



Clínica
Universidad
de Navarra

Utilidad de la CRM y TCMC en las valvulopatías

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Unidad de Imagen Cardíaca

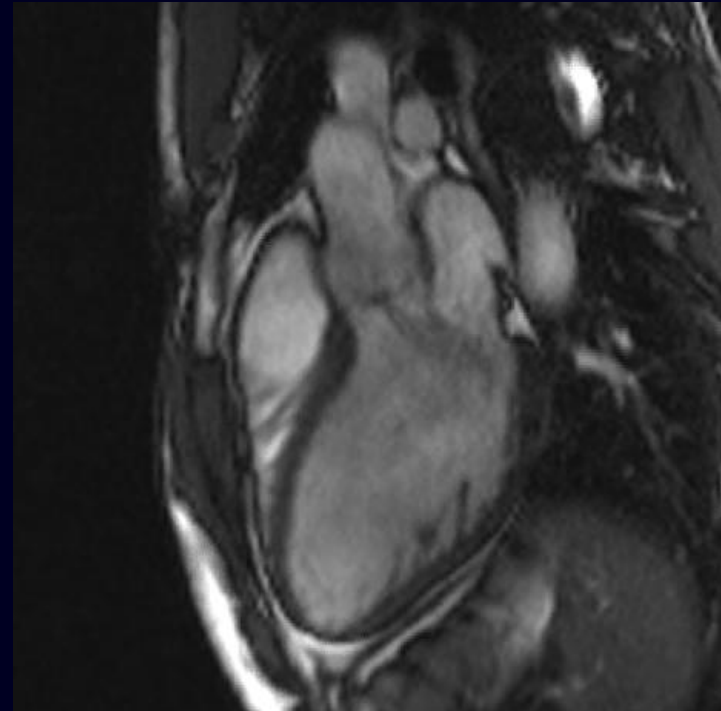
Servicio de Radiología

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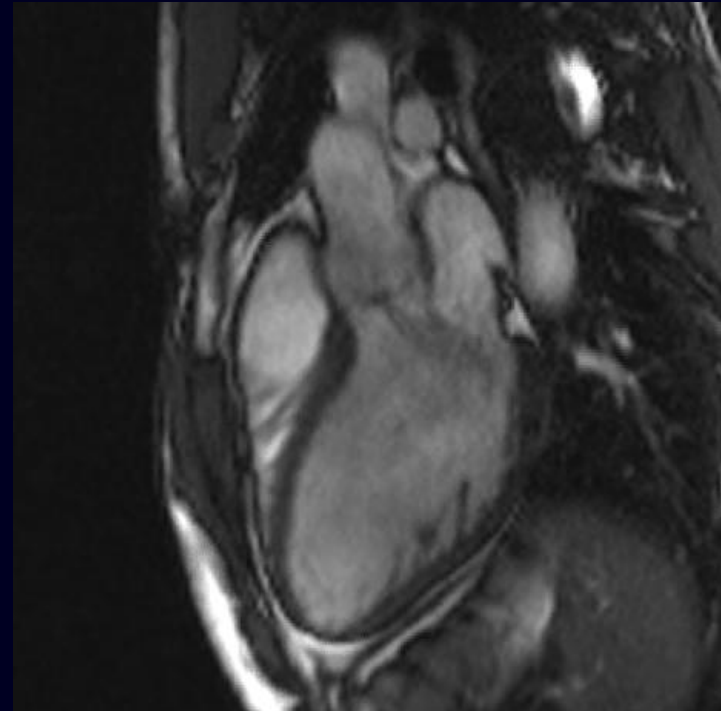
CRM en las valvulopatías: ¿tiene utilidad clínica?

- Indicaciones CRM
- Protocolo de estudio
- Cuantificación
 - Insuficiencia valvular
 - Estenosis valvular
- TCMC en las valvulopatías



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Clinical indications for cardiovascular magnetic resonance (CMR): Consensus Panel report[☆]

Dudley J. Pennell*, Udo P. Sechtem, Charles B. Higgins, Warren J. Manning, Gerald M. Pohost, Frank E. Rademakers, Albert C. van Rossum, Leslee J. Shaw, E. Kent Yucel

Table 5 Indications for CMR in patients with valvular heart disease

Indication	Class
1. Valve morphology	
Bicuspid aortic valve	II
Other valves	III
Vegetations	Inv
2. Cardiac chamber anatomy and function	I
3. Quantification of regurgitation	I
4. Quantification of stenosis	III
5. Detection of paravalvular abscess	Inv
6. Assessment of prosthetic valves	Inv

ACCF/ACR/SCCT/SCMR/ASNC/NASCI/SCAI/SIR APPROPRIATENESS CRITERIA

**ACCF/ACR/SCCT/SCMR/
ASNC/NASCI/SCAI/SIR 2006 Appropriateness
Criteria for Cardiac Computed Tomography
and Cardiac Magnetic Resonance Imaging***

A Report of the American College of Cardiology Foundation Quality Strategic Directions Committee Appropriateness Criteria Working Group, American College of Radiology, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, American Society of Nuclear Cardiology, North American Society for Cardiac Imaging, Society for Cardiovascular Angiography and Interventions, and Society of Interventional Radiology

