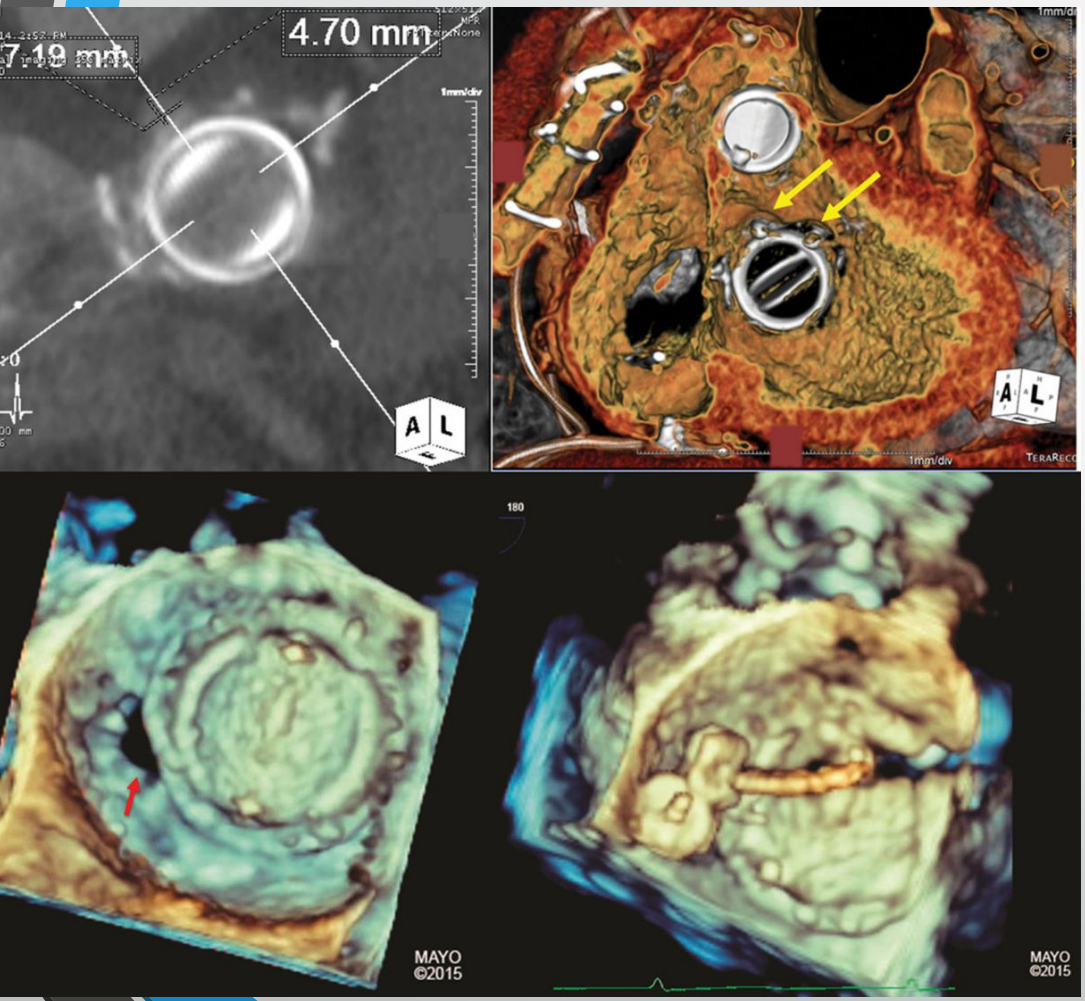
R
JPEG
104 bpm
PAT T: 37.0C
TEE T: 39.5C

