

# Integración de imágenes en el intervencionismo estructural

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# Puntos a tratar

- Concepto de imagen
- Perspectiva histórica
- Fuentes de imágenes
- Tipos de integración
- Aplicación en intervencionismo

# Concepto

Del latín *imāgo*, *-inis*.

Figura, representación, semejanza y apariencia de algo.

Real Academia Española. Versión en línea de la 23<sup>a</sup> edición

Es la **representación visual** de un elemento que se logra a partir de **técnicas** enmarcadas en fotografía, el arte, el diseño, el video u otras disciplinas.

Googleando

# Perspectiva històrica

1895. Röntgen. Rayos X

**Abril 1912. Hundimiento Titanic**

**Mayo 1912. 1ª patente US**

**1950. Edler & Herz. US en medicina.**

**1950. Desarrollo del intensificador de señal y cámara de TV**

1953. Rubio-Alvarez. Valvuloplastia pulmonar

1964. Dotter and Judkins. Dilatación mecánica de arterias periféricas

1966. Rashkind and Miller. ASD paliativo en TGA

1967. Porstmann. Cierre de PDA

1974. King. Cierre de ASD

1979. Grüntzig. ACTP

**1982. EBCT**

**1983. RM con sincronización ECG**

**Late 1980. MDCT**

1992. Hourihan. Cierre de leaks

**1998. Eco 3D**

2002. Cribier. TAVI FIM

2009. Webb. TMVR FIM

# Perspectiva històrica



Profesor Wilhelm Conrad Röntgen  
8 de noviembre de 1895



20 minutos de exposición

# Perspectiva històrica

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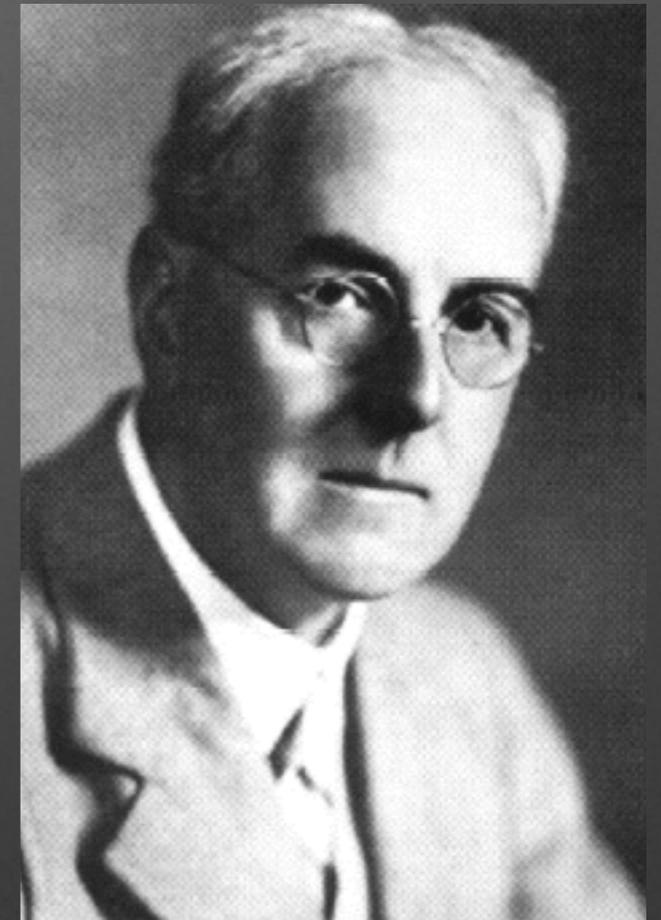
2002. Cribier. TAVI FIM

2009. Webb. TMVR FIM

# Perspectiva històrica



Hundimiento del Titánic  
15 de abril de 1912



Richardson  
1<sup>a</sup> patente en US  
Mayo de 1912

# THE EARLY WORK ON ULTRASOUND IN MEDICINE AT THE UNIVERSITY OF LUND

*by* Inge Edler and Carl Hellmuth Hertz

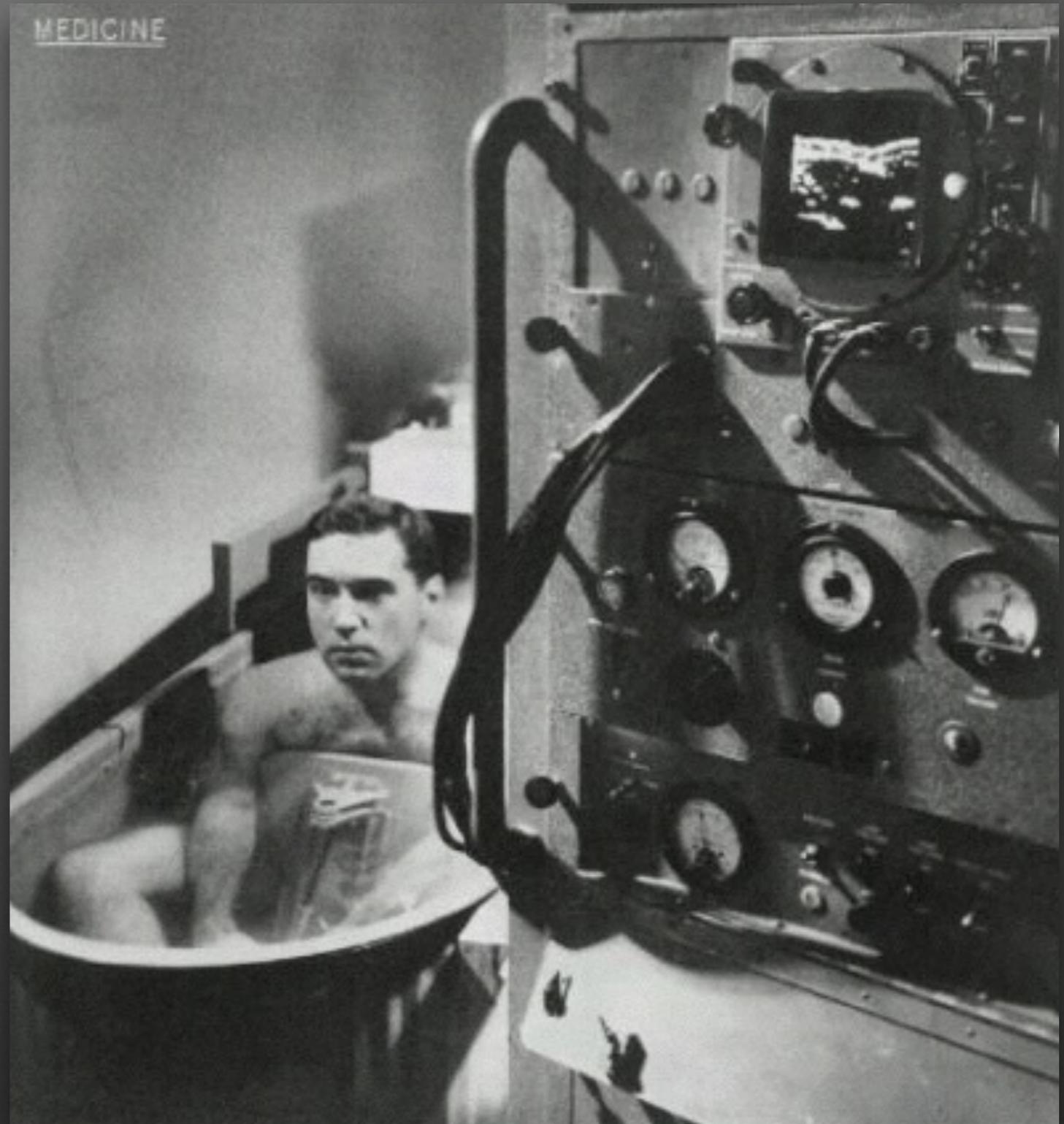
## **ABSTRACT**

In the early 1950's, research was started at the University of Lund on the use of ultrasound as a diagnostic tool in cardiology, neurology, and gynecology. The results of this work provided impetus for the later development of the ultrasonic echo method into a routine procedure in many fields of medicine. A historical review of this fundamental work is given in this paper which also stresses the importance of a stimulating and free atmosphere for the development of new ideas in research.

J Clin Ultrasound. 1977;5(5):352-6.

**LIFE**

**SEPTEMBER 20, 1954**



**A sonarlike device produces pictures of the human body's soft tissues which are invisible to X-rays**

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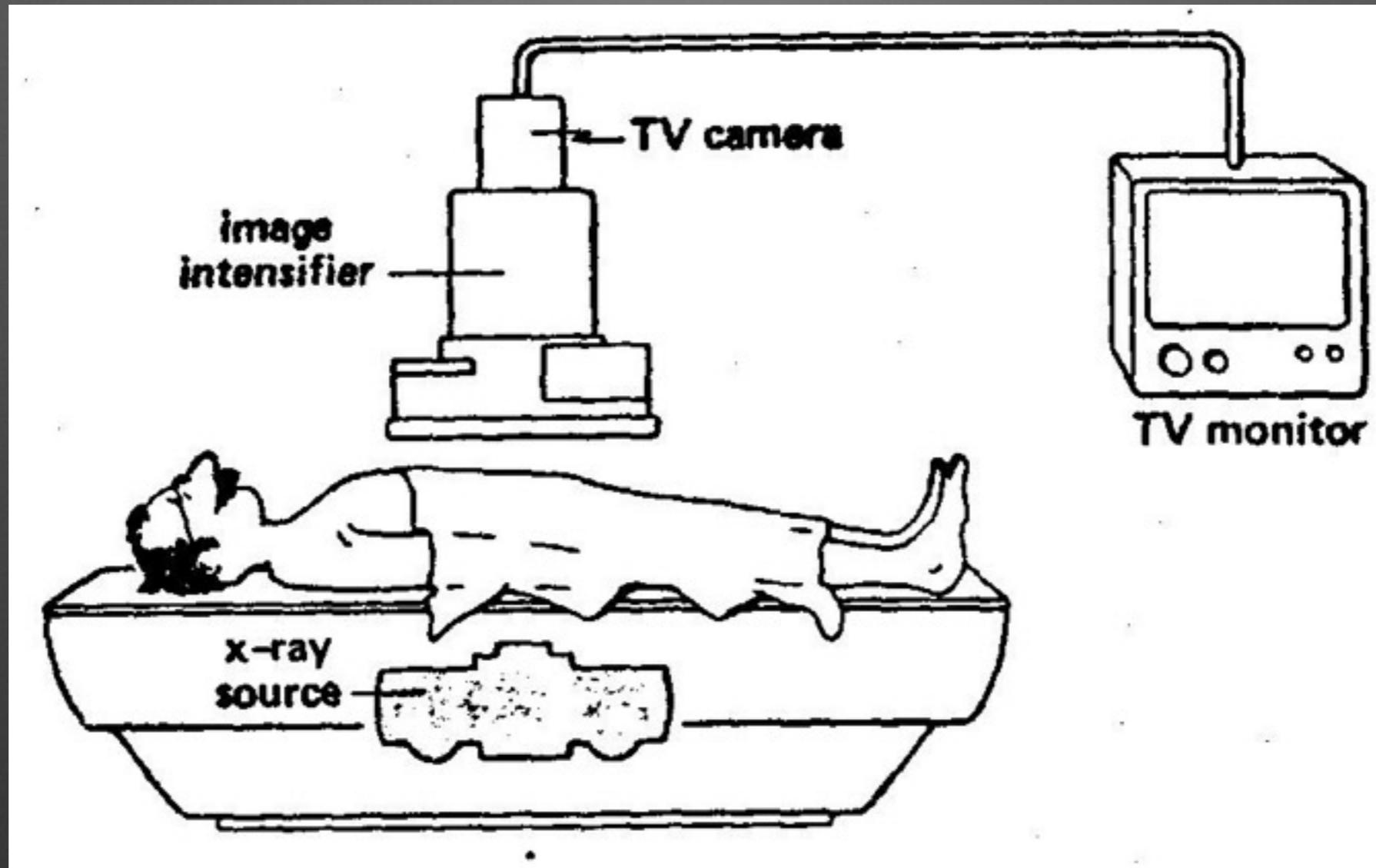
2002. Cribier. TAVI FIM

2009. Webb. TMVR FIM

# Perspectiva històrica



# Perspectiva hist3rica



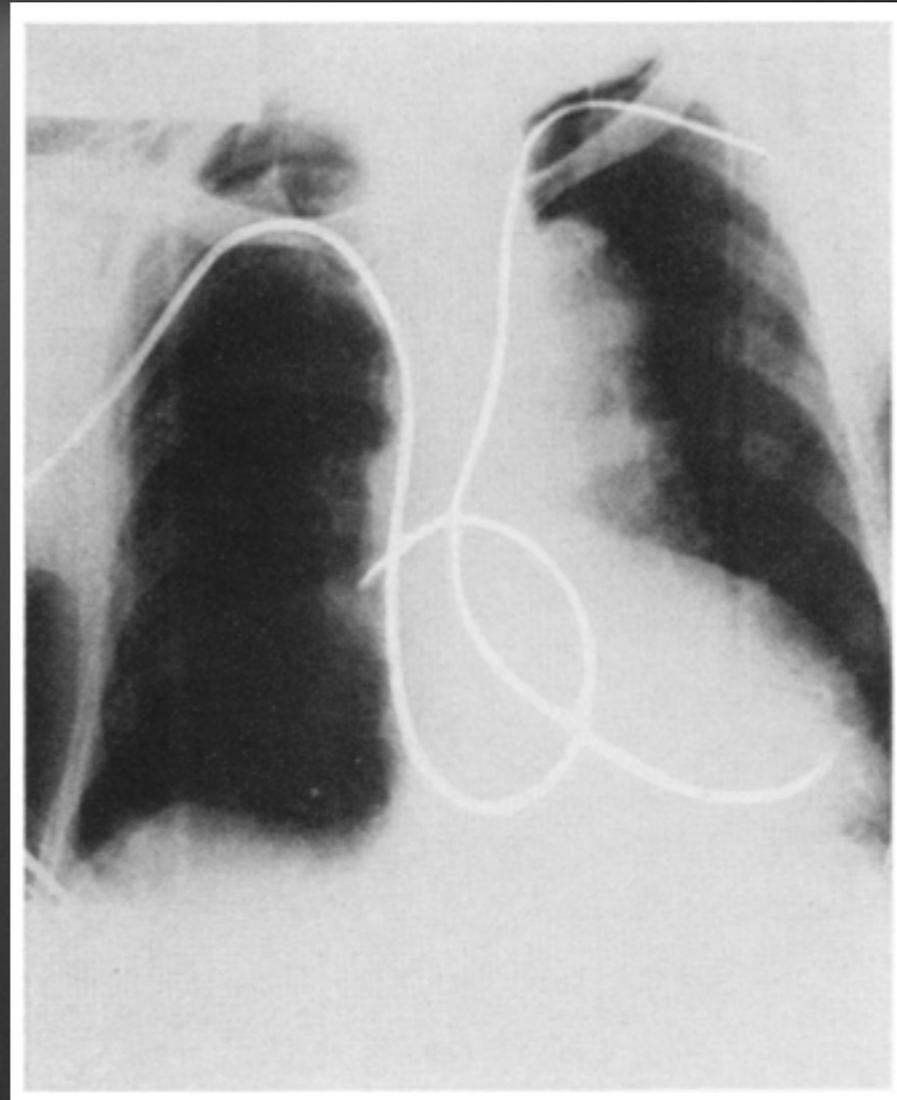
1950 - Desarrollo del intensificador de se1al y c1mara de TV

# Catheterization of the Left Side of the Heart in Man

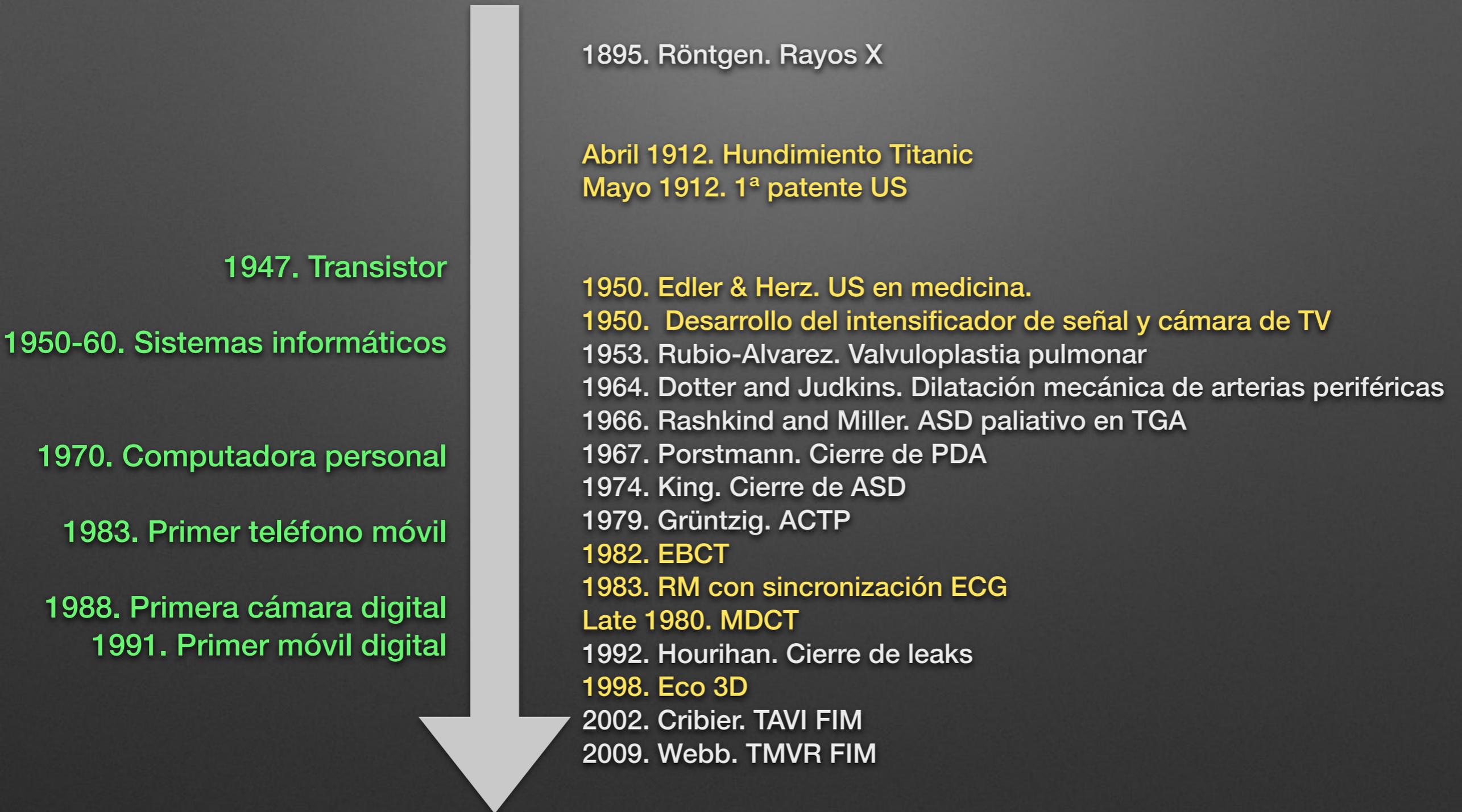
*By* HENRY A. ZIMMERMAN, M.D., ROY W. SCOTT, M.D., AND NORMAN O. BECKER, M.D.

The technic employed in catheterization of the left heart in man is described. A catheter is introduced into the left ulnar artery and passed through the brachial, axillary and subclavian arteries into the arch of the aorta. With the tip of the catheter at the root of the aorta, we have succeeded in entering the left ventricle only in patients with free aortic insufficiency due to syphilis. Failure to pass the aortic valves in normal subjects is discussed.

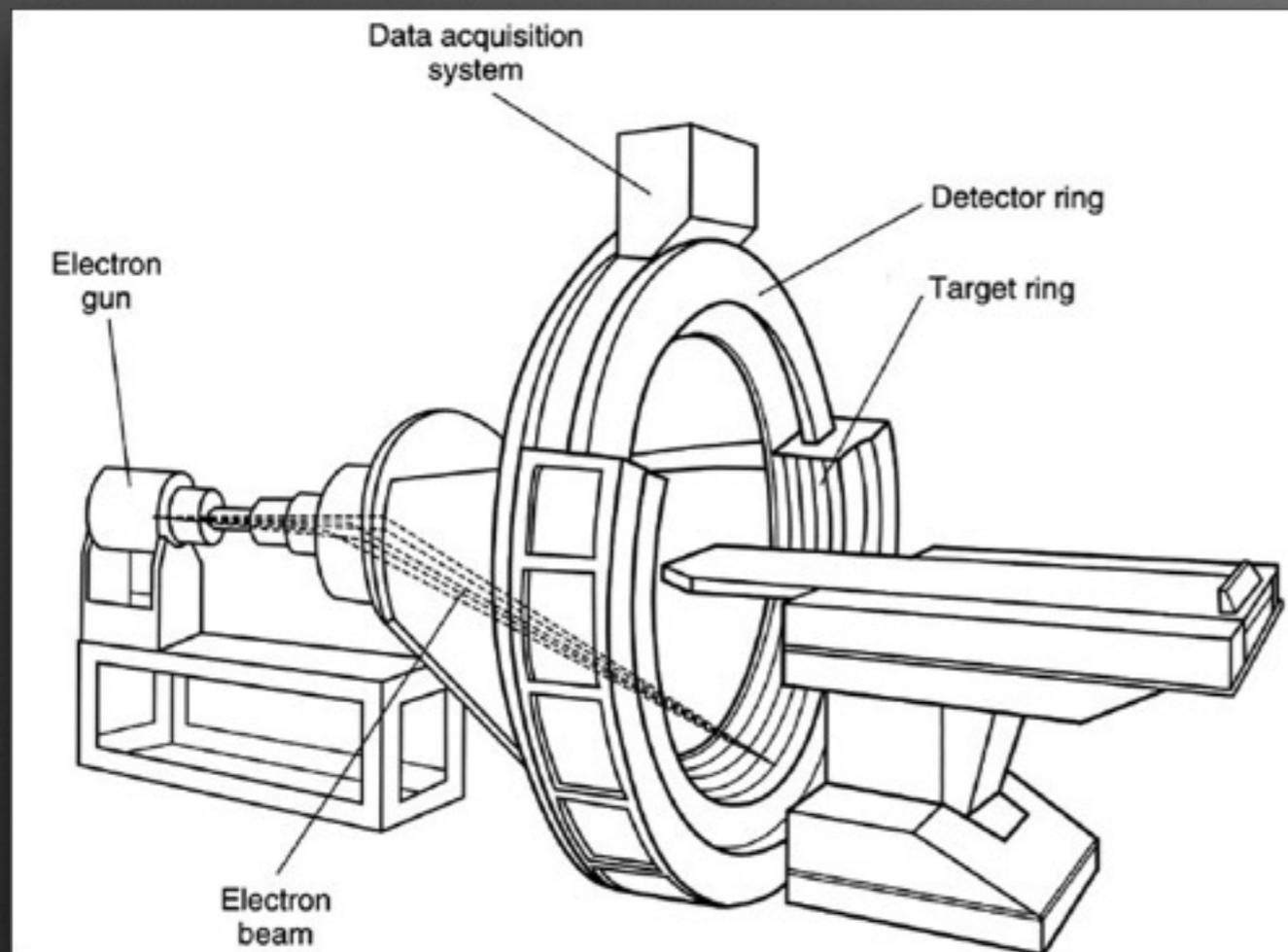
Circulation. 1950;1(3):357-9.