Structure and Function—Evaluation of Ventricular and Valvular Function

Procedures may include LV/RV mass and volumes, MR angiography, quantification of valvular disease, and delayed contrast enhancement

18.	<ul style="list-style-type: none">• Assessment of complex congenital heart disease including anomalies of coronary circulation, great vessels, and cardiac chambers and valves• Procedures may include LV/RV mass and volumes, MR angiography, quantification of valvular disease, and contrast enhancement	A (9)
20.	<ul style="list-style-type: none">• Evaluation of LV function following myocardial infarction OR in heart failure patients• Patients with technically limited images from echocardiogram	A (8)
21.	<ul style="list-style-type: none">• Quantification of LV function• Discordant information that is clinically significant from prior tests	A (8)
22.	<ul style="list-style-type: none">• Evaluation of specific cardiomyopathies (infiltrative [amyloid, sarcoid], HCM, or due to cardiotoxic therapies)• Use of delayed enhancement	A (8)
23.	<ul style="list-style-type: none">• Characterization of native and prosthetic cardiac valves—including planimetry of stenotic disease and quantification of regurgitant disease• Patients with technically limited images from echocardiogram or TEE	A (8)
24.	<ul style="list-style-type: none">• Evaluation for arrhythmogenic right ventricular cardiomyopathy (ARVC)• Patients presenting with syncope or ventricular arrhythmia	A (9)
25.	<ul style="list-style-type: none">• Evaluation of myocarditis or myocardial infarction with normal coronary arteries• Positive cardiac enzymes without obstructive atherosclerosis on angiography	A (8)

EXPERT CONSENSUS DOCUMENT

ACCF/ACR/AHA/NASCI/SCMR 2010 Expert Consensus Document on Cardiovascular Magnetic Resonance

A Report of the American College of Cardiology Foundation Task Force on
Expert Consensus Documents

3.6. Assessment of Valvular Heart Disease

CMR may be used for assessing individuals with valvular heart disease in which evaluation of valvular stenosis, regurgitation, para- or perivalvular masses, perivalvular complications of infectious processes, or prosthetic valve disease are needed. CMR is particularly useful in identifying serial changes in LV volumes or mass in patients with valvular dysfunction.



PRACTICE GUIDELINE

2008 Focused Update Incorporated Into the ACC/AHA 2006 Guidelines for the Management of Patients With Valvular Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1998 Guidelines for the Management of Patients With Valvular Heart Disease)

Endorsed by the Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons

3.3. Bicuspid Aortic Valve With Dilated Ascending Aorta

CLASS I

1. Patients with known bicuspid aortic valves should undergo an initial transthoracic echocardiogram to assess the diameters of the aortic root and ascending aorta. (Level of Evidence: B)

2. Cardiac magnetic resonance imaging or cardiac computed tomography is indicated in patients with bicuspid aortic valves when morphology of the aortic root or ascending aorta cannot be assessed accurately by echocardiography. (Level of Evidence: C)

3. Patients with bicuspid aortic valves and dilatation of the aortic root or ascending aorta (diameter greater than 4.0 cm*) should undergo serial evaluation of aortic root/ascending aorta size and morphology by echocardiography, cardiac magnetic resonance, or computed tomography on a yearly basis. (Level of Evidence: C)

4. Surgery to repair the aortic root or replace the ascending aorta is indicated in patients with bicuspid aortic valves if the diameter of the aortic root or ascending aorta is greater than 5.0 cm* or if the rate of increase in diameter is 0.5 cm per year or more. (Level of Evidence: C)