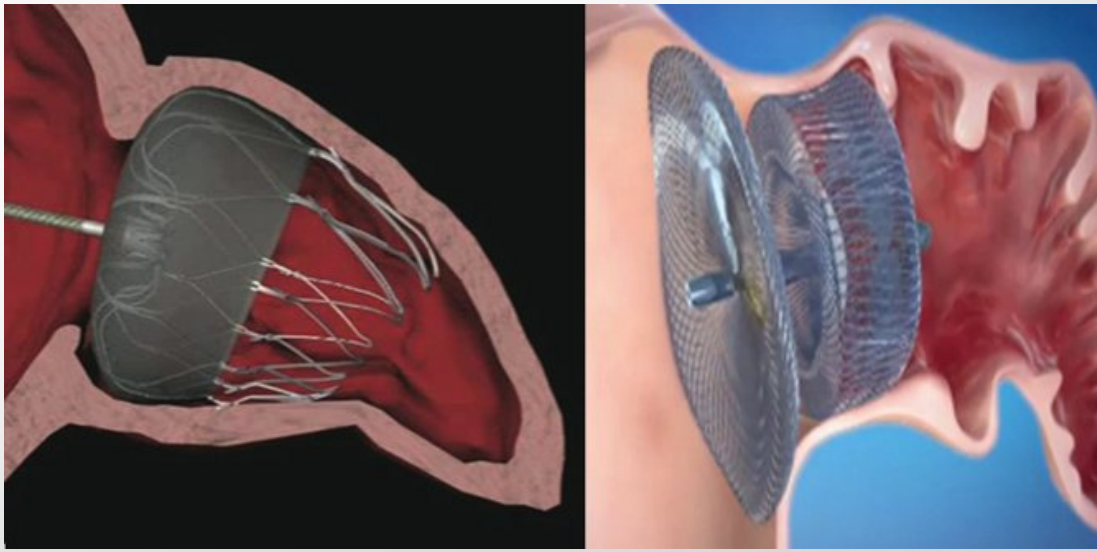




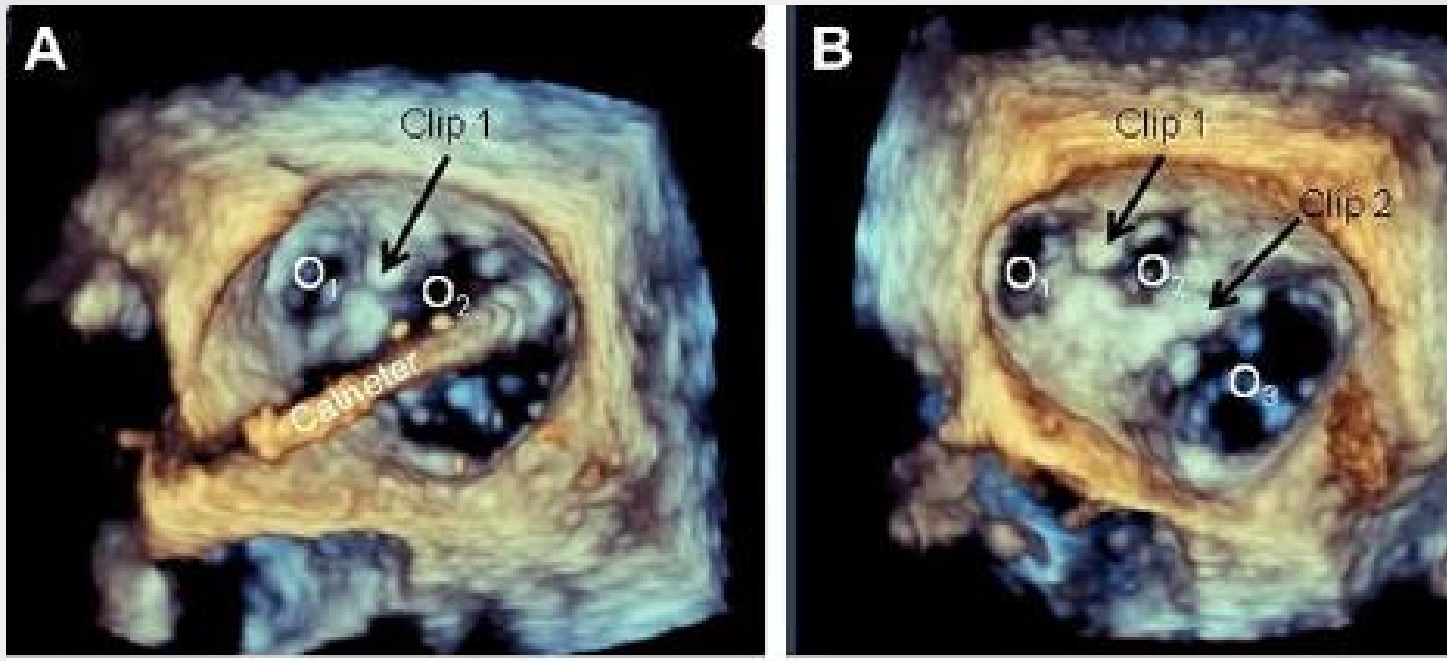

# PROCEDIMENTOS TRANSCATETER

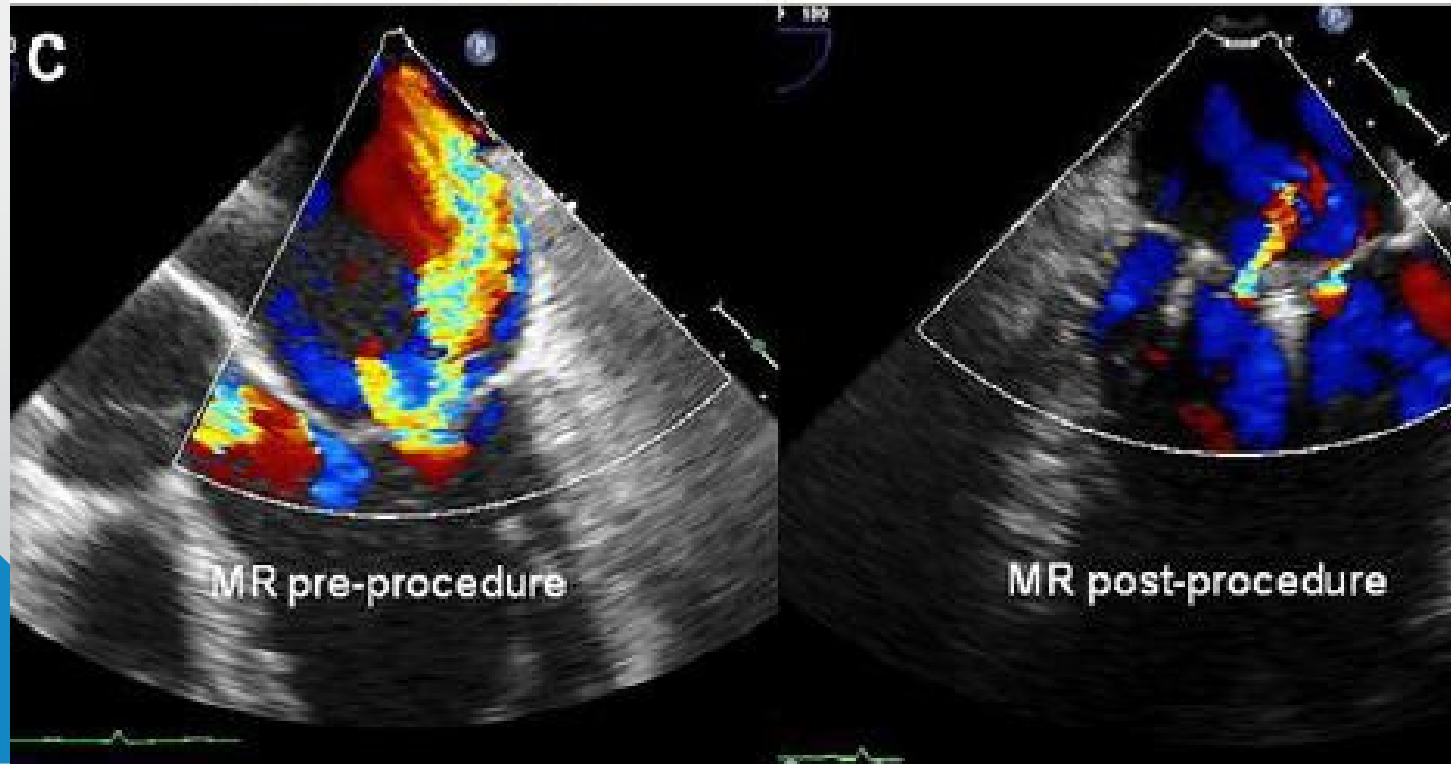
# PROCEDIMENTOS TRANSCATETER



# OCEDIMENTOS
# RANSCATETER



# Mensagem Final

- A ecocardiografia tridimensional é uma realidade e veio para ficar
- A ecocardiografia convencional continuará sendo a pedra fundamental para avaliação cardiovascular estrutural e funcional
- A ecocardiografia 3D é superior a 2D na análise de disfunção de próteses valvares
- A ecocardiografia 3D pode ajudar na definição de gravidade de disfunções valvares
- A ecocardiografia 3D já faz parte do rol da ANS, porém ainda não foi precificada
- Na sala de hemodinâmica, o eco 3D é superior ao 2D como guia para procedimentos transcateter
- Programação de plastia mitral...


# OBRIGADO

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