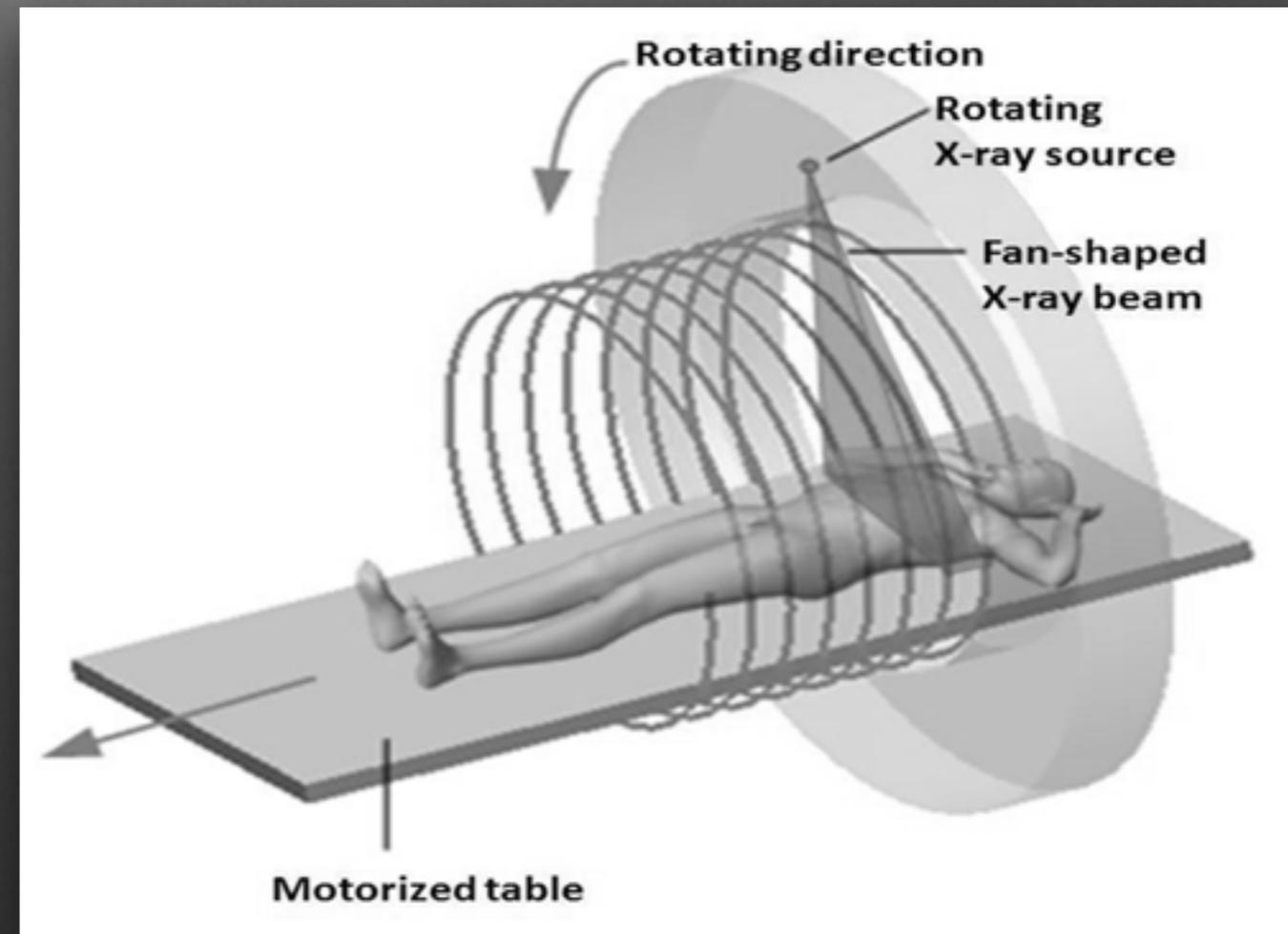
# Perspectiva històrica



# Perspectiva històrica

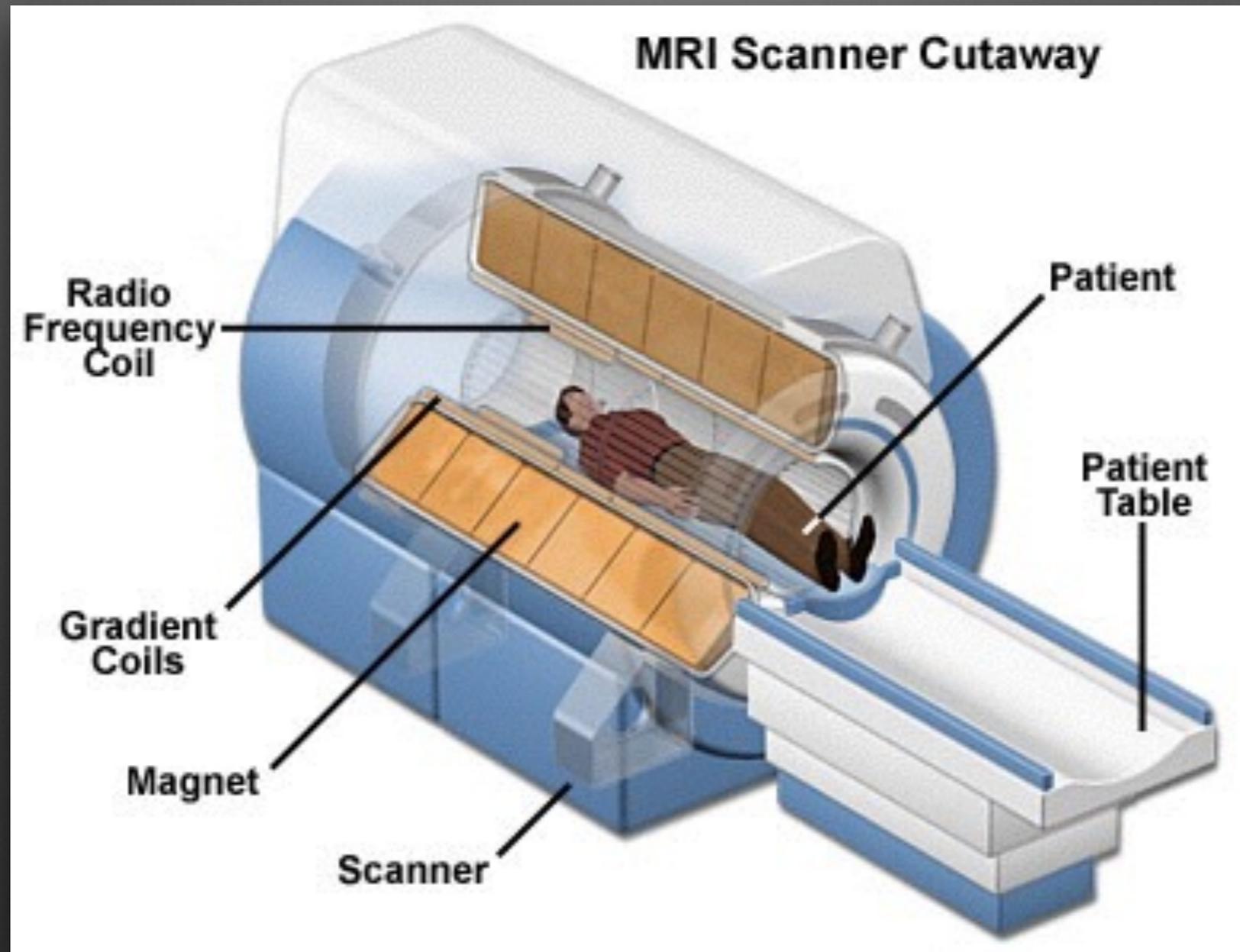


Electron Beam CT  
Early '80



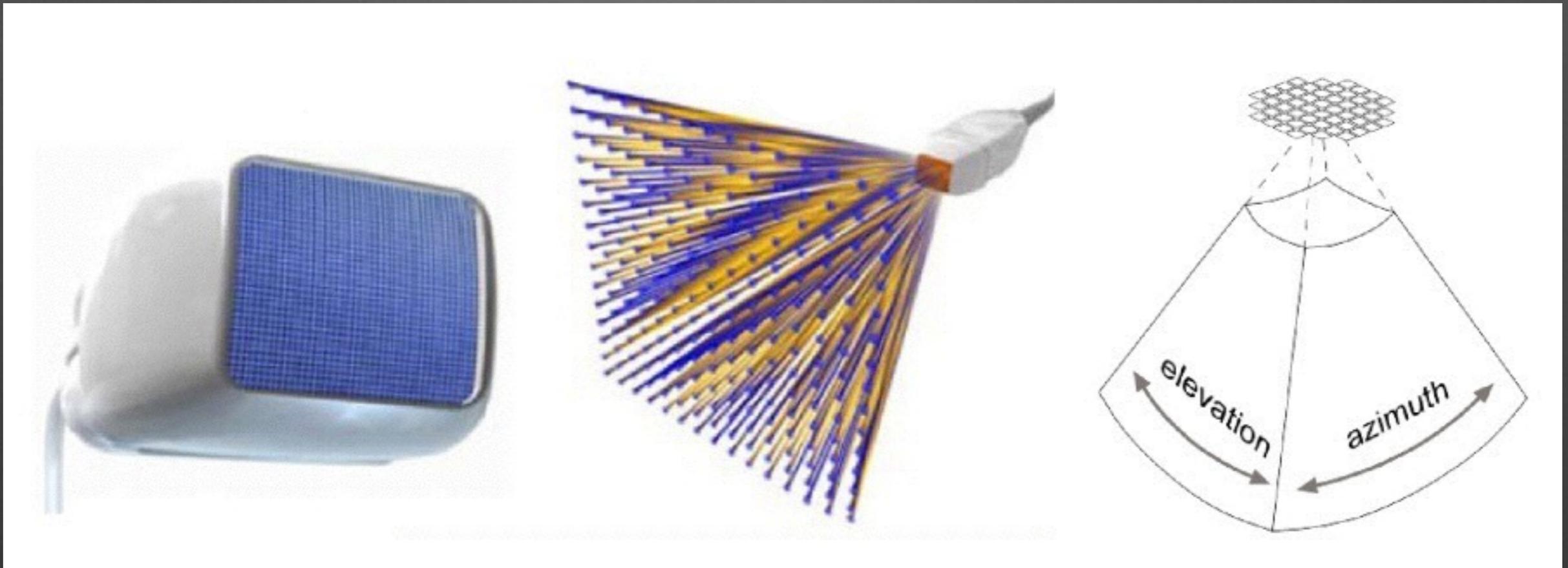
Multidetector CT  
'90

# Perspectiva històrica



RM con sincronización ECG  
1983

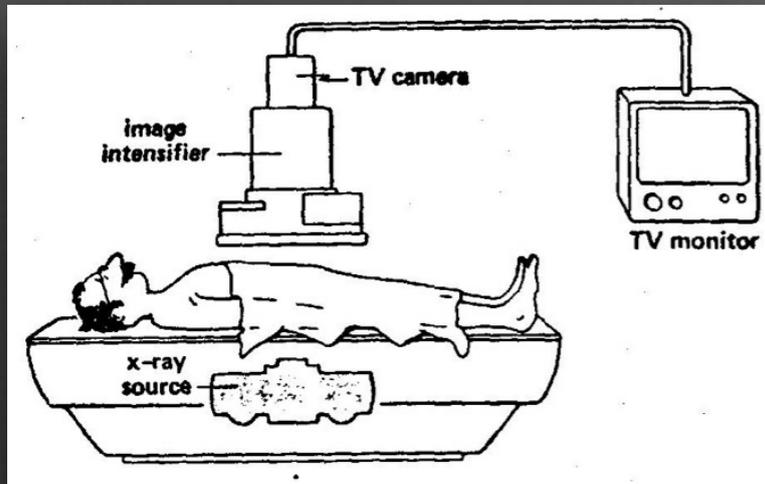
# Perspectiva històrica



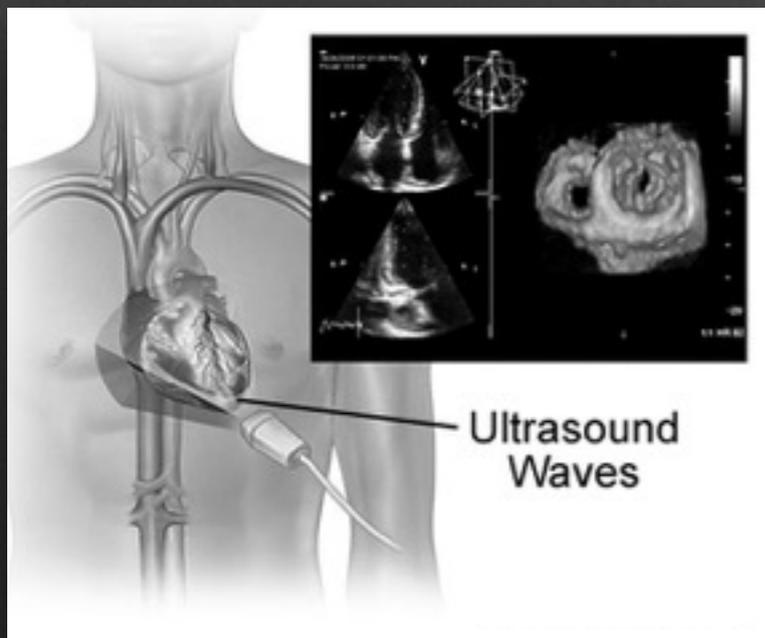
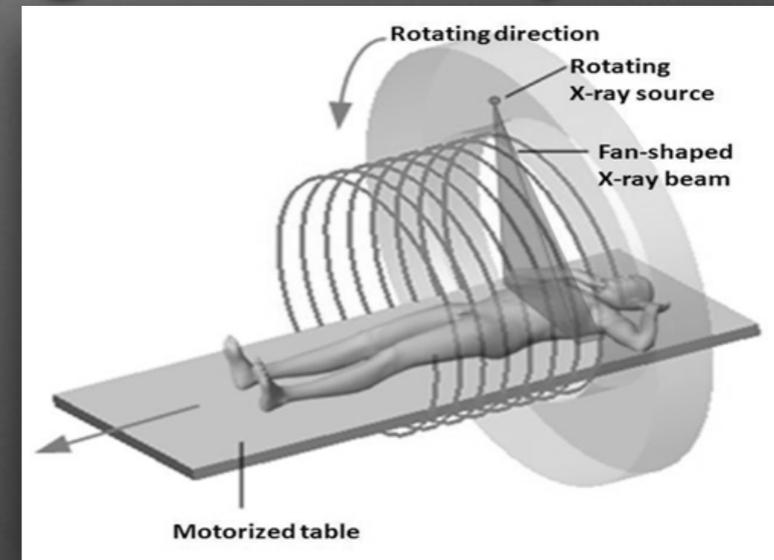
Eco 3D con sondas Matriciales  
1998

# Fuentes de imagen

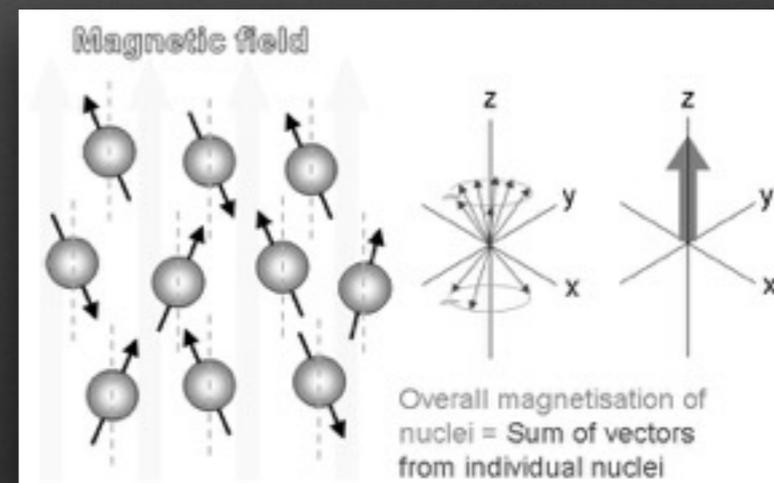
## Fluoroscopia



## Tomografía computerizada



## Ecocardiografía



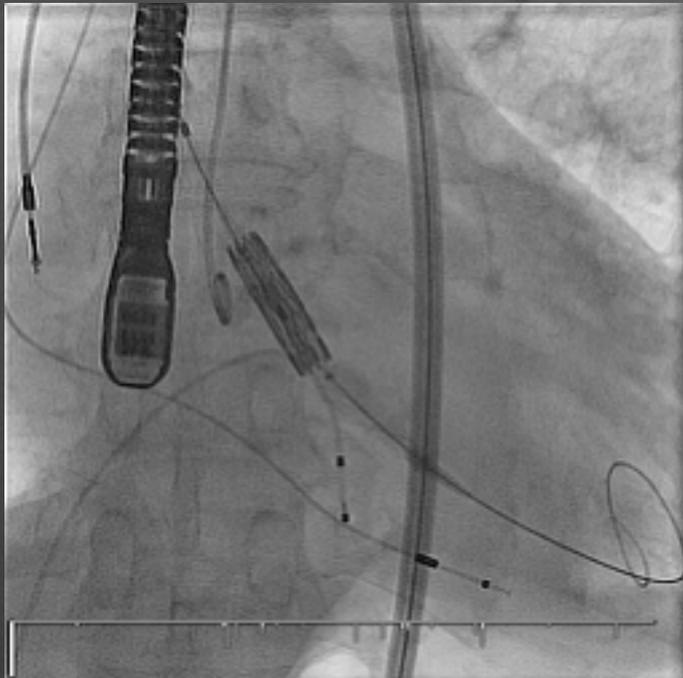
## Resonancia magnética

# Fuentes de imagen

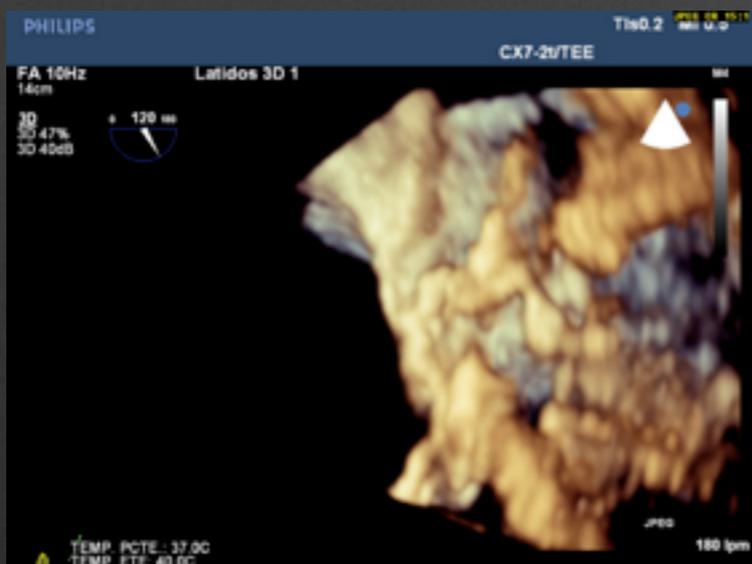
	Fluoro	Echo	CT	MRI
Tiempo real	+	+	-	-
Campo de visión	+ 2D	- 2D/3D	++ 3D	+ 2D
Tejidos blandos	-	+	+	+
Flujos cardíacos	+/-	+	-	+
Irradiación	+	-	+	-