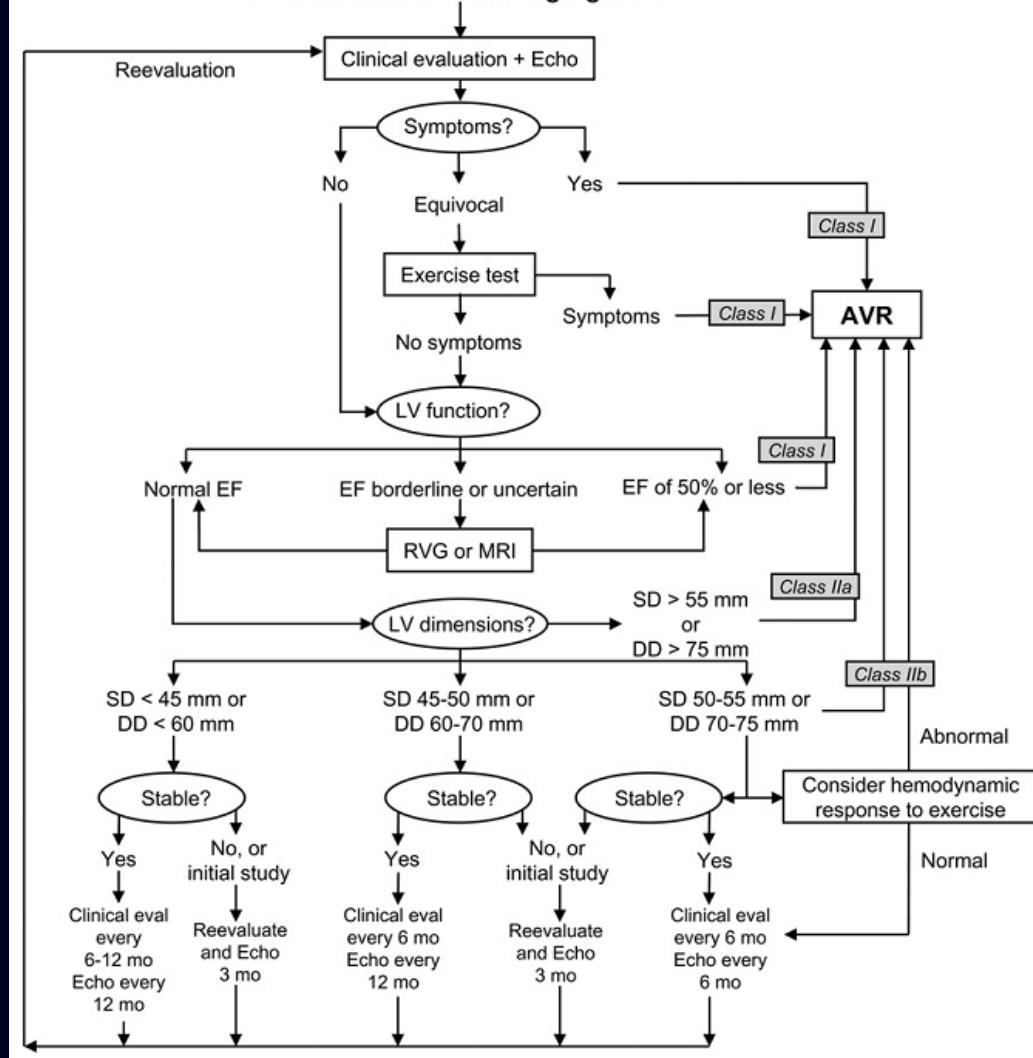
5. In patients with bicuspid valves undergoing AVR because of severe AS or AR (see Sections 3.1.7 and 3.2.3.8), repair of the aortic root or replacement of the ascending aorta is indicated if the diameter of the aortic root or ascending aorta is greater than 4.5 cm.* (Level of Evidence: C)

CLASS IIa

1. It is reasonable to give beta-adrenergic blocking agents to patients with bicuspid valves and dilated aortic roots (diameter greater than 4.0 cm*) who are not candidates for surgical correction and who do not have moderate to severe AR. (Level of Evidence: C)

2. Cardiac magnetic resonance imaging or cardiac computed tomography is reasonable in patients with bicuspid aortic valves when aortic root dilatation is detected by echocardiography to further quantify severity of dilatation and involvement of the ascending aorta. (Level of Evidence: B)

Chronic Severe Aortic Regurgitation



¿Qué queremos?

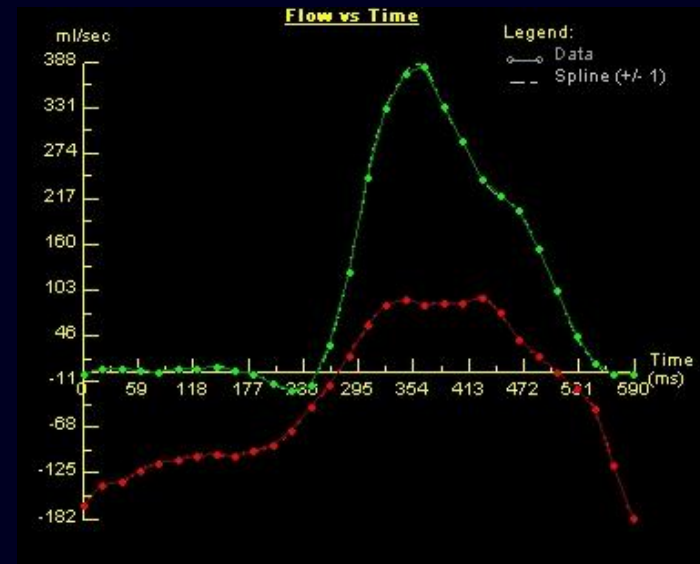
- Estudiar la anatomía valvular
- Estimar la severidad de la insuficiencia
 - Cualitativa
 - Cuantitativa
- Establecer su repercusión sobre las cavidades cardiacas
- Conocer la anatomía vascular

¿Qué tenemos? CRM

- Secuencias anatómicas
- Secuencias de flujo
- Secuencias de función
- Angio-RM

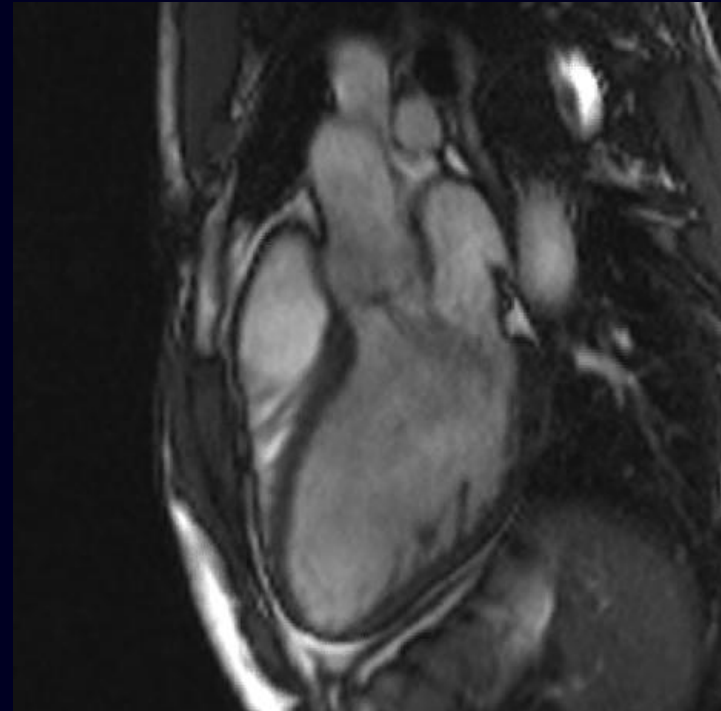
CRM en valvulopatías

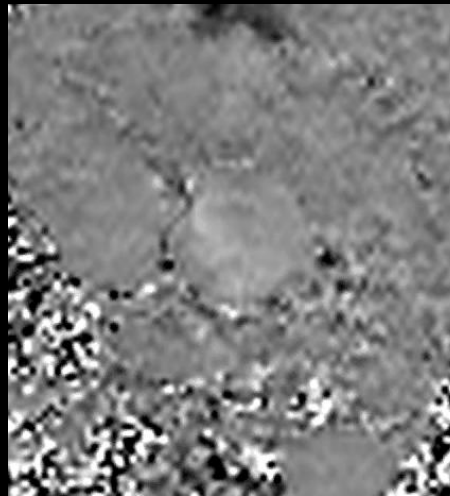
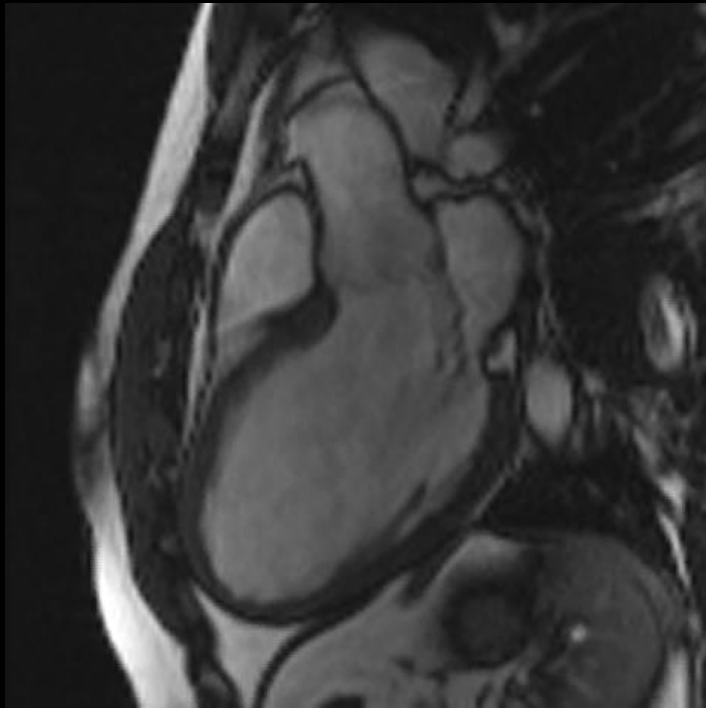
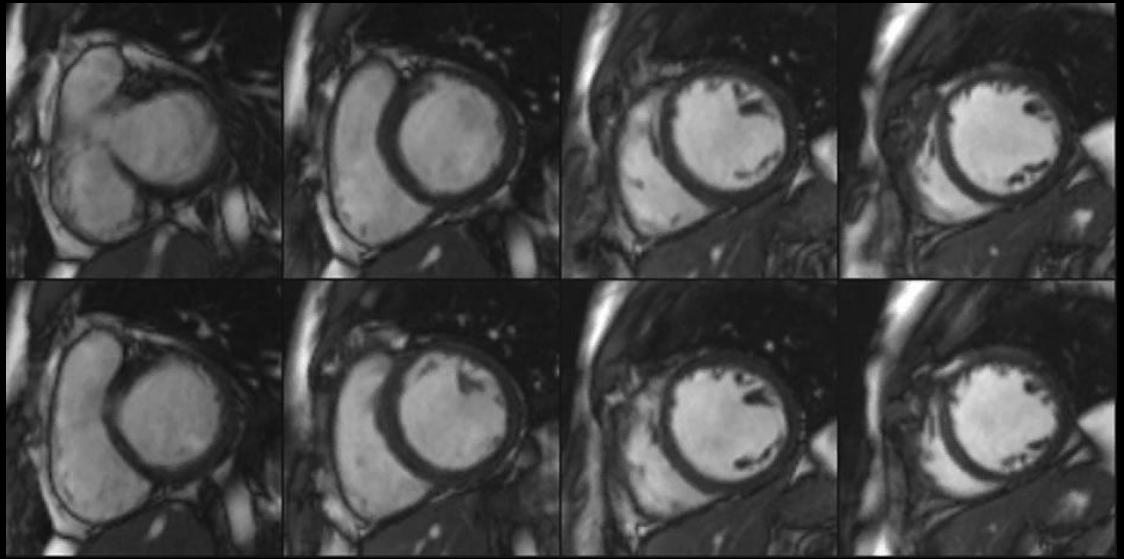
- No existe estándar de referencia para medir la velocidad del flujo sanguíneo *in vivo*
- La RM aporta información anatómica y funcional tridimensional
- Permite cuantificar la velocidad y el flujo
- Con respecto a la *ecografía Doppler*
 - Velocidad: menor velocidad pico
 - Flujo promedio: cuantificación más exacta
- No posee limitaciones de ventana acústica
- *Cuantificación de velocidad en tiempo real*