# Fuentes de imagen

## Fluoroscopia



## Tomografía computarizada

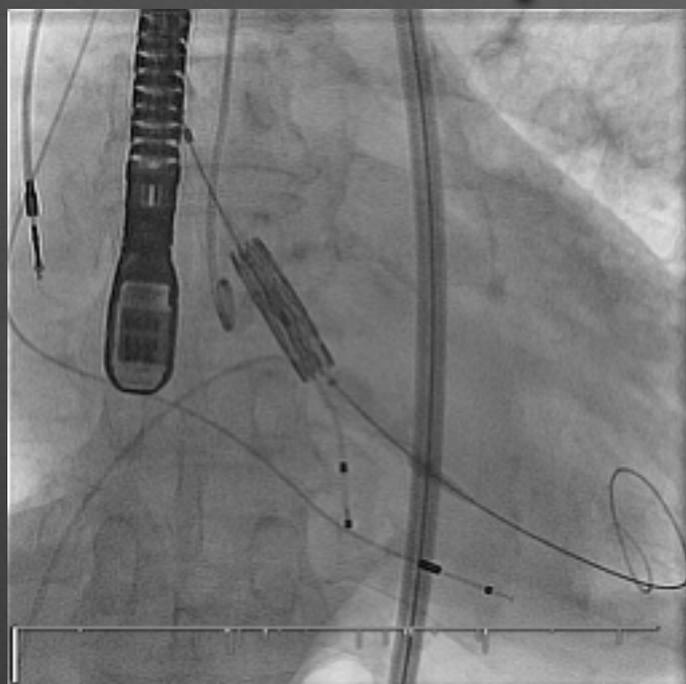


## Ecocardiografía

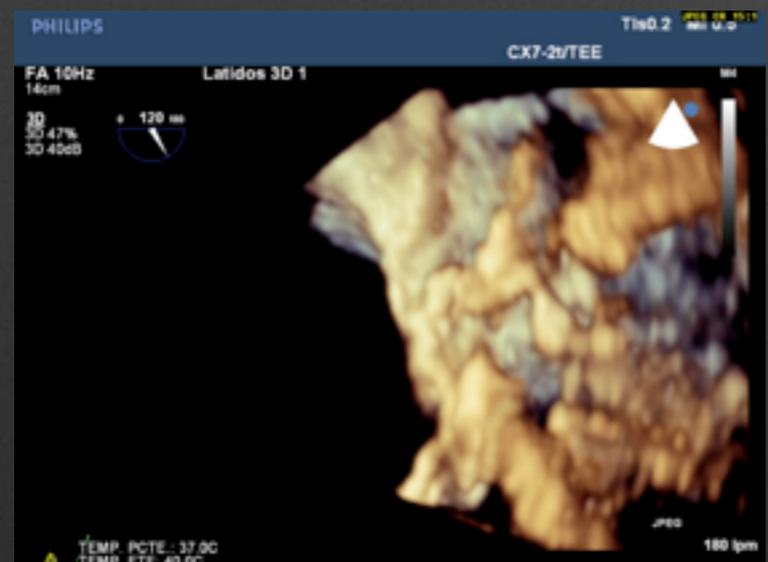
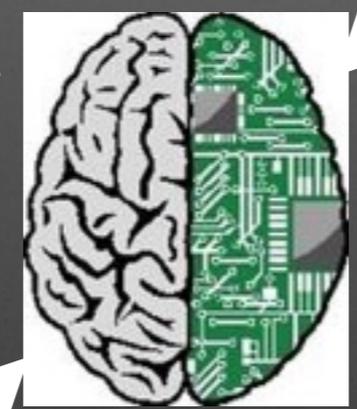
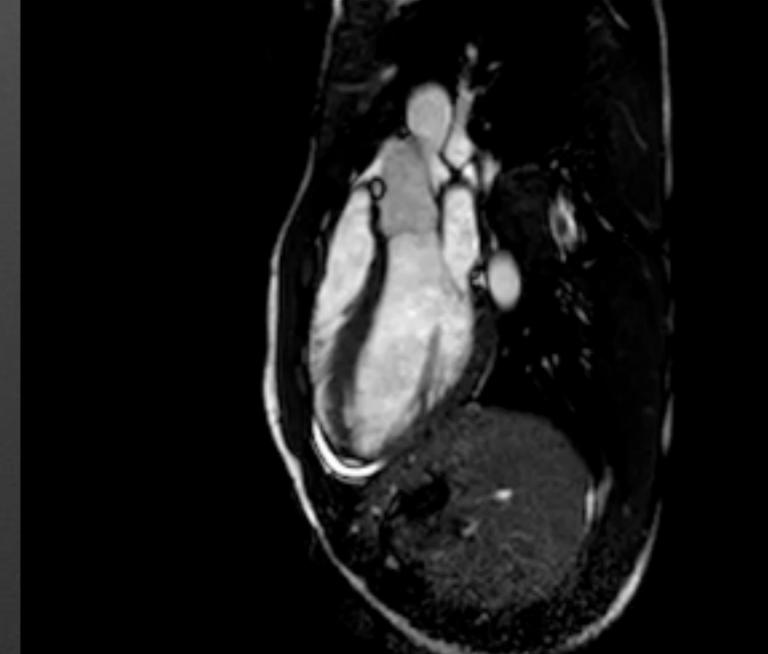
## Resonancia magnética

# Integración de imágenes

Fluoroscopia



Tomografía computerizada

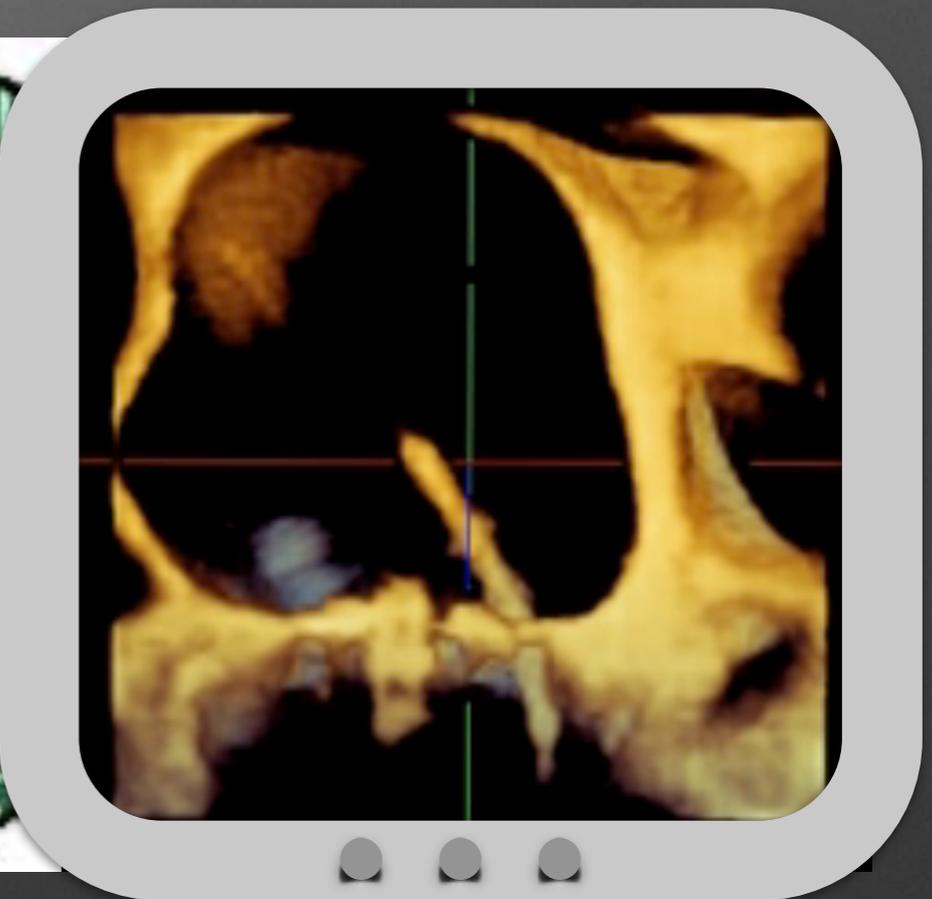
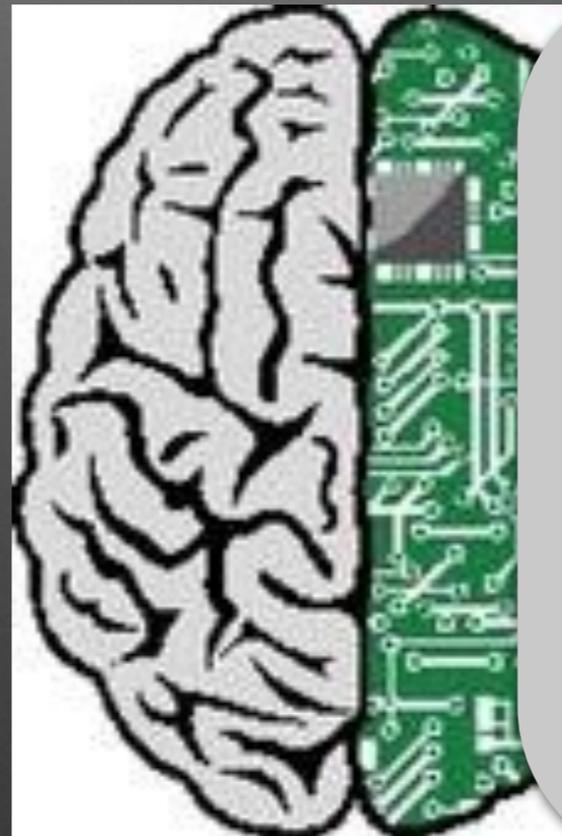
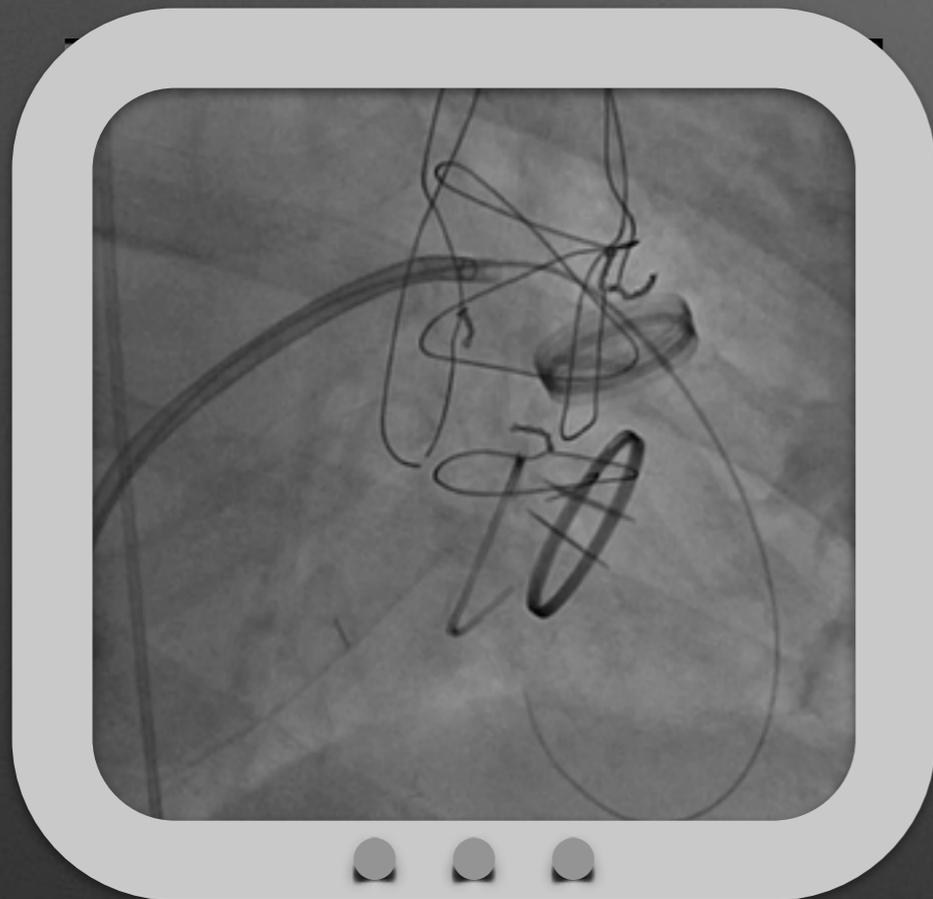


Ecocardiografía

Resonancia magnética

# Integración de imágenes

## Fusión mental



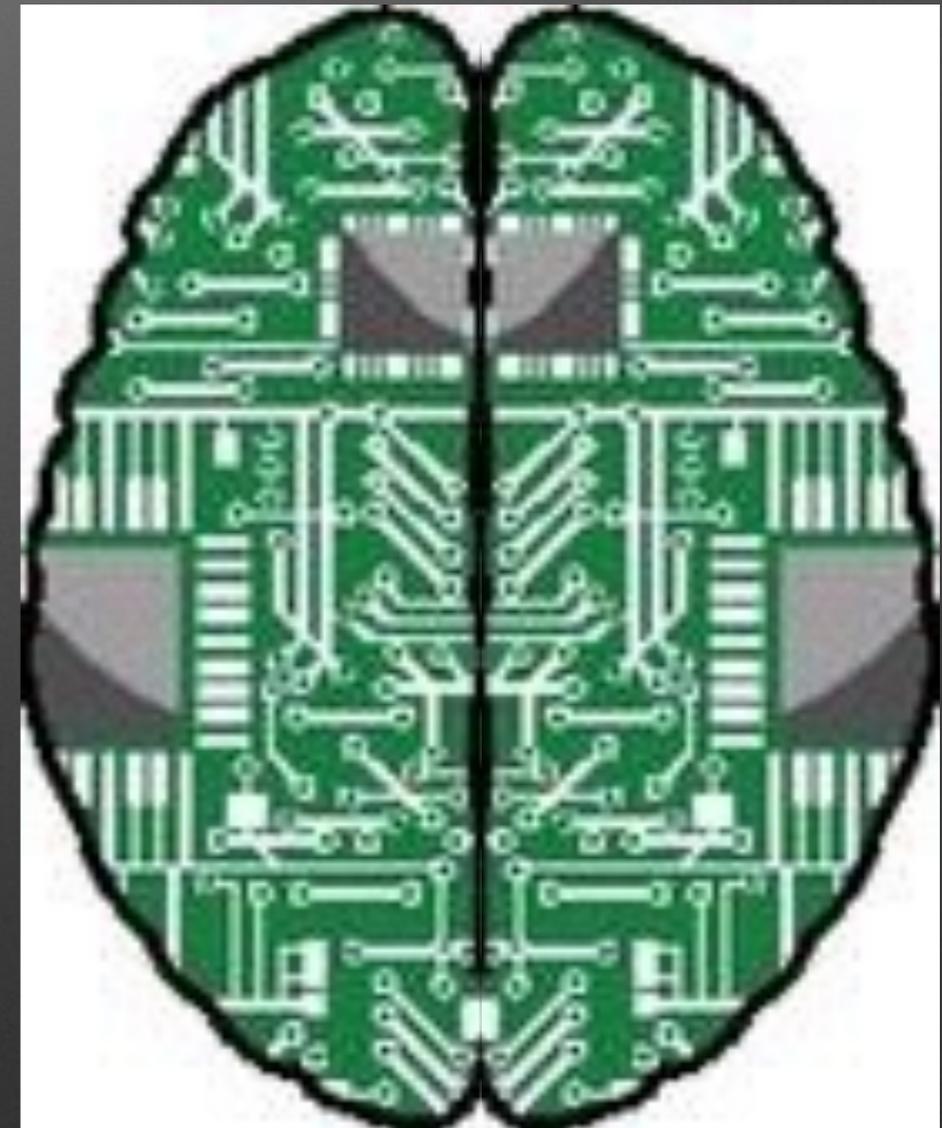
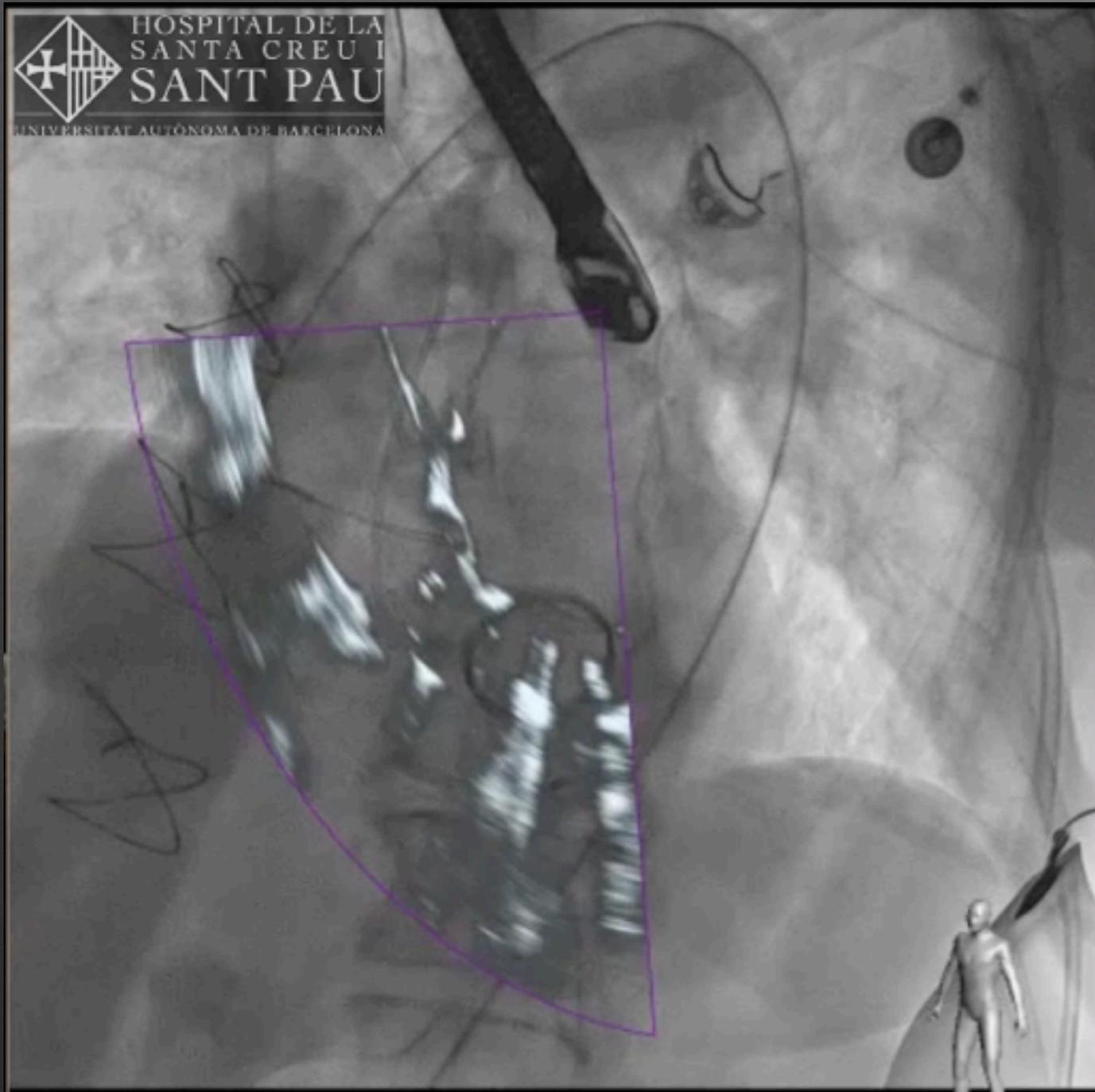
# Integración de imágenes

## Fusión mental



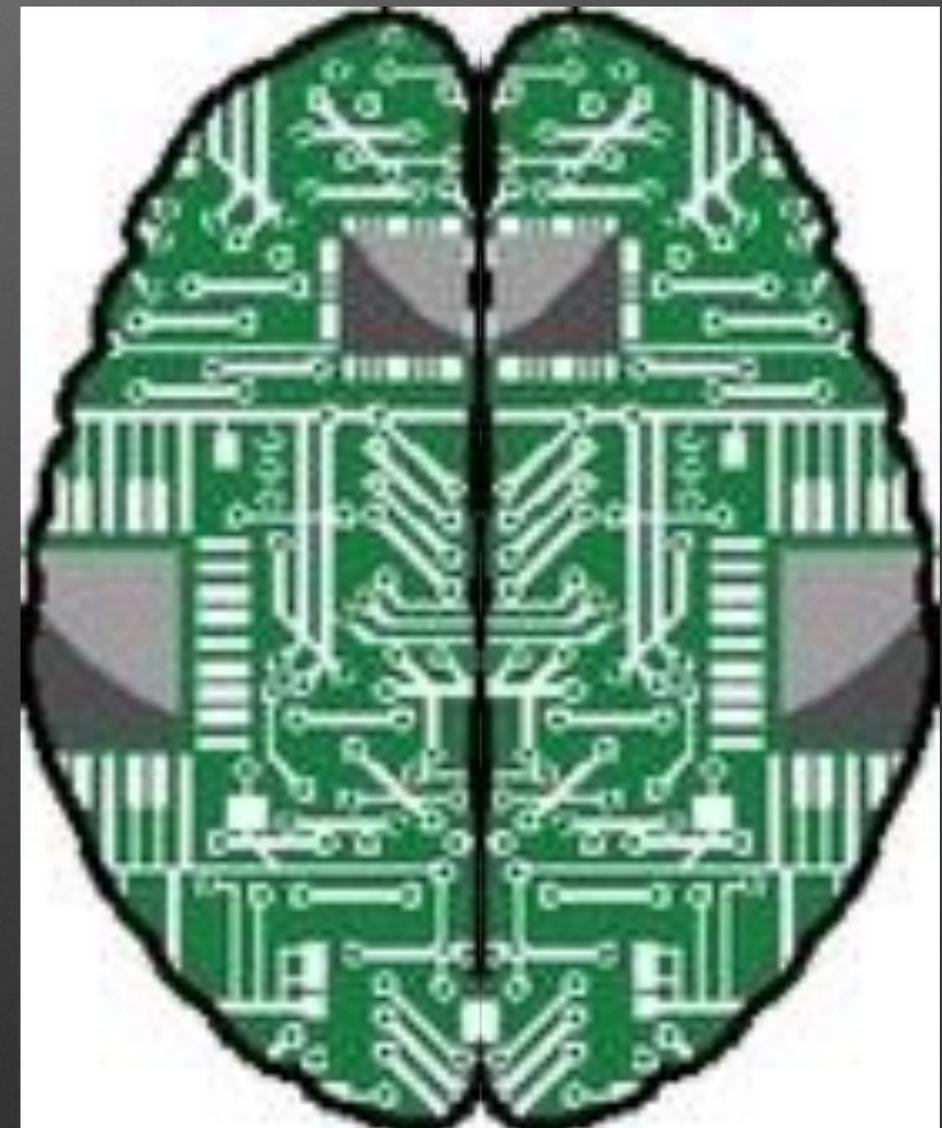
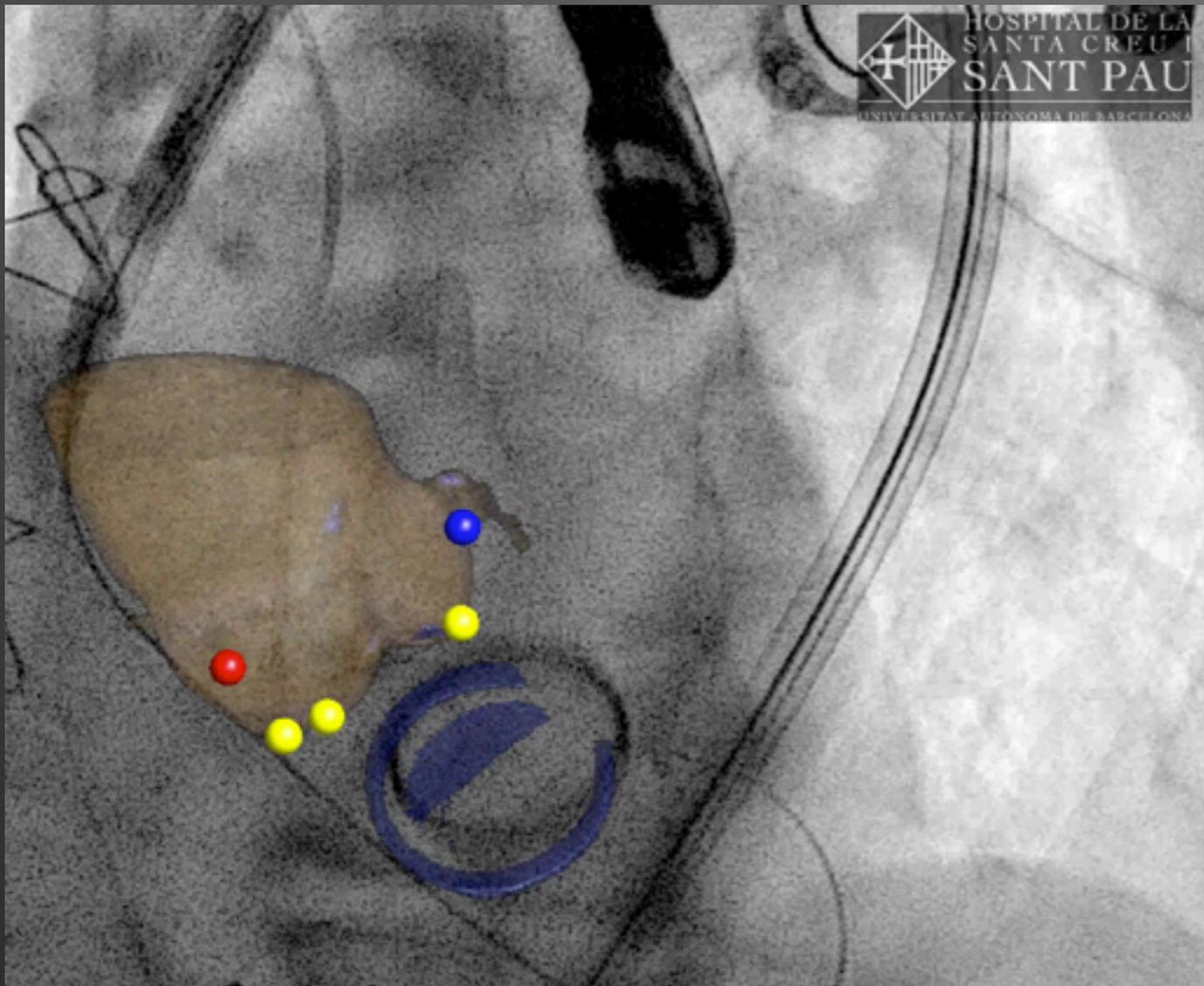
# Integración de imágenes

Fusión real



# Integración de imágenes

## Fusión real



# Fusión real

Clinical experience with percutaneous left ventricular transapical access for interventions in structural heart defects: A safe access and secure exit.

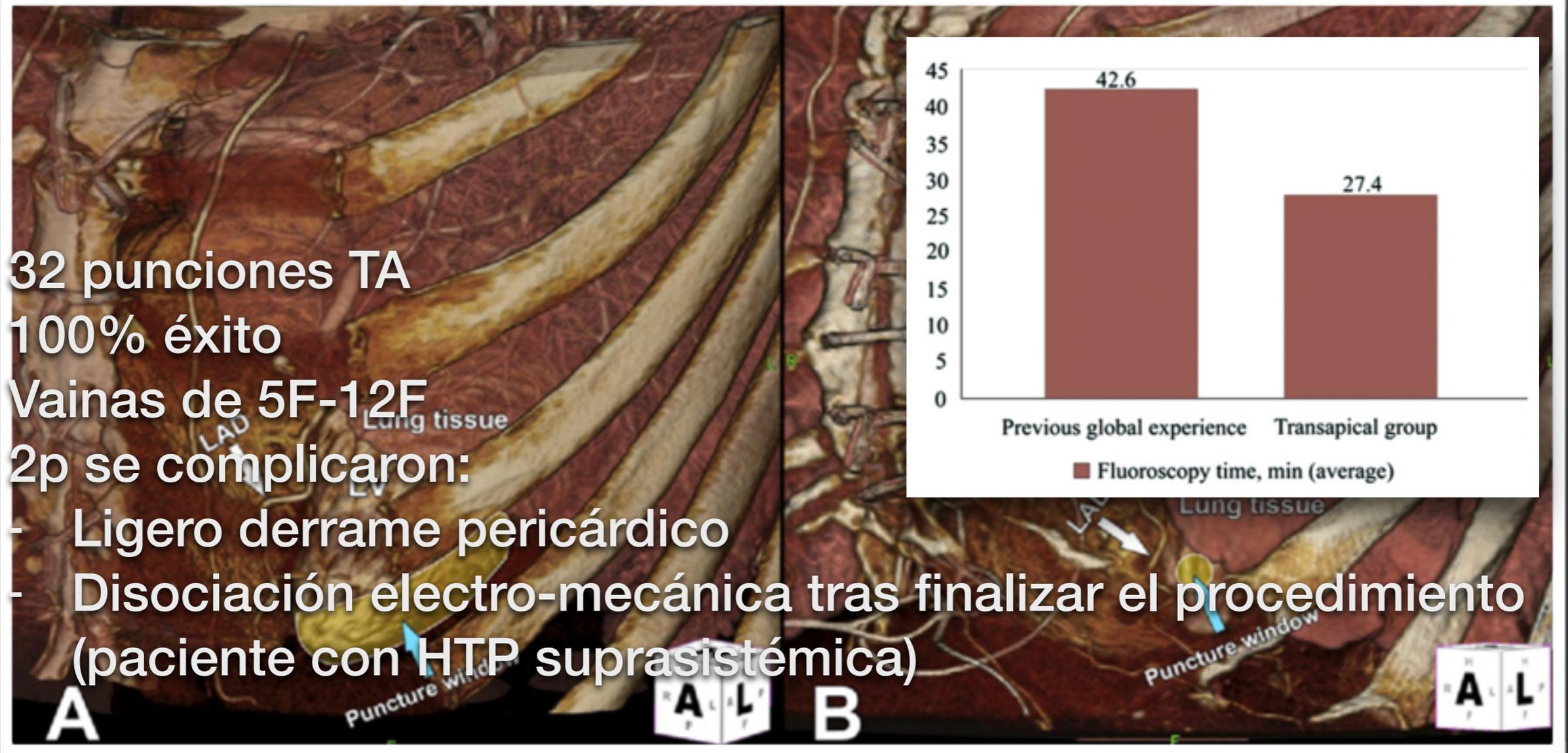
32 punciones TA

100% éxito

Vainas de 5F-12F

2p se complicaron:

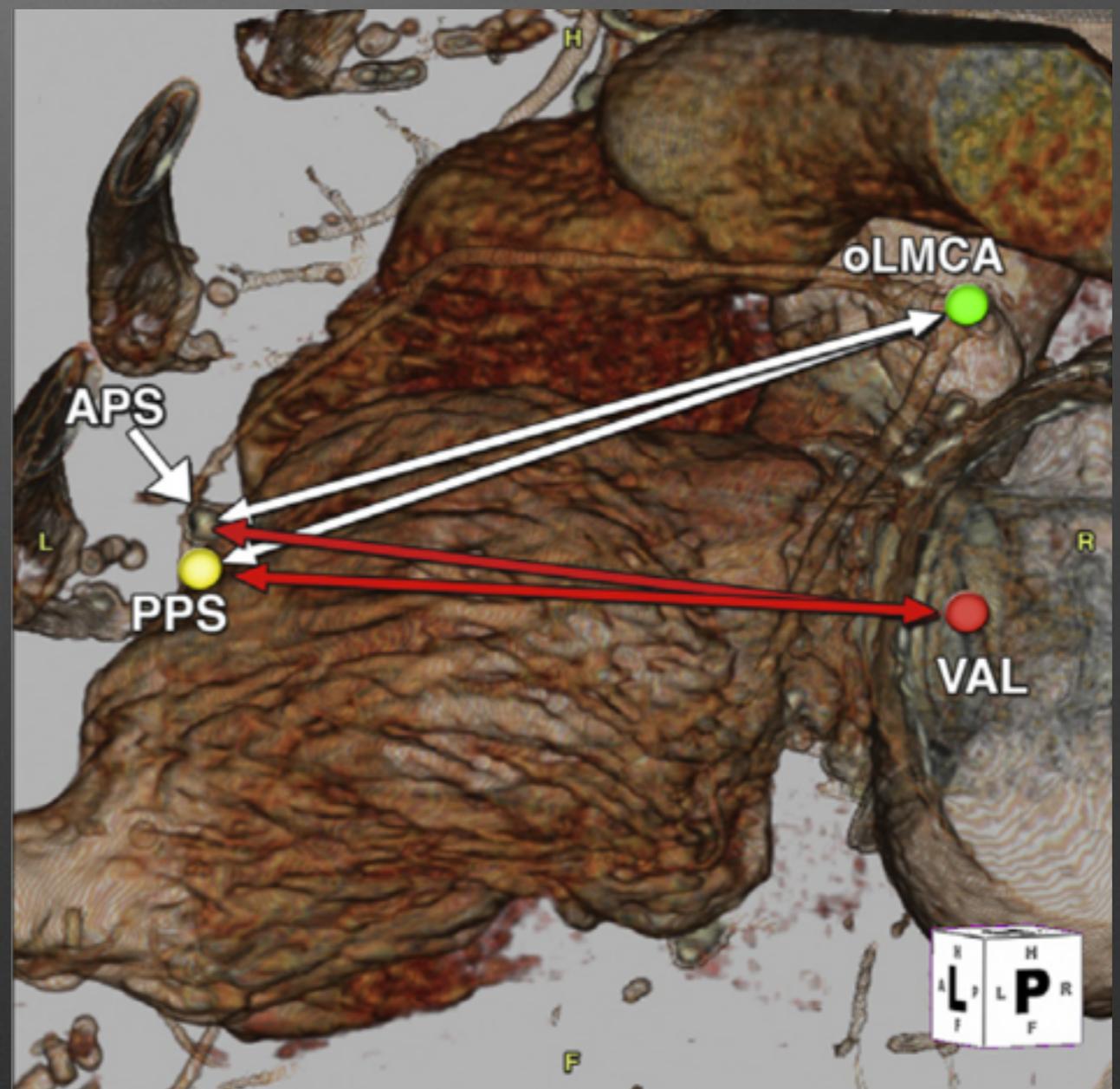
- Ligero derrame pericárdico
- Disociación electro-mecánica tras finalizar el procedimiento (paciente con HTP suprasistémica)



# Fusión real

CT angiography-fluoroscopy fusion imaging for percutaneous transapical access.

- 20 pacientes
- Mediana de la desviación:  
3-5mm X, 4-4.5mm Y, 5-5.6mm  
Z



# Fusión real

Initial clinical experience using the EchoNavigator(®)-system during structural heart disease interventions.

Feasibility: 100%

127 intervenciones:

3 PVL: Localización de defectos

11 ASDs: Marcar la CIA

21 TAVI TA: Buscar el plano de implante

35 LAA: TS, alineación de la landing zone

47 MitraClip: TS, CG, Localizar el jet en múltiples clips

# Fusión real

## Safety and feasibility of novel technology fusing echocardiography and fluoroscopy images during MitraClip interventions

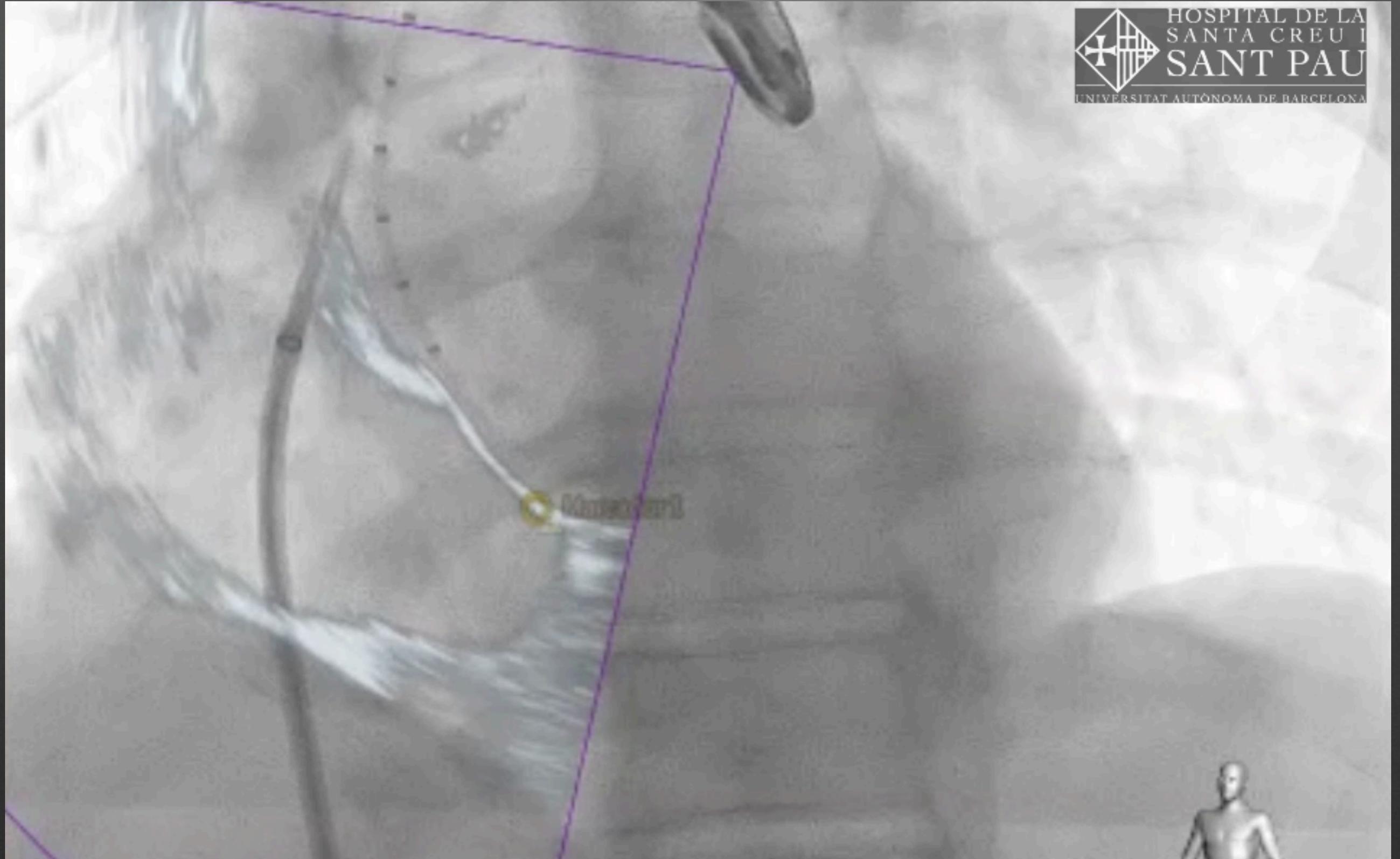
	Total (n=42)	with EchoNavigator (n=21)	without EchoNavigator (n=21)	<i>p</i>
Number of clips implanted, n (%)	81 (100%)	45 (56%)	36 (44%)	0.3
Patients with 1/2/3/4 clips (n)	12/23/5/2	4/12/3/2	8/11/2/0	–
Length (minutes) all patients	131±50.3	136.2±50.2	125.7±51.2	0.5
Length (minutes) patients ≤2 clips	112.7±26.8	113.9±29.9	111.8±24.9	0.8
Fluoroscopy time (minutes) all patients	31.4±15.8	32.3±16.8	30.6±15.3	0.8
Fluoroscopy time (minutes) patients ≤2 clips	25.1±7.1	23.9±8.1	26.1±6.4	0.4
Radiation dose (Gy/cm <sup>2</sup> ) all patients	146.7±127.4	146.5±123.6	146.8±134.1	1.0
Radiation dose (Gy/cm <sup>2</sup> ) patients ≤2 clips	112.8±73	102.1±65	119.8±78.9	0.5
Time to first clip (minutes)	53.6±15.8	52.4±17.6 (n=21)	53.7±14.0 (n=21)	0.8
Time to second clip (minutes)	85.7±27.7	83.2±27.4 (n=17)	88.9±29.0 (n=13)	0.6
Time to third clip (minutes)	152.86±47.5	134.2±23.2 (n=5)	199.5±72.8 (n=2)	0.4

No hubo diferencias significativas en la duración del procedimiento, el tiempo de escopia ni la irradiación