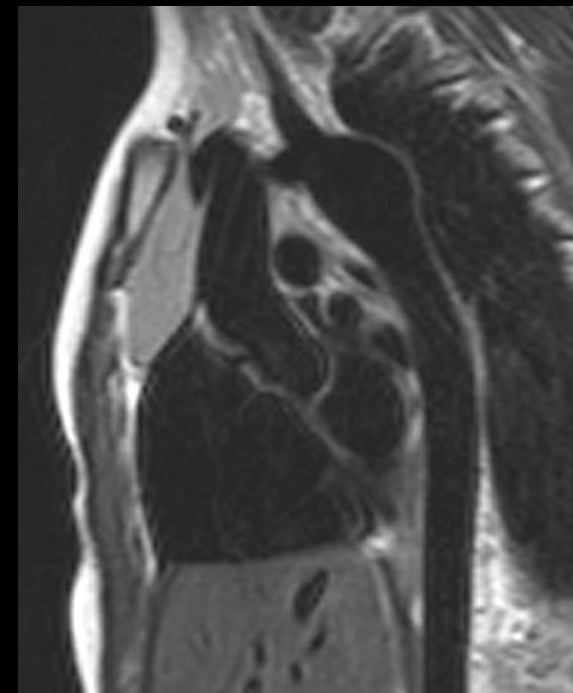
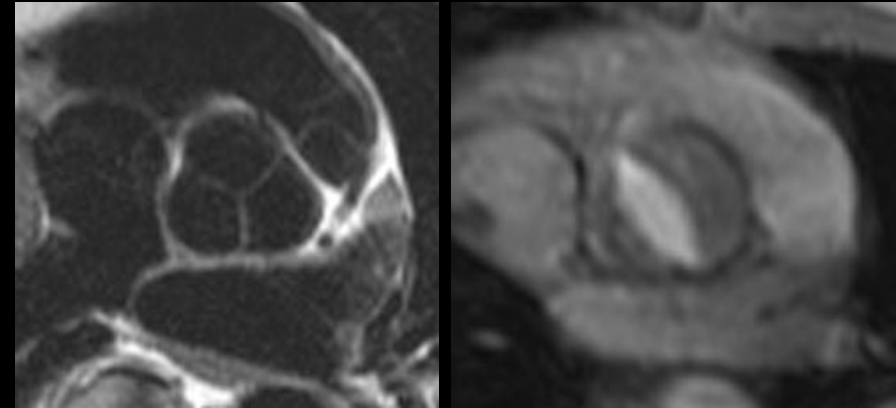
CRM en las valvulopatías: ¿tiene utilidad clínica?

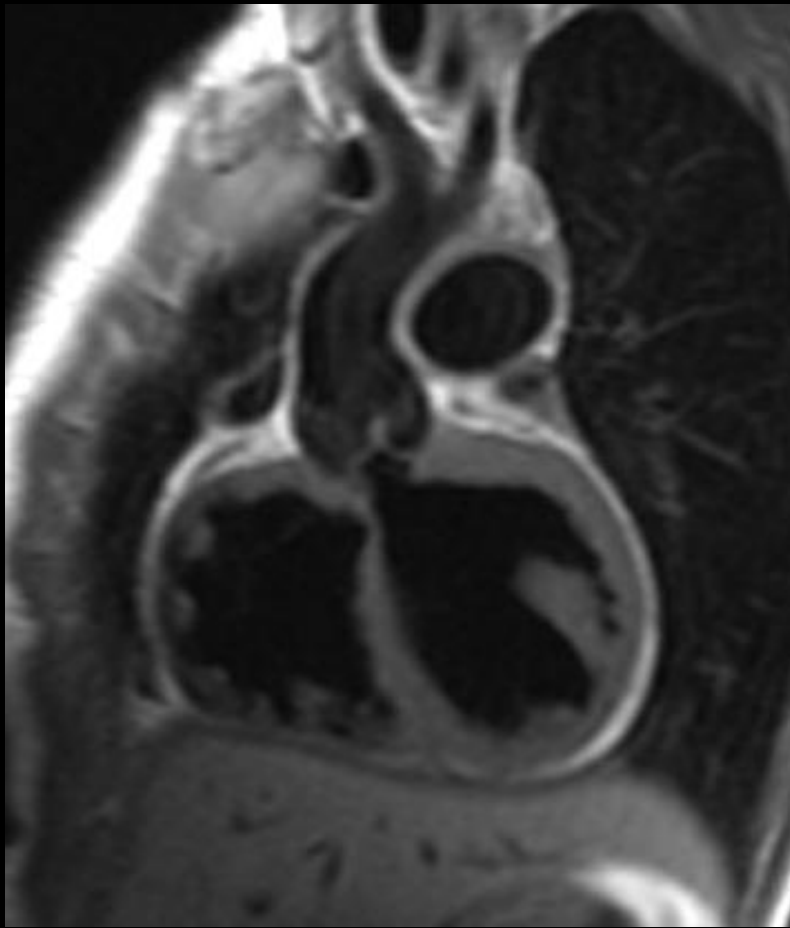
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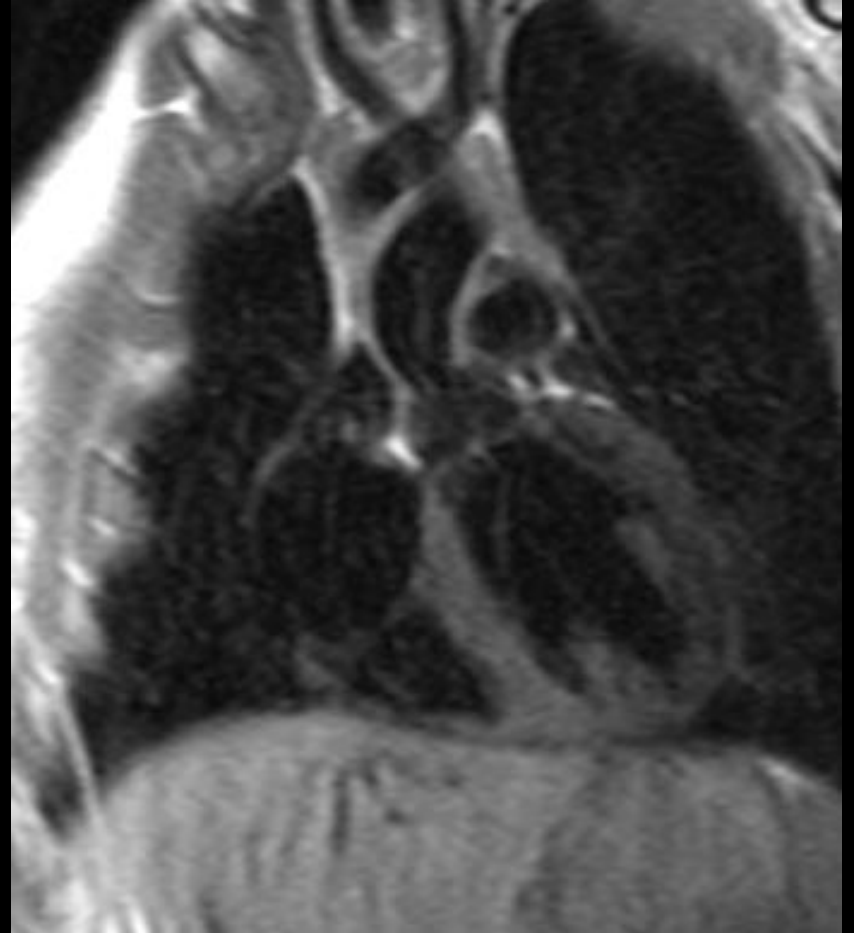


- Sangre negra (sangre blanca)
- *Spin echo, fast spin echo (SSFP, Flash)*
- **Morfología**
 - Válvulas: engrosamiento, válvula bicúspide
 - Cambios en vasos y cavidades cardiacas
 - Dilatación o hipertrofia de la cavidad
 - Morfología vascular



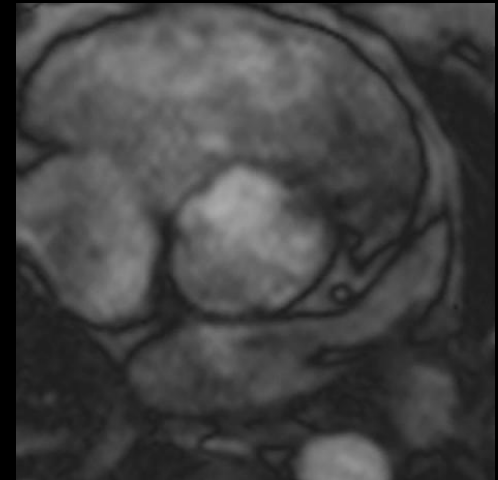
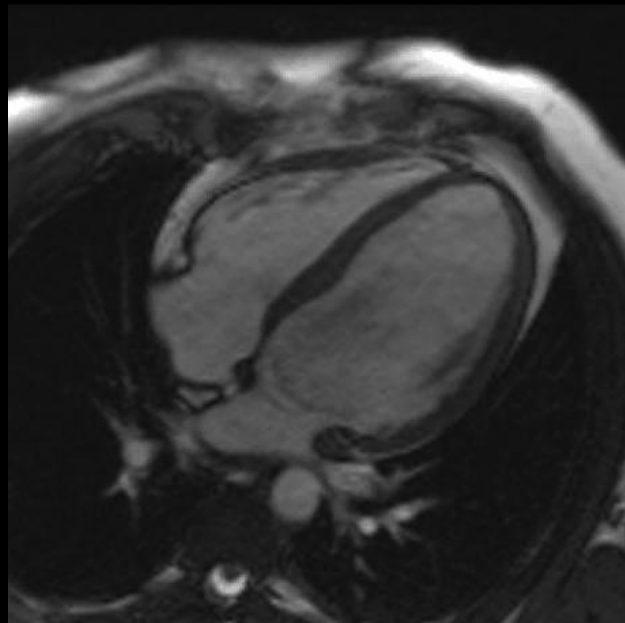
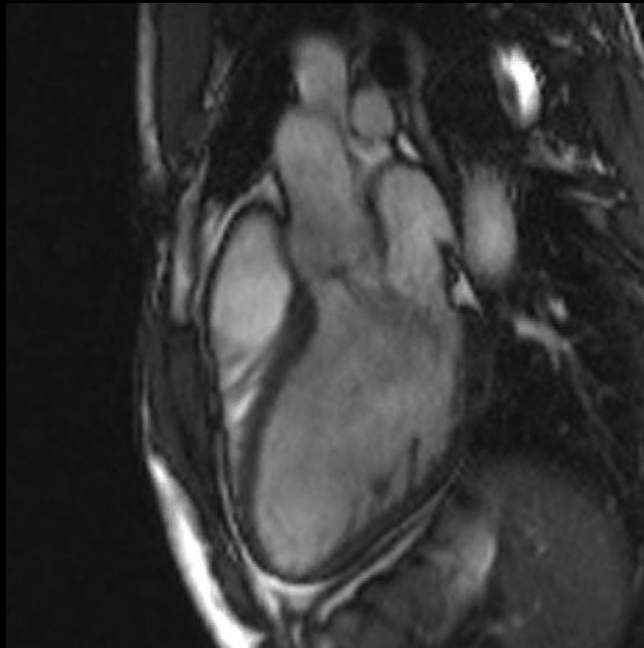