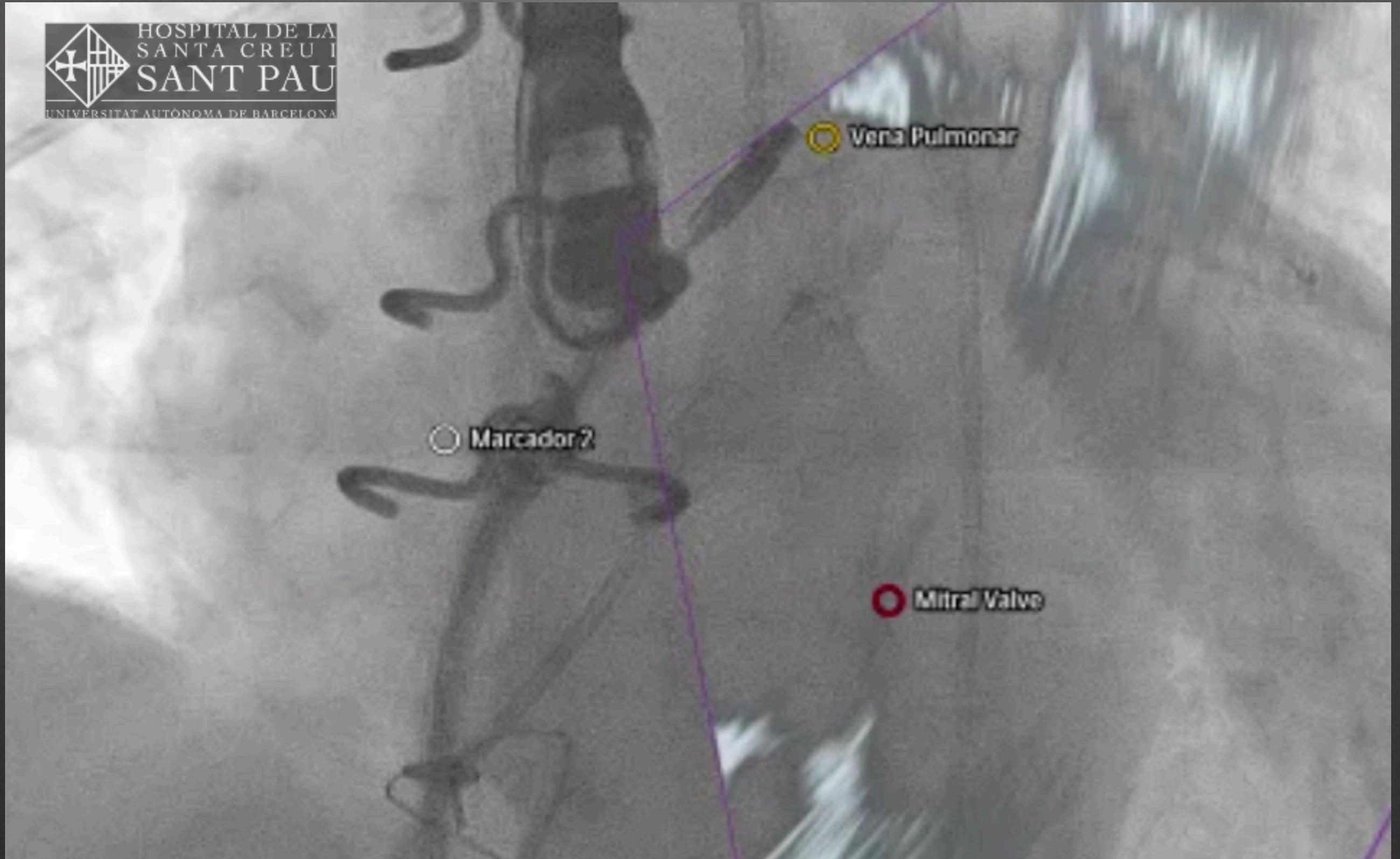
# Fusión real: EchoNavigator



# EchoNavigator en transeptal

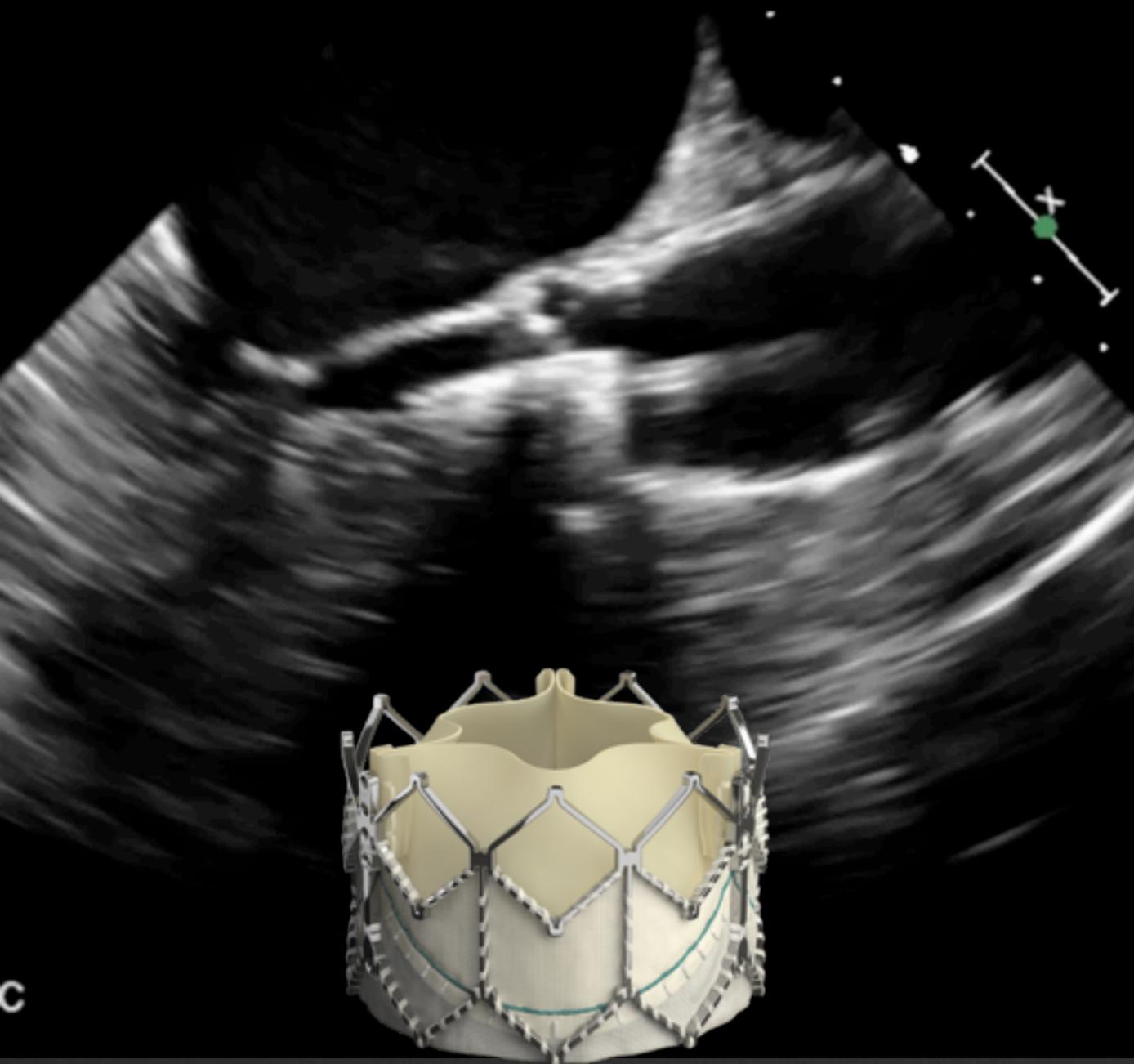


# EchoNavigator en MitraClip

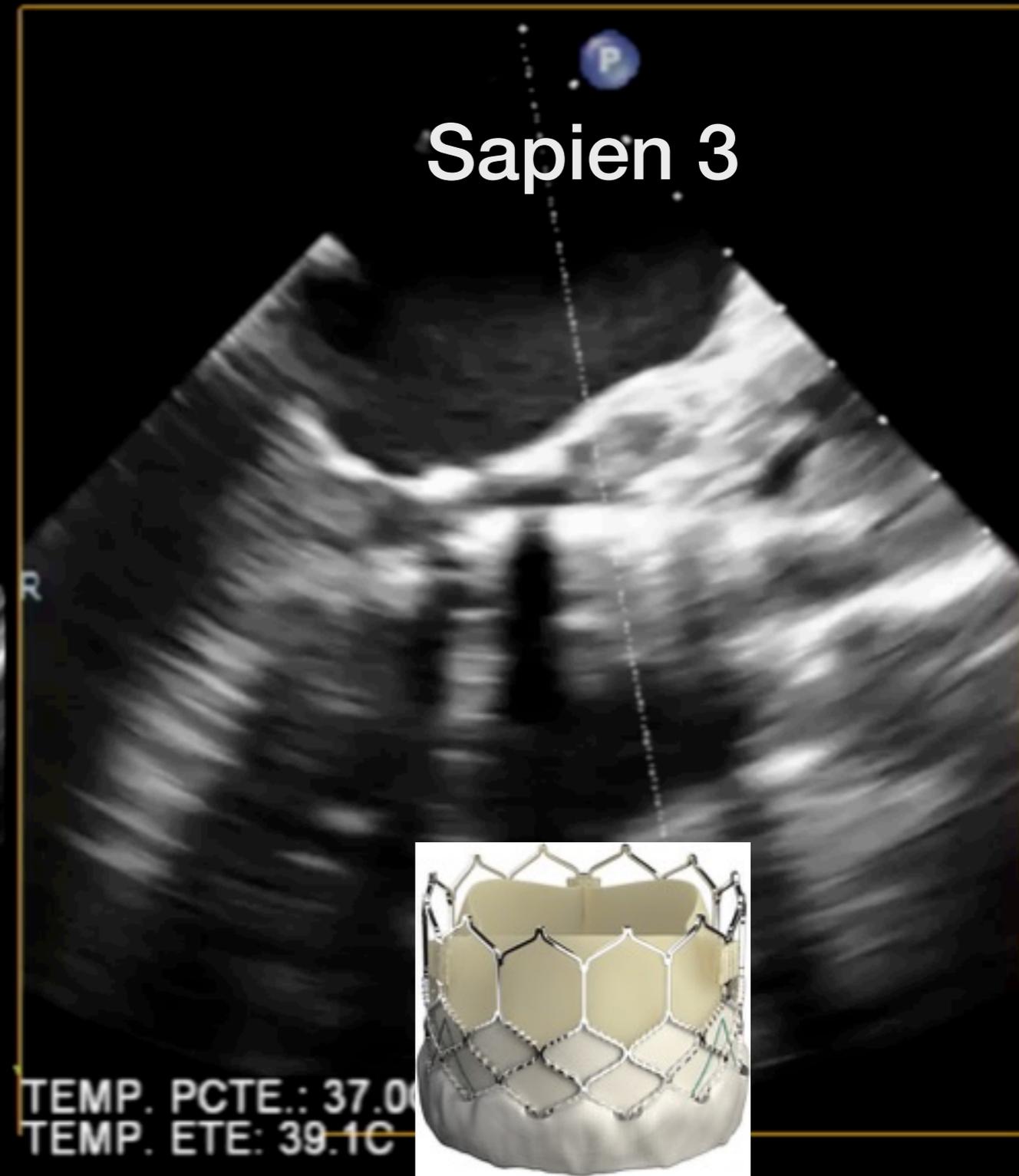


# EchoNavigator en TAVI

Sapien XT



Sapien 3

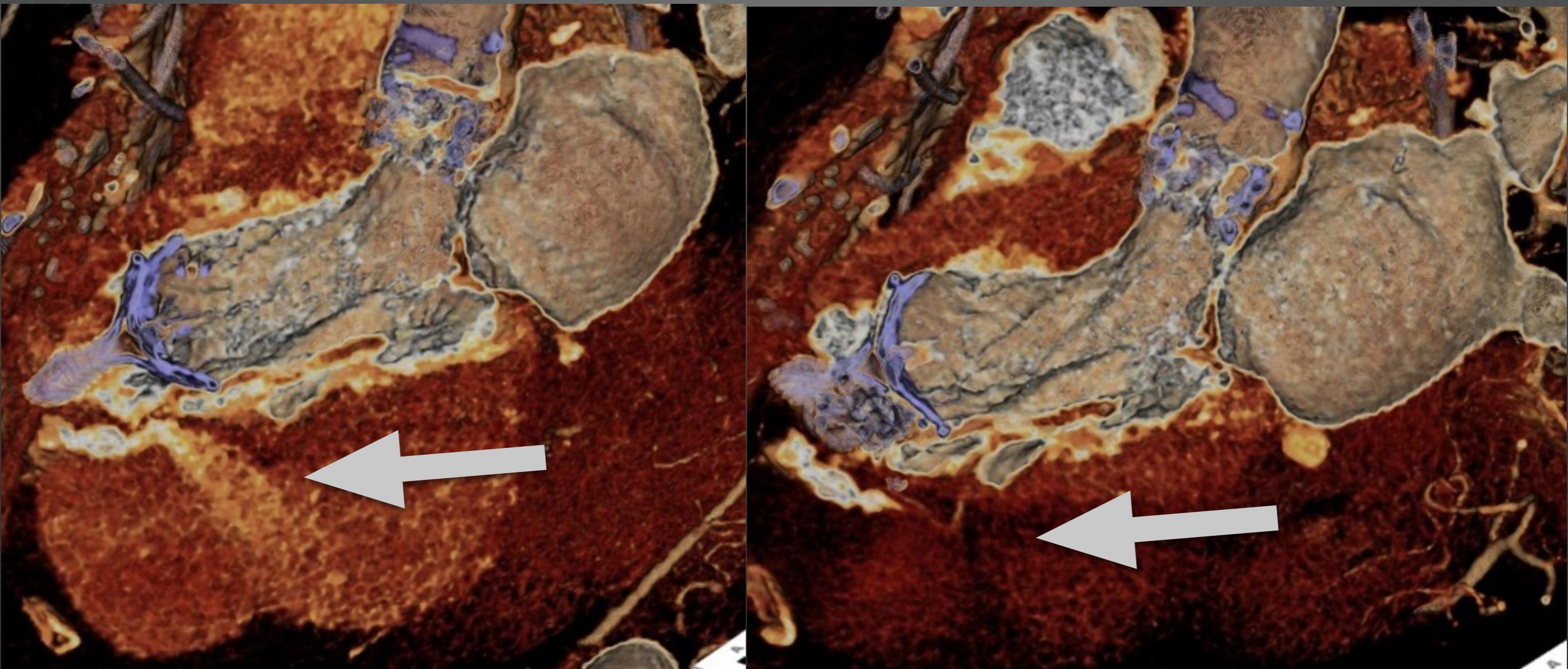


# EchoNavigator en TAVI



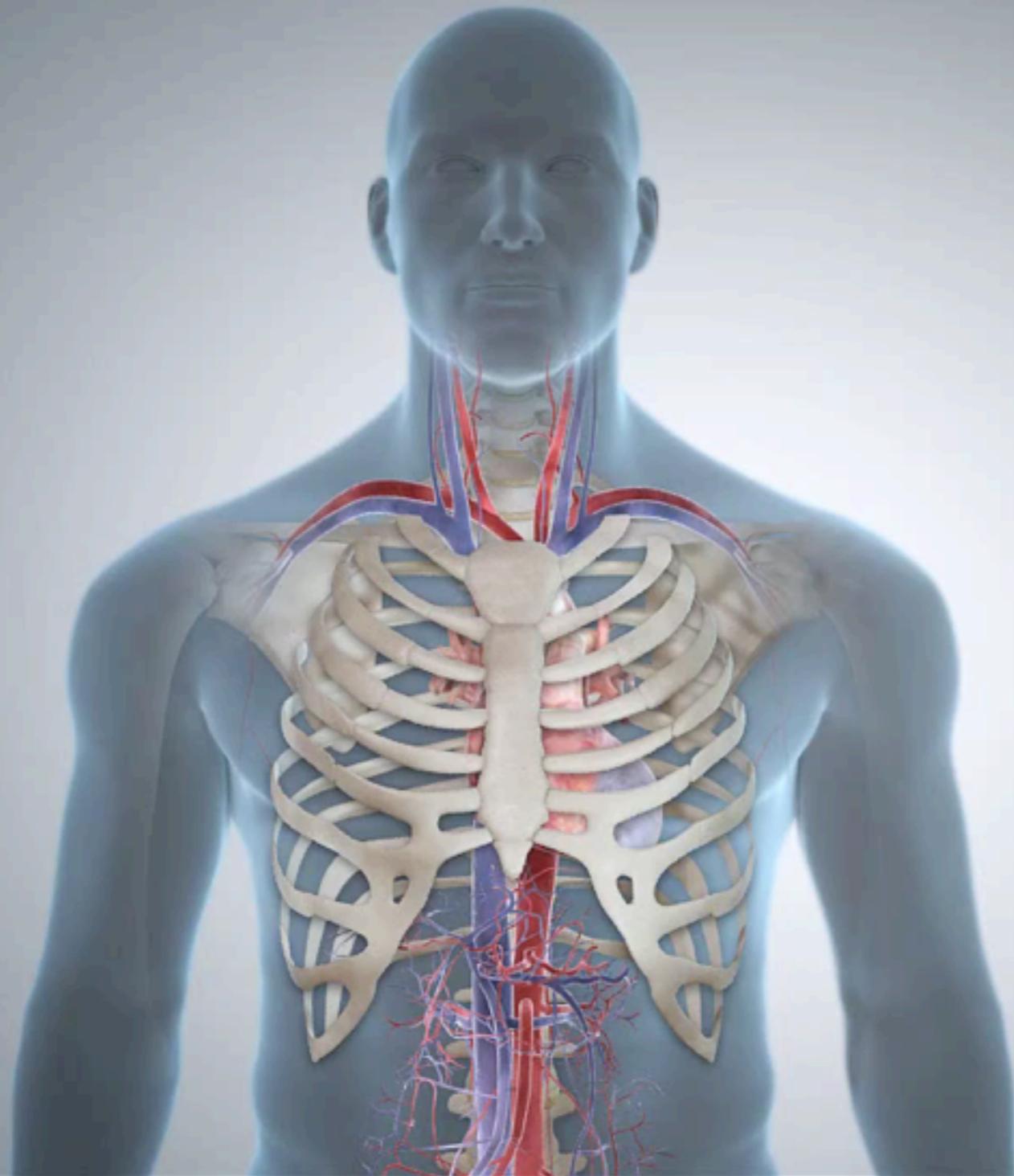
# Fusión necesaria

Novel Percutaneous Apical Exclusion of a Left Ventricular Pseudoaneurysm After Complicated Transapical Transcatheter Aortic Valve Replacement.



# Fusión necesaria

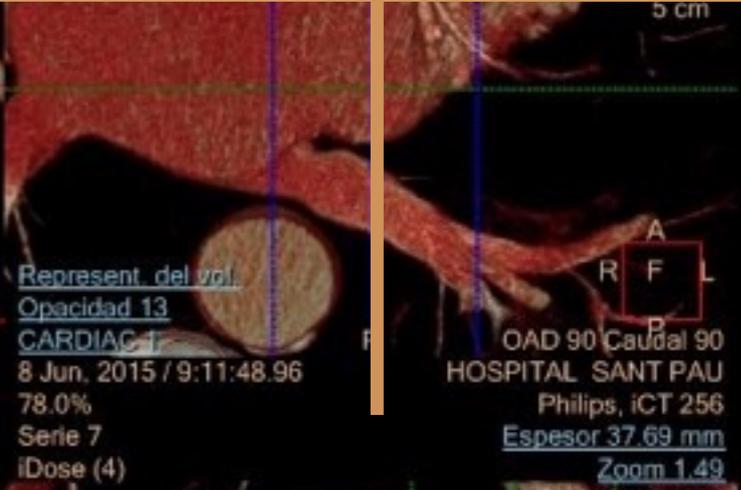
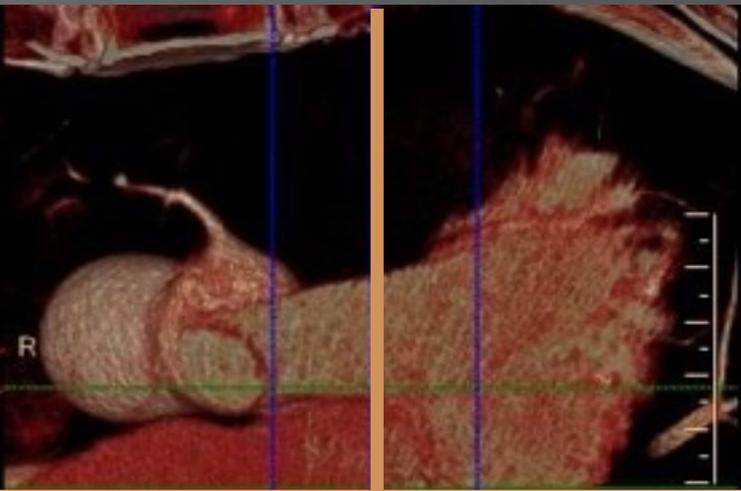
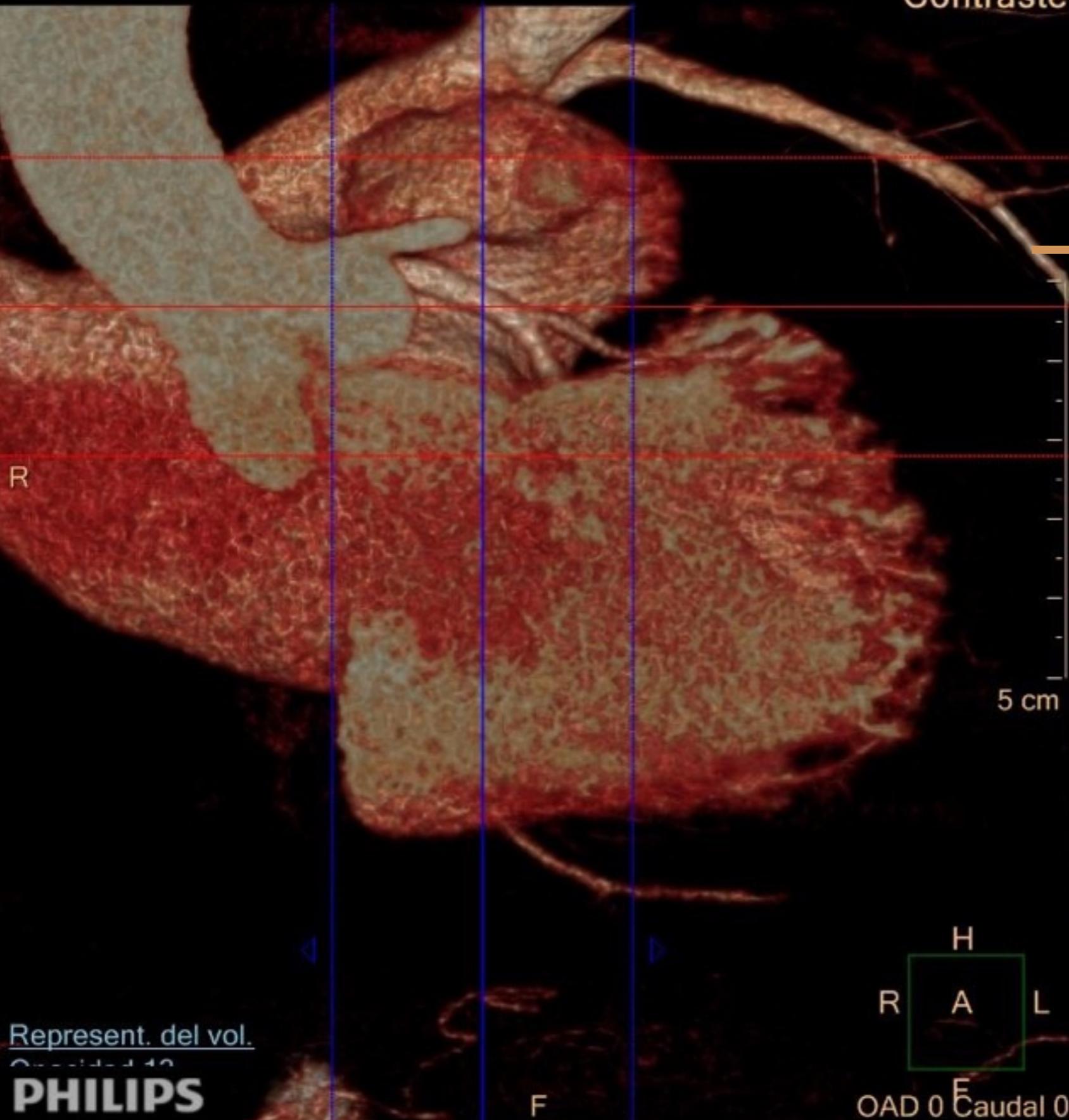




# Integración de imágenes: Planificación

iDose (4)