Estenosis subaórtica



Estenosis aórtica supravalvular

- Eco de gradiente SSFP y FLASH
- Cuantificación de función ventricular (SSFP)
- Valoración cualitativa de insuficiencia valvular (FLASH)



Valoración de los grandes vasos

un

Introducción



SSFP

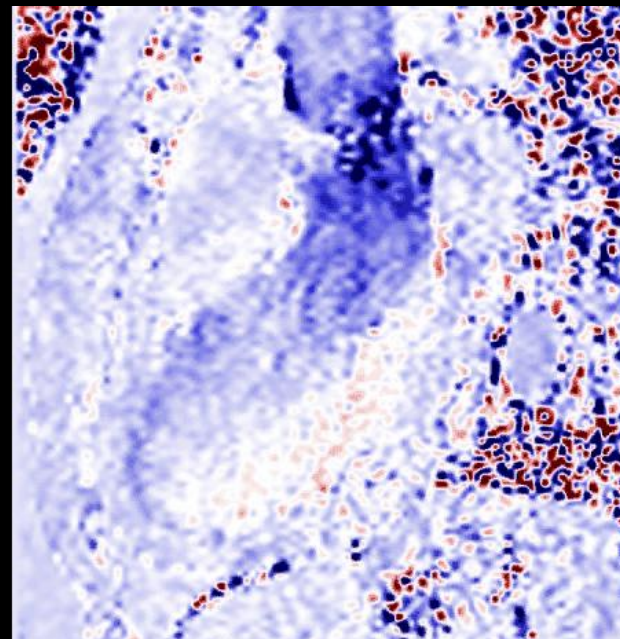
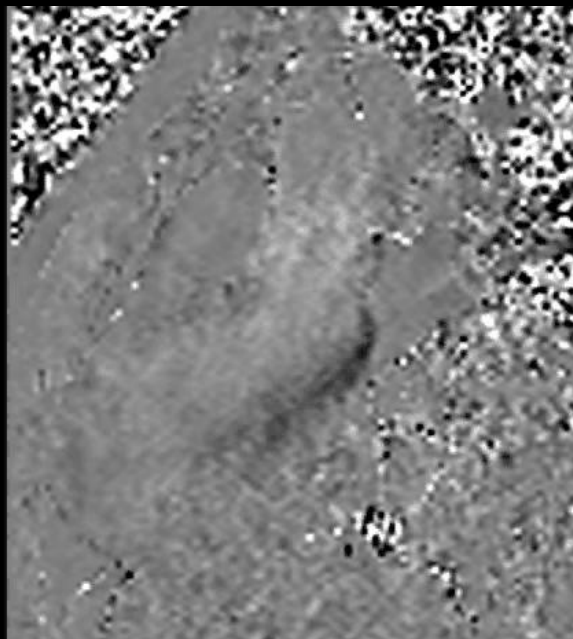
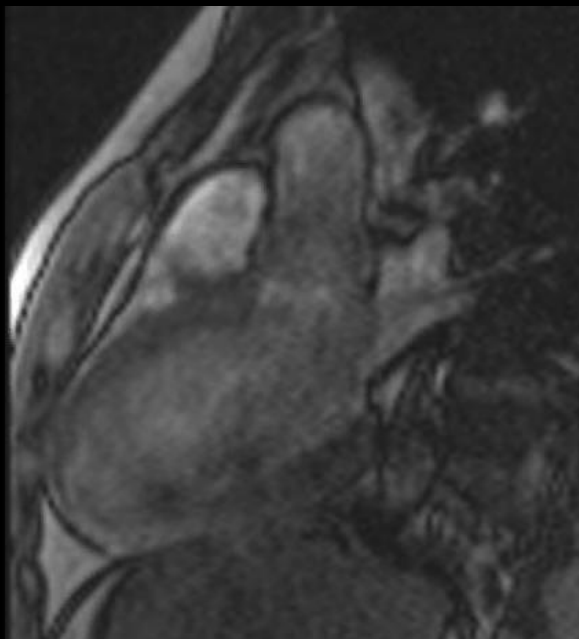