Zoom 1.49  
Contraste



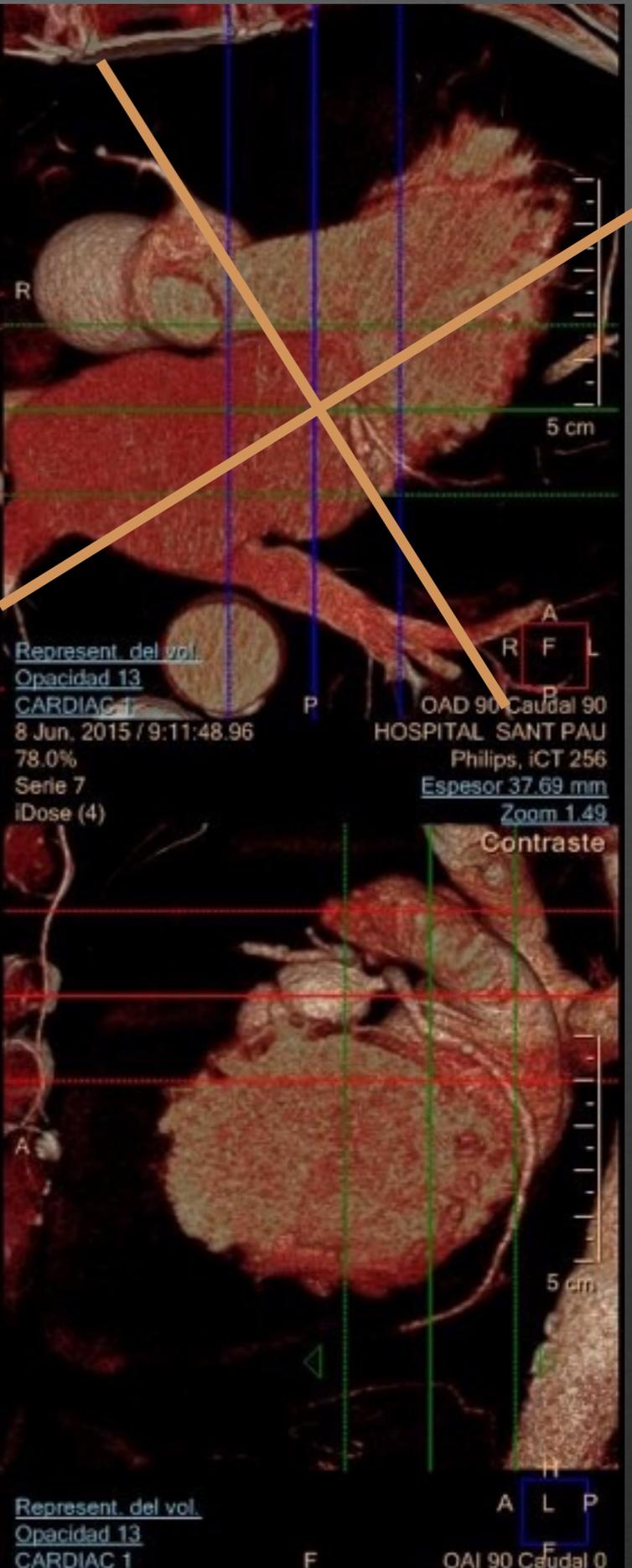
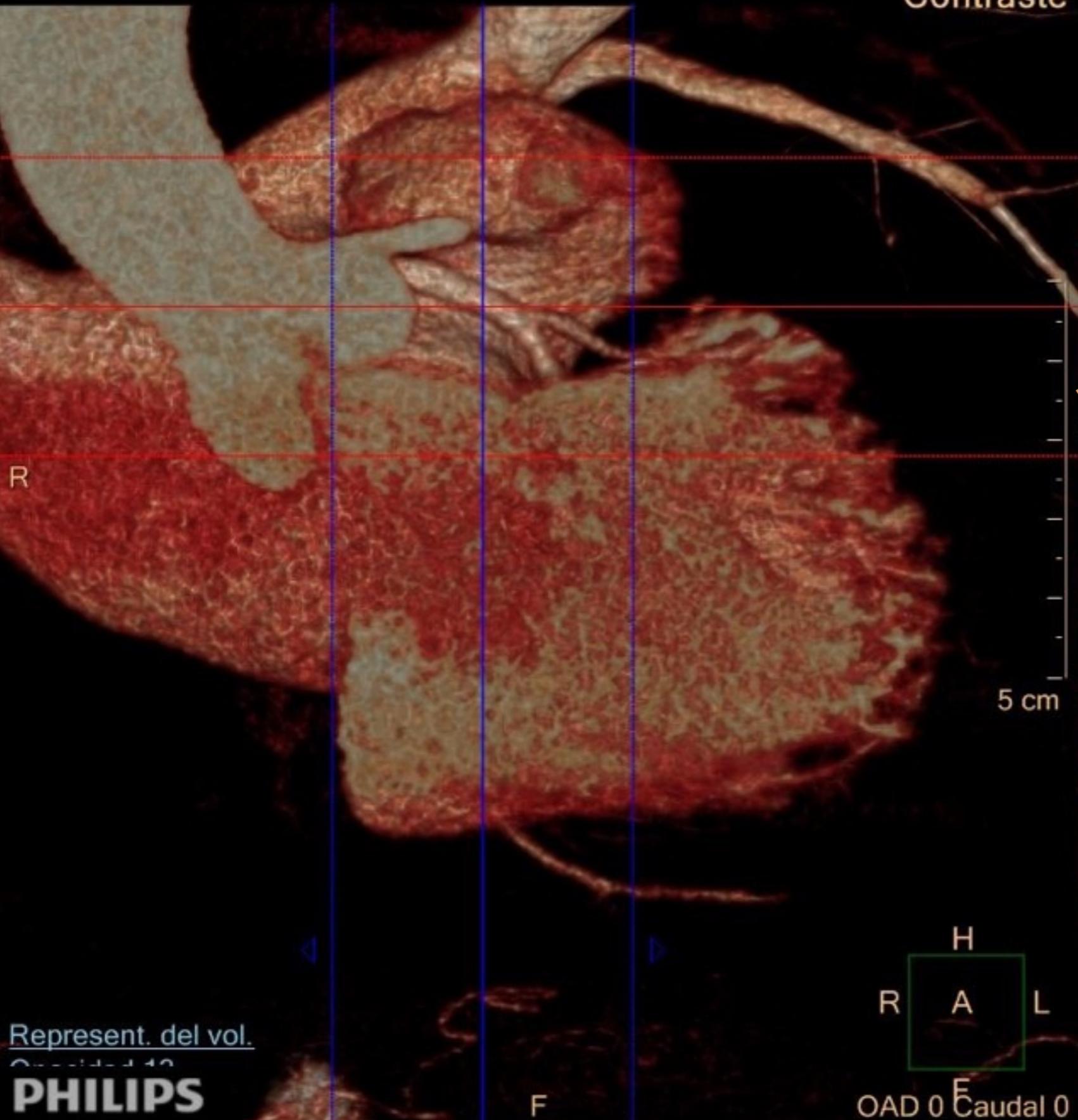
Represent. del vol.  
Opacidad 13  
**PHILIPS**

OAD 0 Caudal 0

OAI 90 Caudal 0

iDose (4)

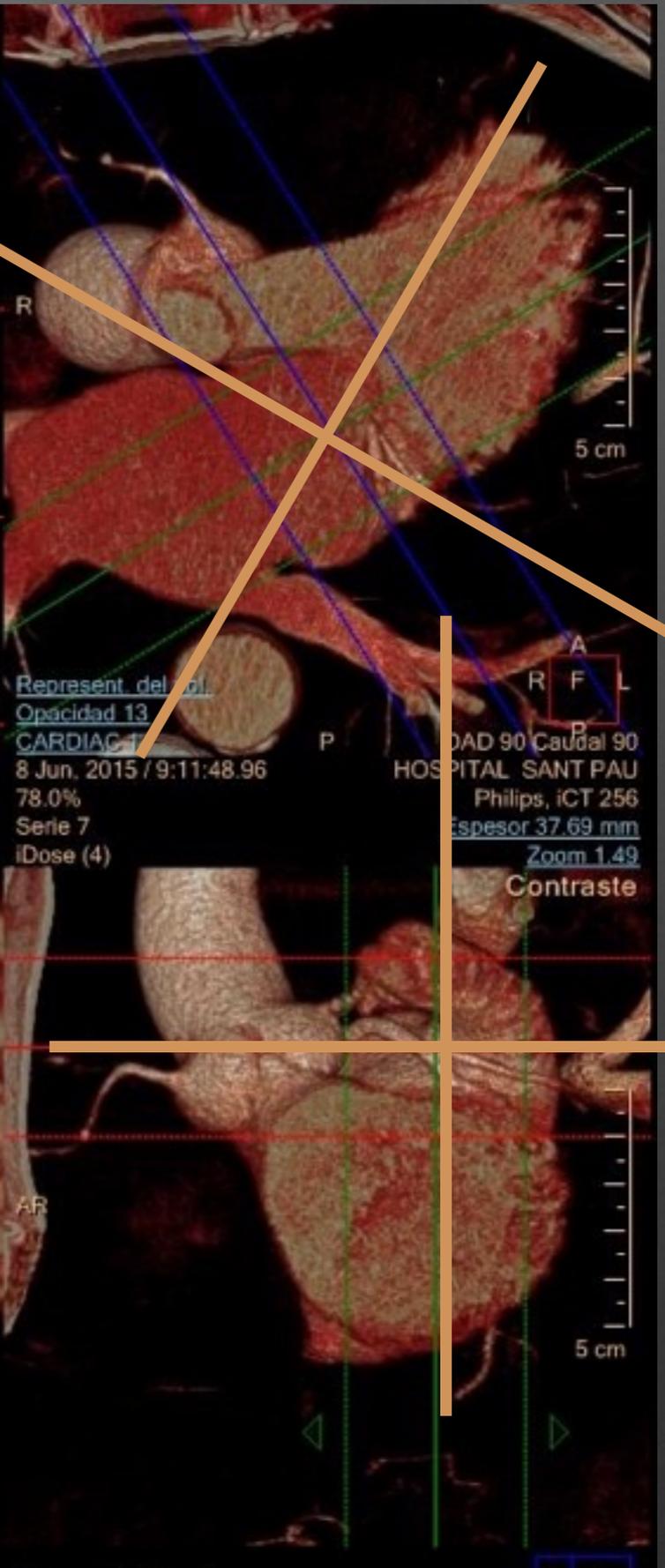
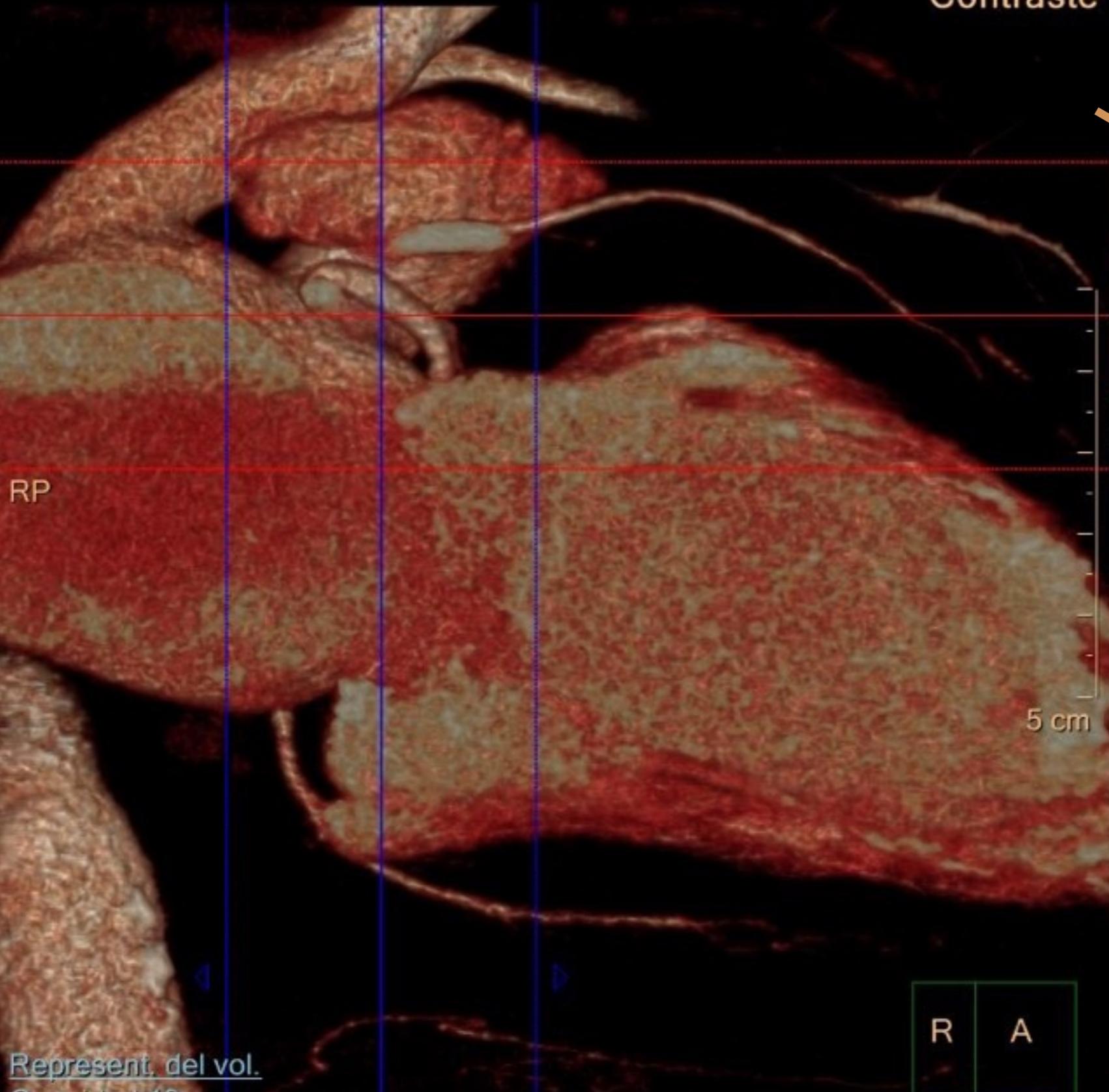
Zoom 1.49  
Contraste



Represent. del vol.  
Opacidad 13  
CARDIAC 1  
8 Jun. 2015 / 9:11:48.96  
78.0%  
Serie 7  
iDose (4)

iDose (4)

Zoom 1.49  
Contraste



Represent. del vol.  
Opacidad 13  
CARDIAC 1  
8 Jun. 2015 / 9:11:48.96  
78.0%  
Serie 7  
iDose (4)

OAD 90 Caudal 90  
HOSPITAL SANT PAU  
Philips, iCT 256  
Espesor 37.69 mm  
Zoom 1.49  
Contraste

Represent. del vol.

PHILIPS

R A

OAD 32 Caudal 0

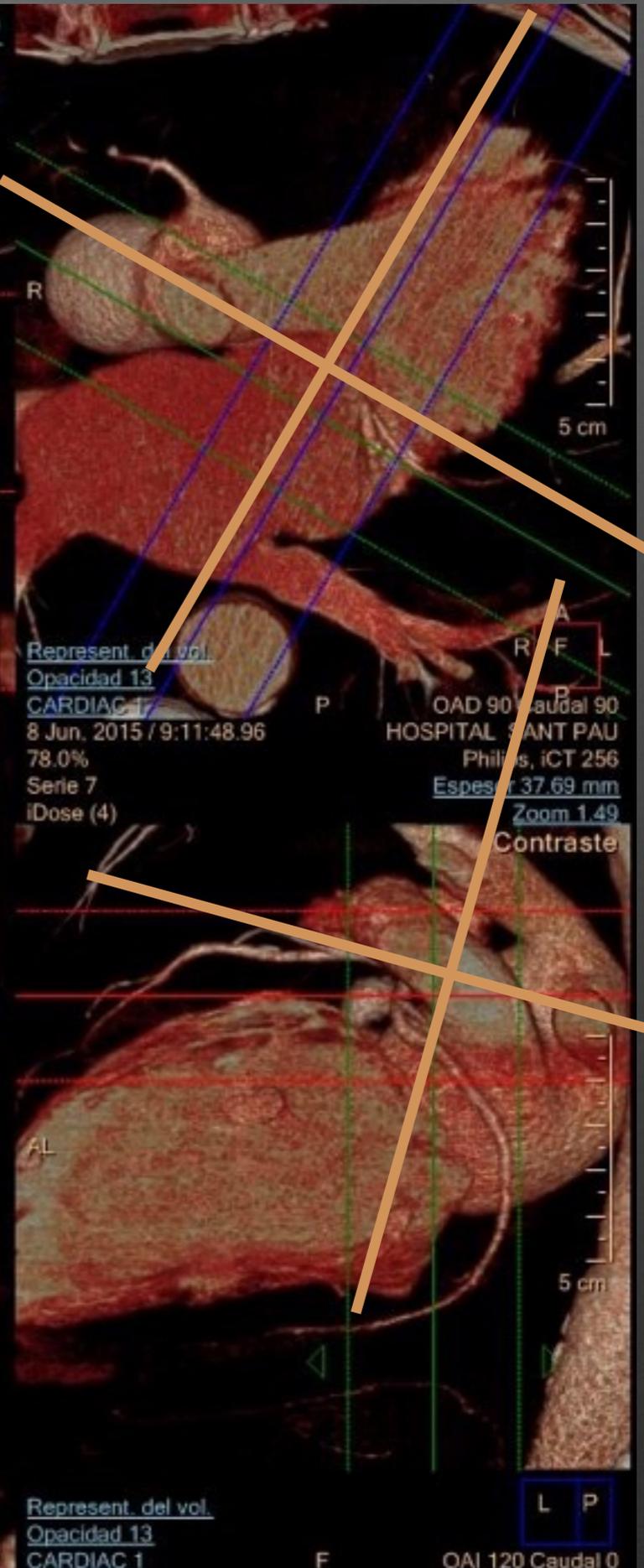
Represent. del vol.  
Opacidad 13  
CARDIAC 1

A L

OAI 58 Caudal 0

iDose (4)

Zoom 1.49  
Contraste



iDose (4)

Zoom 1.49  
Contraste



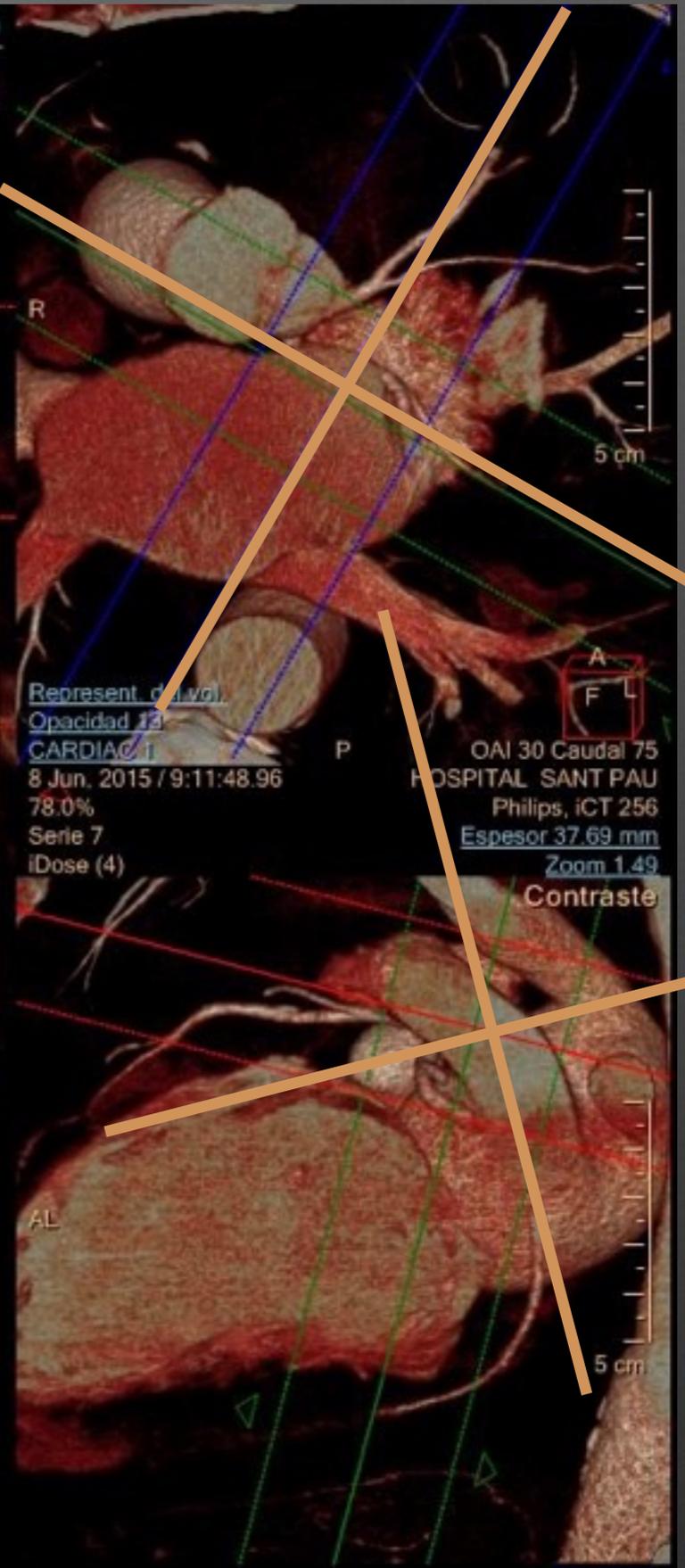
RA

Represent. del vol.  
Opacidad 13  
**PHILIPS**

F



OAI 30 Craneal 15



Represent. del vol.  
Opacidad 13  
CARDIAC 1  
8 Jun. 2015 / 9:11:48.96  
78.0%  
Serie 7  
iDose (4)

OAI 30 Caudal 75  
HOSPITAL SANT PAU  
Philips, iCT 256  
Espesor 37.69 mm  
Zoom 1.49  
Contraste

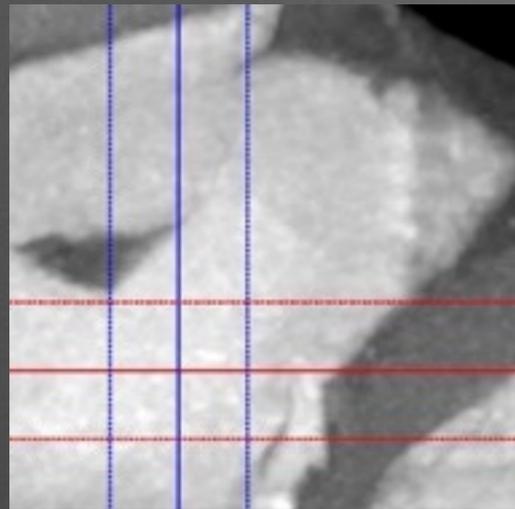
Represent. del vol.  
Opacidad 13  
CARDIAC 1

OAI 120 Caudal 0

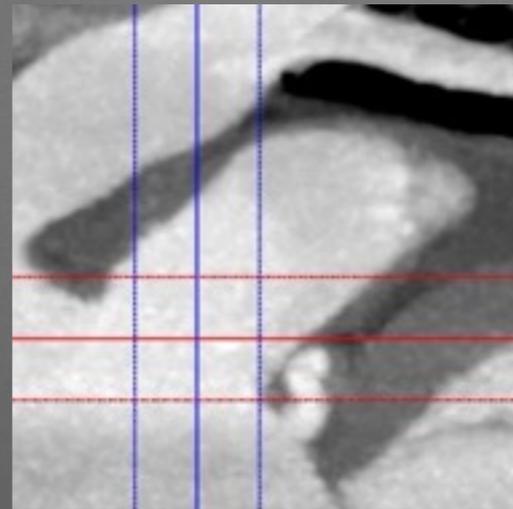
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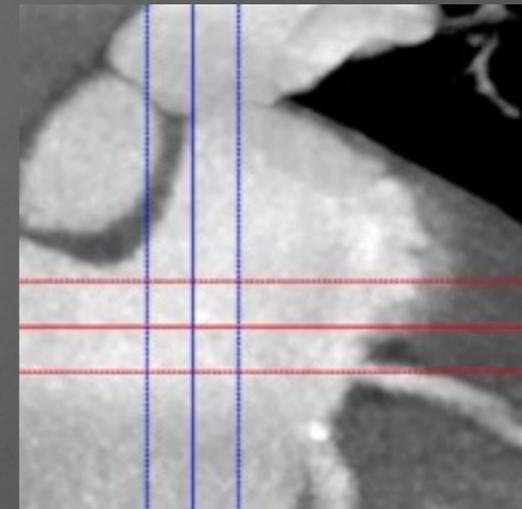
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**OAD 33 CAU 19**



**OAD 33 CRA 11**

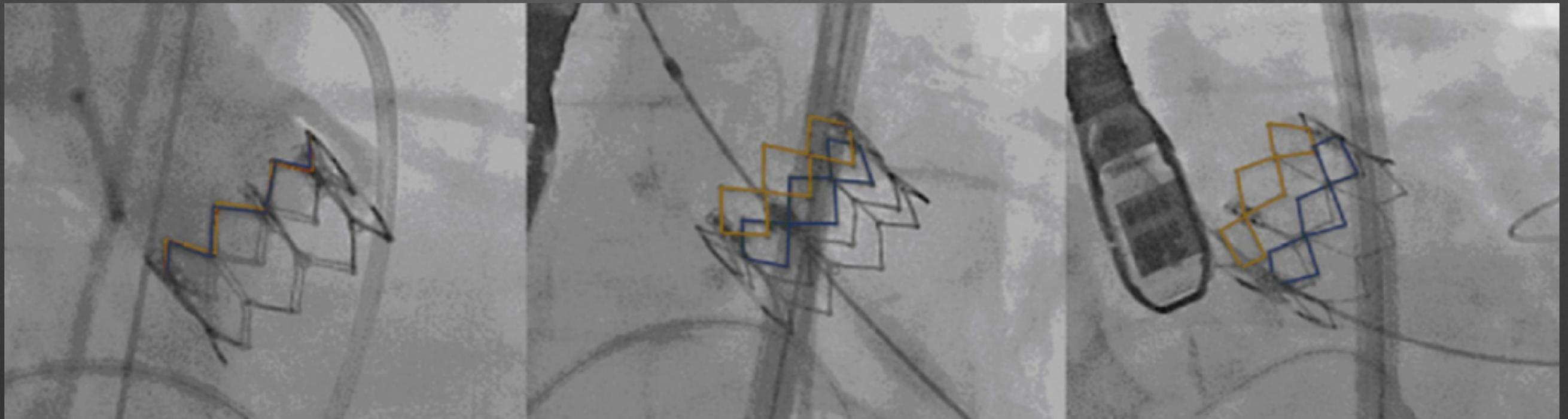


**OAI 20 CAU 3**

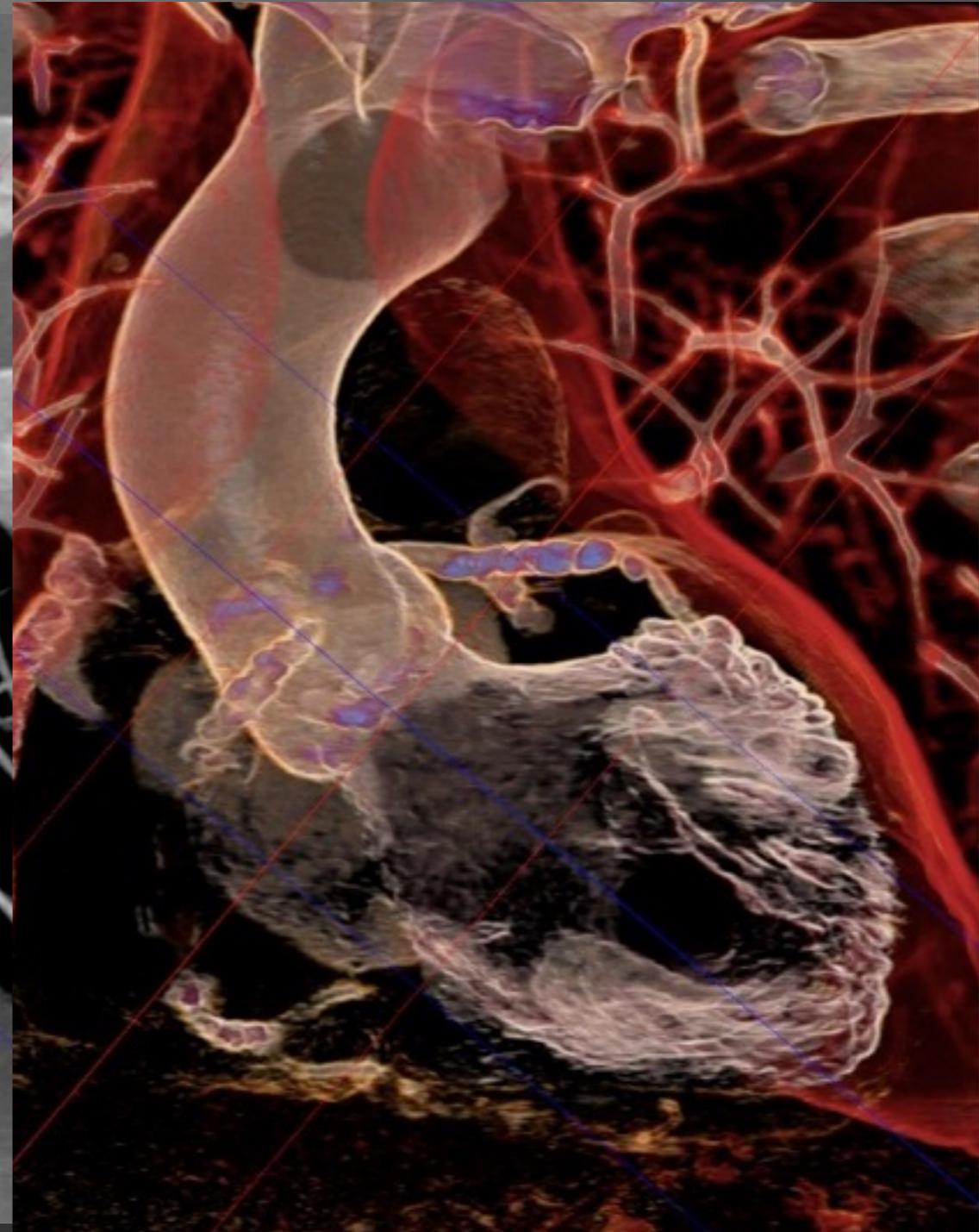
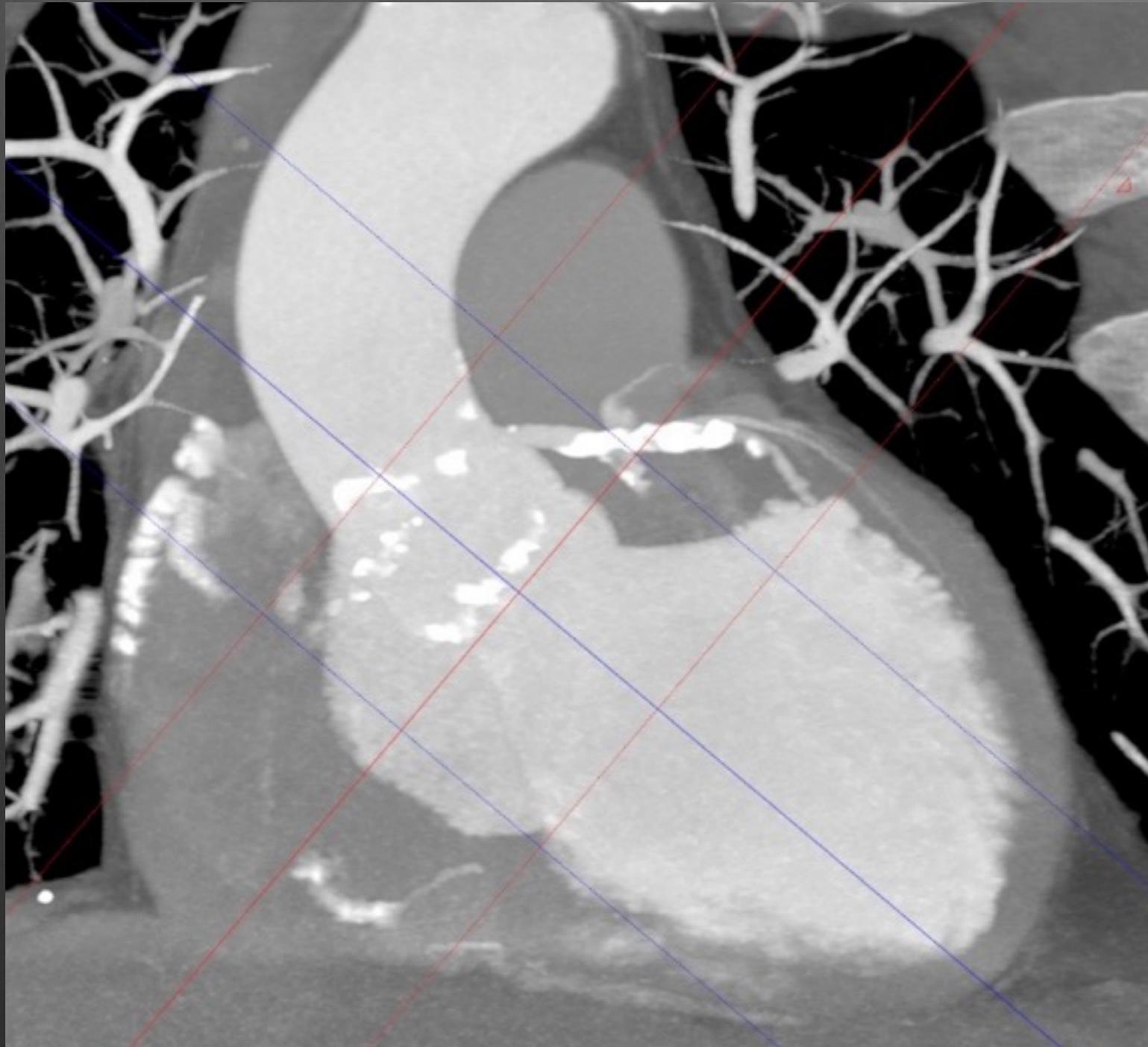


# Multislice computed tomography for prediction of optimal angiographic deployment projections during transcatheter aortic valve implantation

Exactitud de la proyección  
predicha por CT del plano valvular



# Proyección de implante



# Automated 3D Analysis of Pre-Procedural MDCT to Predict Annulus Plane Angulation and C-Arm Positioning.

**Table 2.** Procedural Characteristics and 30-Day Outcome

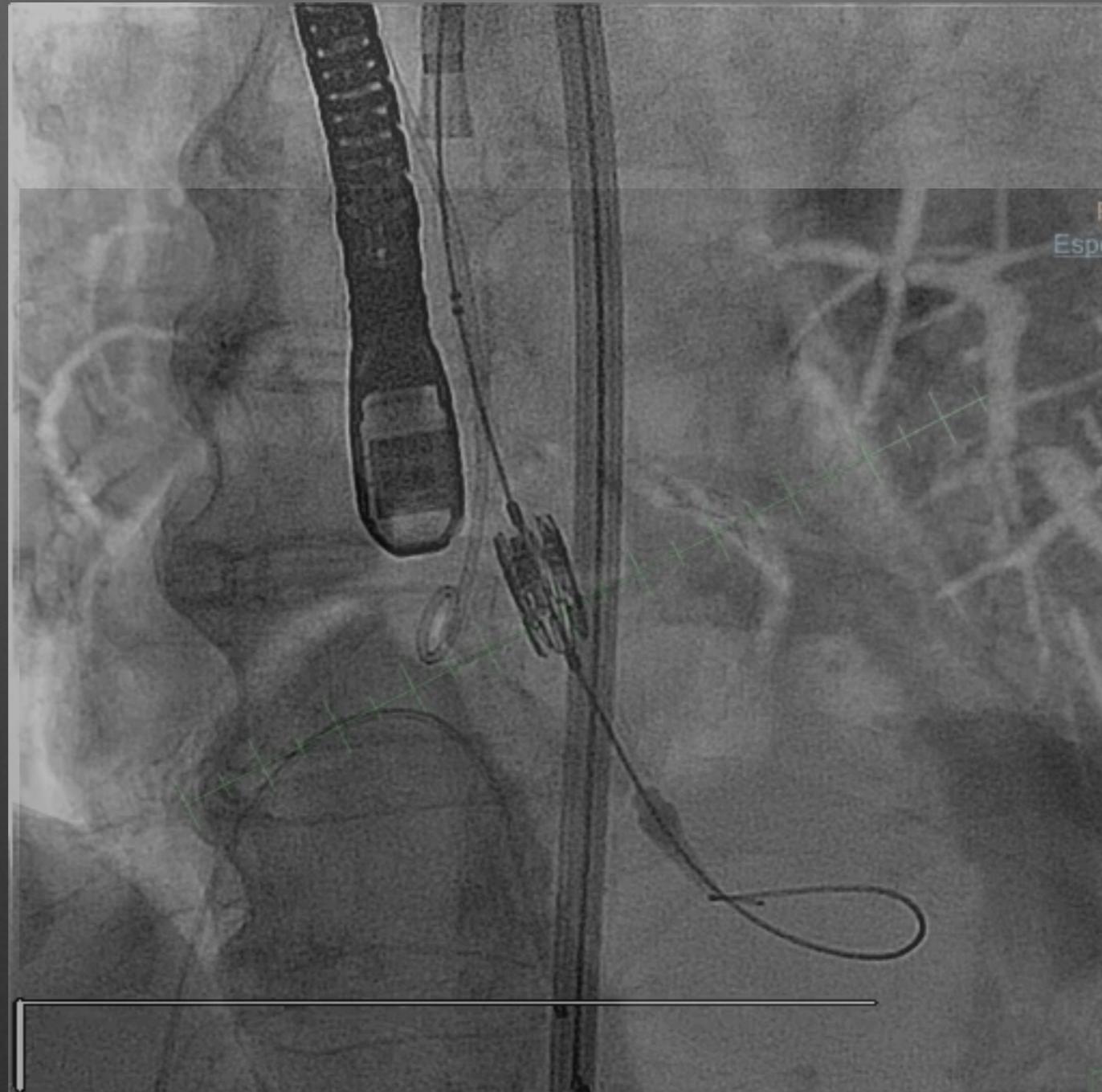
	Angiography Cohort A (n = 24)	Angiography Cohort B (n = 11)	p Value	Angiography Cohort A+B (n = 35)	MDCT Cohort (n = 36)	p Value
Diameter of implanted valve prosthesis						
23 mm	7 (29)	3 (30)	0.32	10 (28.6)	11 (30.6)	0.98
26 mm	17 (71)	7 (29)		24 (68.6)	24 (66.7)	
29 mm	0 (0)	1 (9)		1 (2.9)	1 (2.8)	
TAVR approach						
Transfemoral	11 (46)	7 (64)	0.32	18 (51)	26 (72)	0.09
Transapical	13 (54)	4 (36)		17 (49)	10 (28)	
Procedural outcome						
Implantation time, min	64 ± 18	61 ± 17	0.76	63 ± 17	46 ± 11	<0.0001
Contrast medium, ml	185 ± 124	170 ± 101	0.37	180 ± 109	108 ± 34	0.001
Radiation, Gy	1,688 ± 1,185	1,637 ± 999	0.57	1,671 ± 1,111	1,180 ± 617	0.02
Test angiograms before delivery						
0	0 (0)	0 (0)	0.77	0 (0)	35 (97)	<0.0001
1	3 (12)	1 (9)		4 (11)	1 (3)	
≥2	21 (88)	10 (91)		32 (89)	0 (0)	
Valve malposition*	2 (8)	1 (9)	0.94	3 (9)	0 (0)	0.07
AR grade ≥2 by TTE†	4 (17)	2 (18)	0.91	6 (17)	2 (6)	0.11
Valve malposition* and/or AR grade ≥2 by TTE†	6 (25)	3 (27)	0.88	8 (23)	2 (6)	0.03
Post-procedural acute kidney injury	8 (33)	3 (27)	0.90	11 (31)	4 (11)	0.03
30 day outcome						
Myocardial infarction	1 (4)	0 (0)	0.99	1 (3)	0 (0)	0.98
Stroke	0 (0)	1 (9)	0.66	1 (3)	1 (3)	0.99
Permanent pacemaker	0 (0)	1 (9)	0.66	1 (3)	1 (3)	0.99
Mortality	5 (21)	2 (18)	0.85	7 (20)	2 (6)	0.06

# Impact of optimising fluoroscopic implant angles on paravalvular regurgitation in transcatheter aortic valve replacements - Utility of three-dimensional rotational angiography.

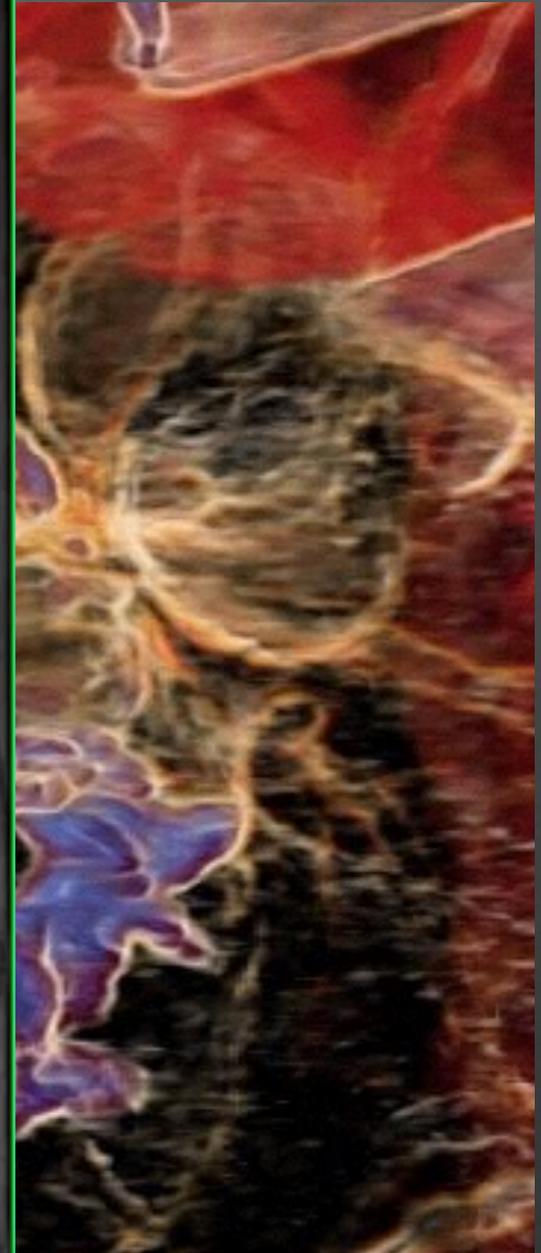
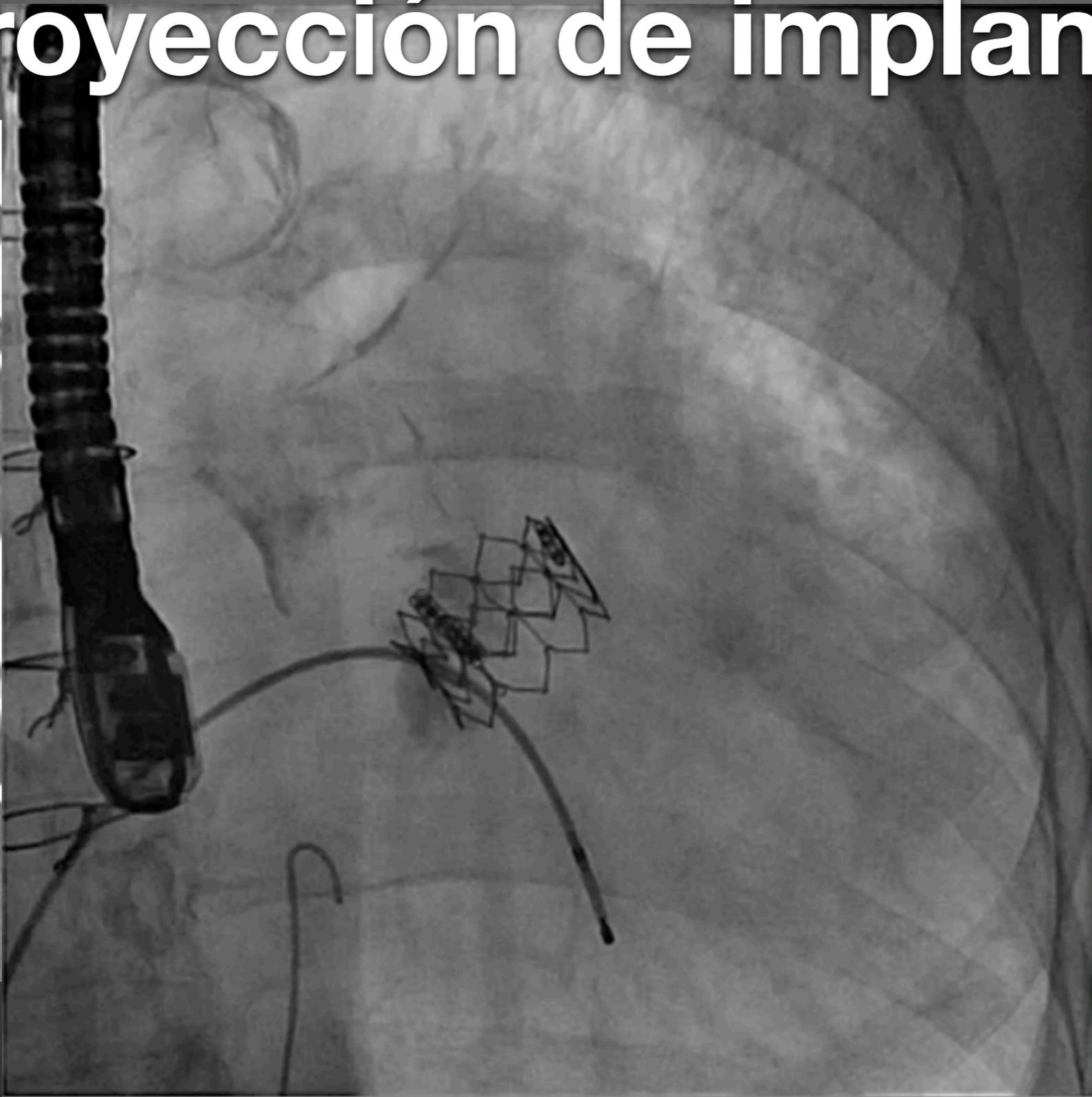
106 pacientes TAVI

Una línea de perpendicularidad excelente se asoció con menos leaks: 41.3% vs 21.6% (p=0.045)

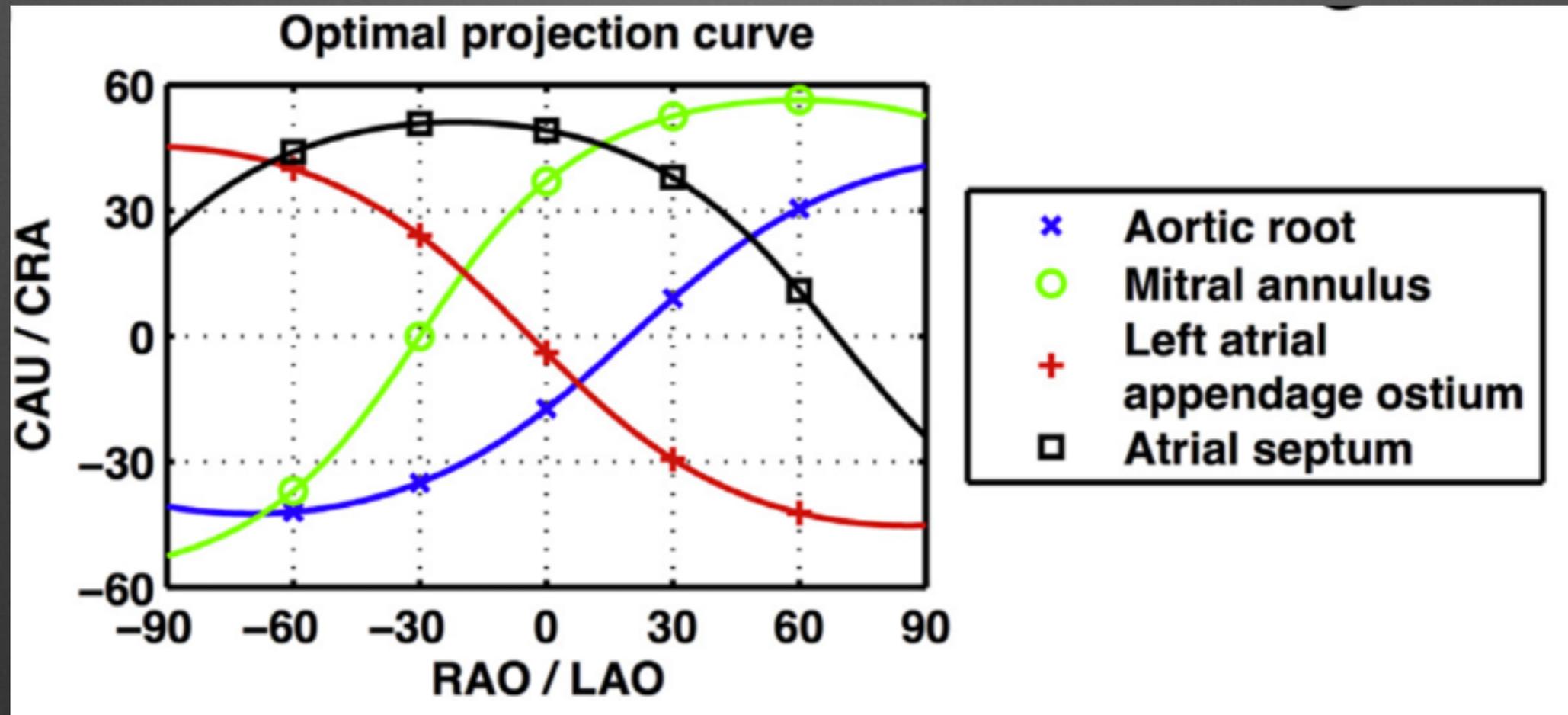
# Proyección de implante

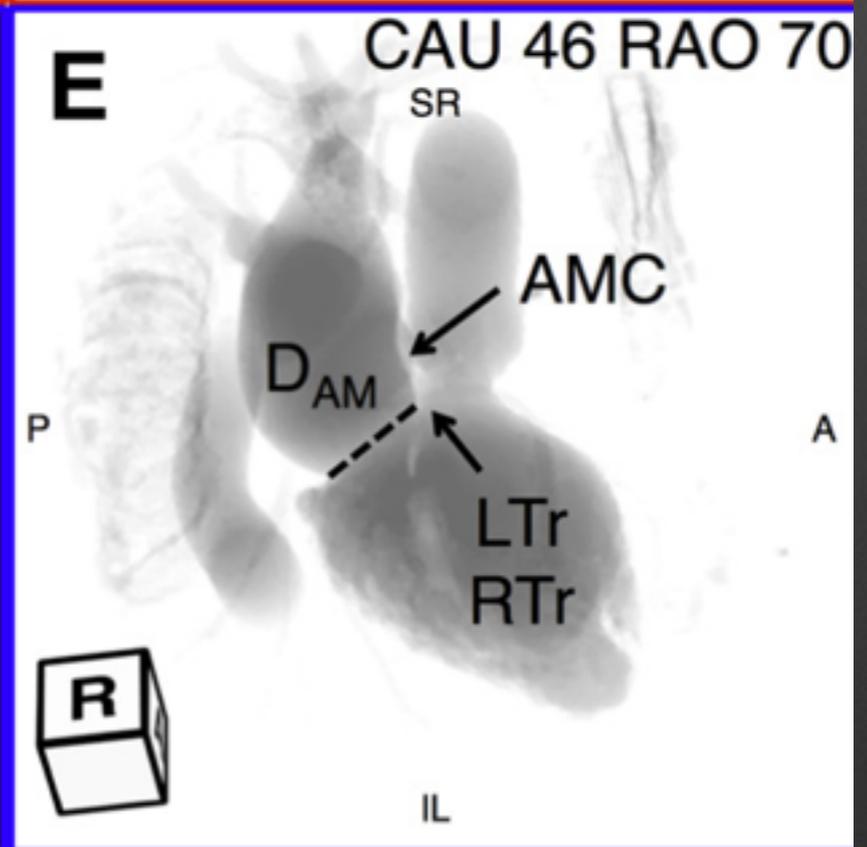
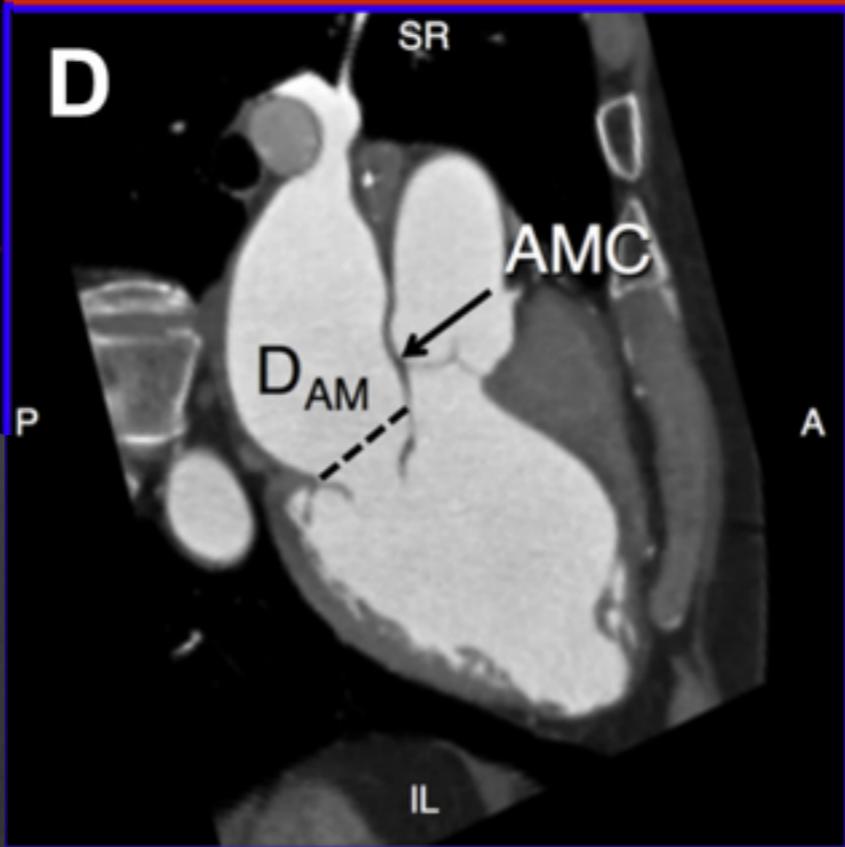
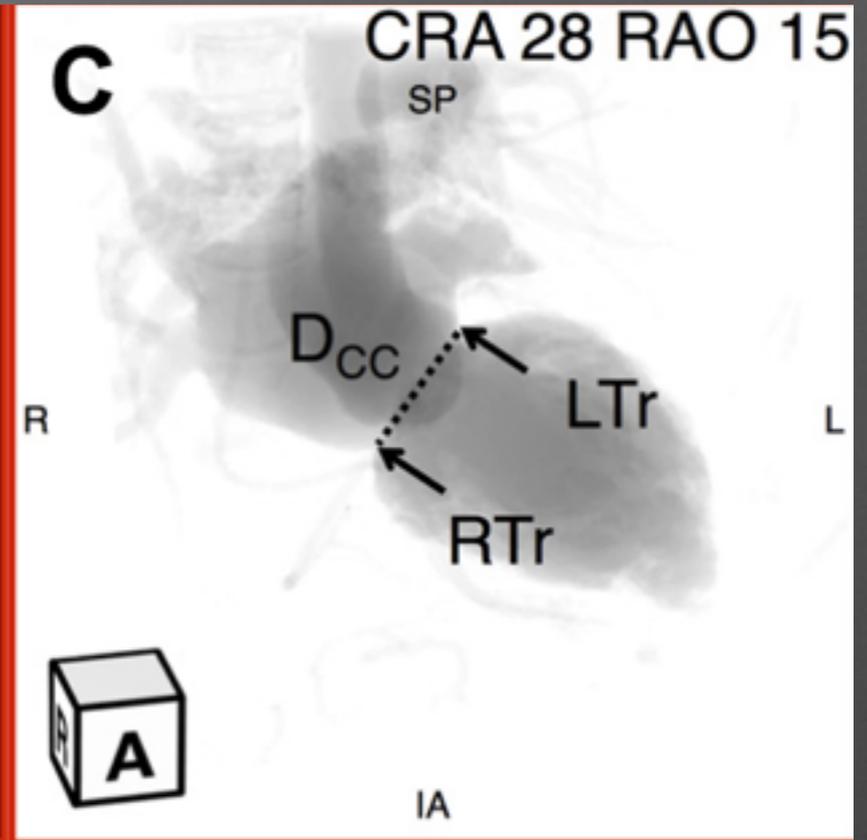
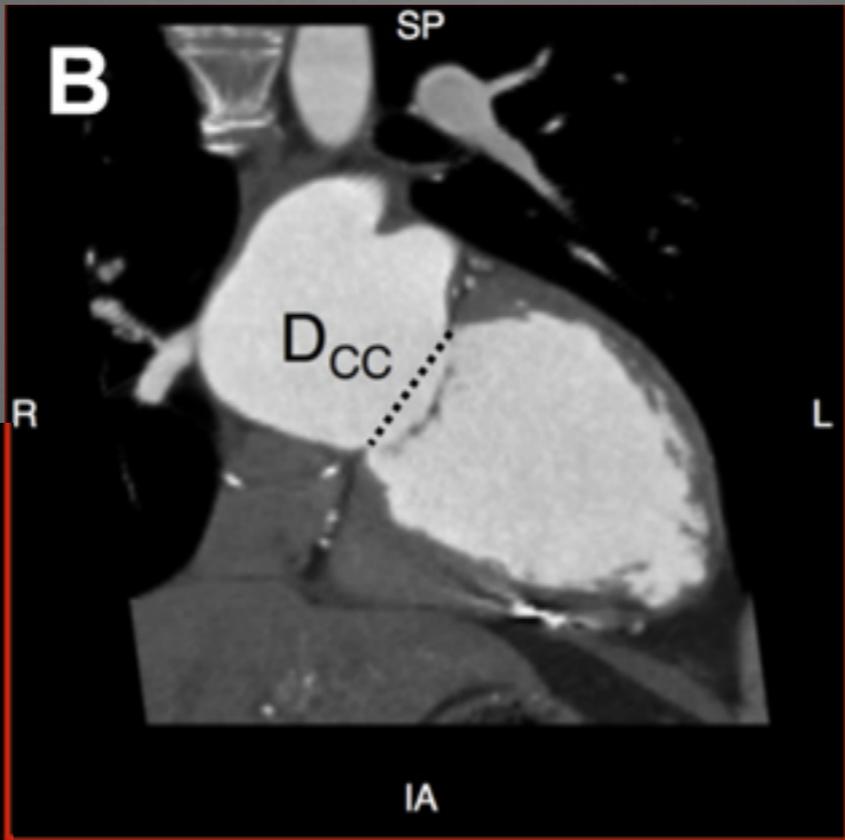
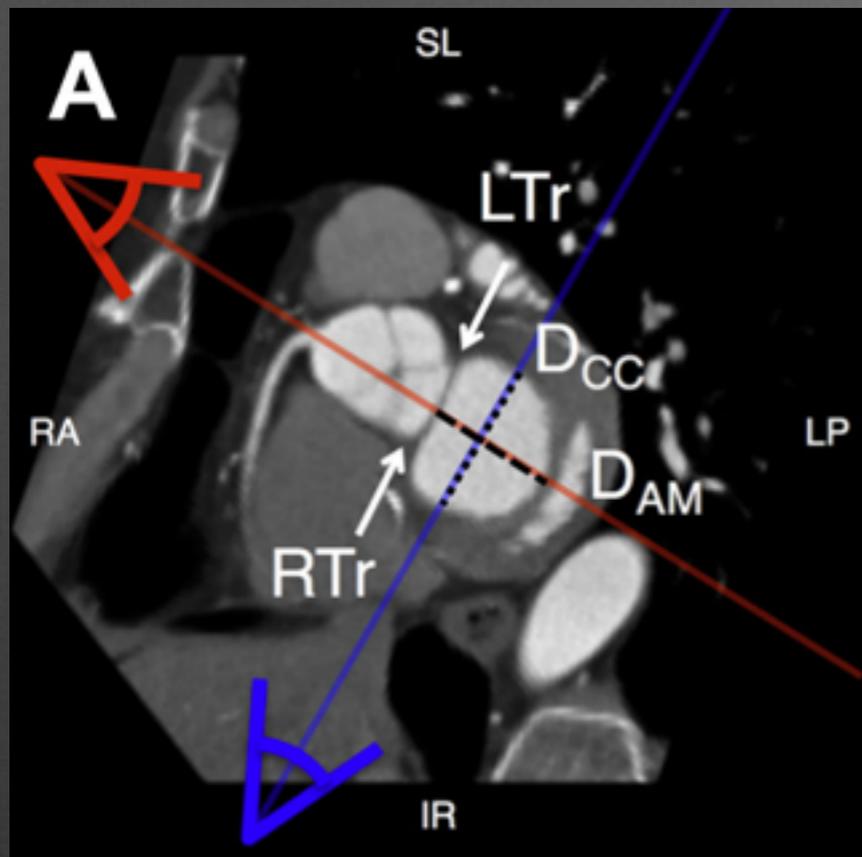


# Proyección de implante



# Fluoroscopic Anatomy of Left-Sided Heart Structures for Transcatheter Interventions.

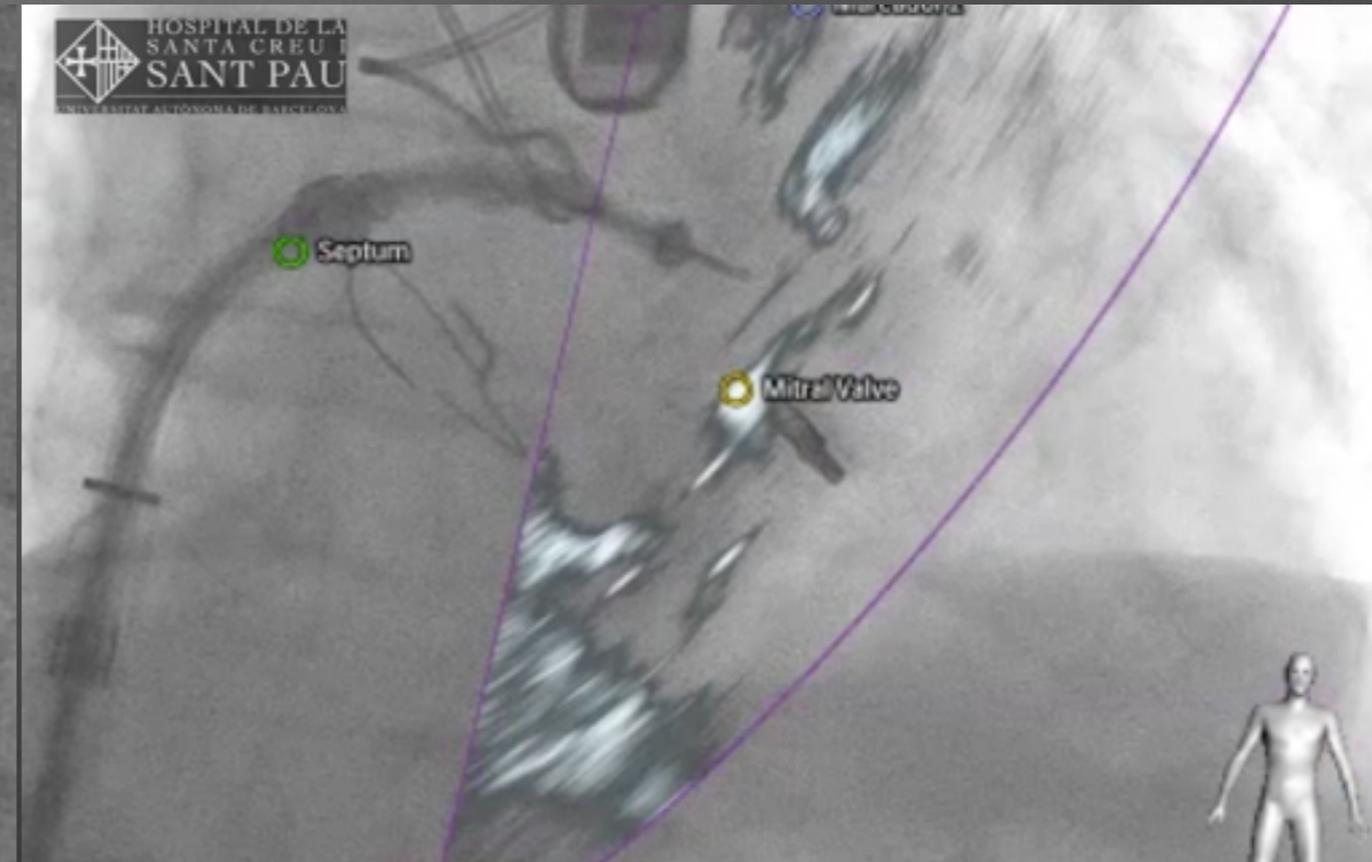




# Mensajes

- Para trabajar con fusión es imprescindible un equipo intervencionista sensible
- La fusión real en la guía de procedimientos actuales no es imprescindible aunque permite entender mejor la anatomía
- La fusión real en la guía de procedimientos abre la puerta a nuevas terapias donde sí puede ser imprescindible
- La planificación de procedimientos con Cardio-TC es BBB y debemos aprovecharla

# La importancia de un equipo intervencionista sensible



# Mensajes

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Gracias