Angio-RM

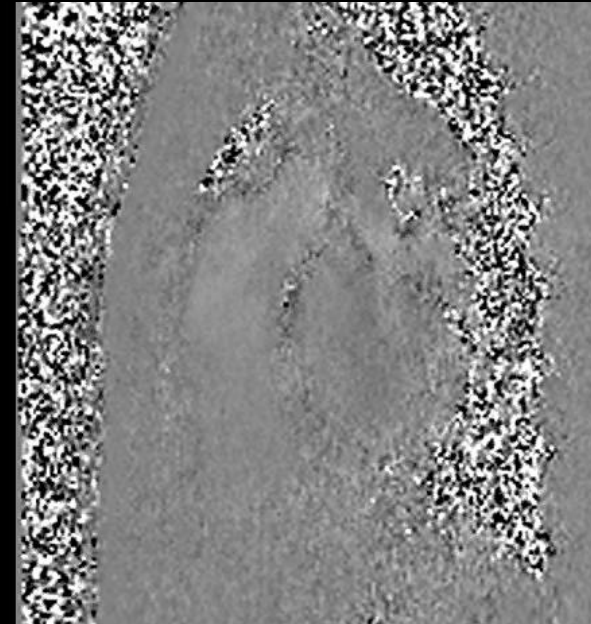
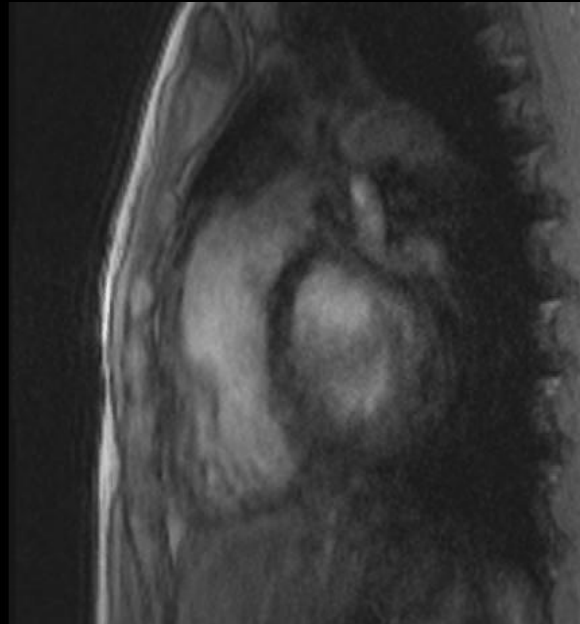
Secuencias de flujo

un

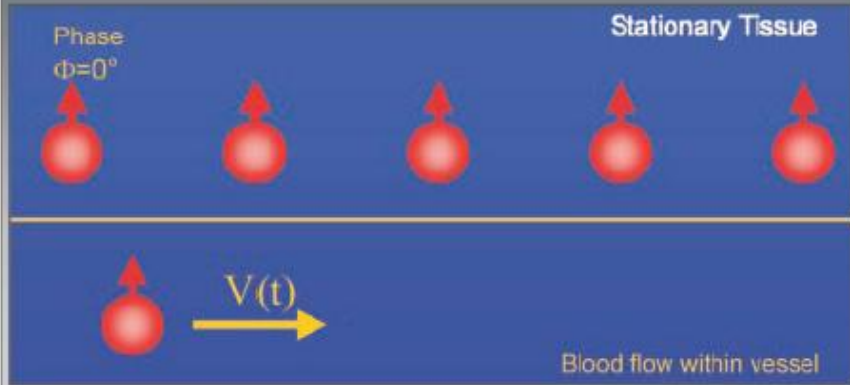
Introducción



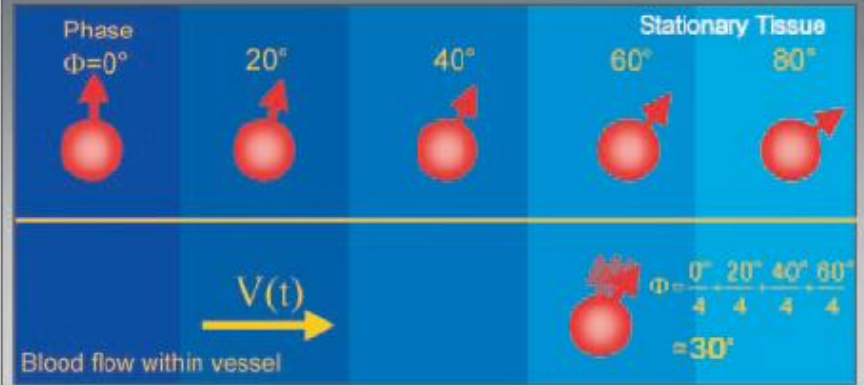
- La señal de RM tiene tres componentes
 - **Frecuencia**
 - **Amplitud**: imagen de RM convencional
 - **Fase**
 - Cambios de fase inducidos por la velocidad
 - Distingue tejido estacionario de la sangre circulante



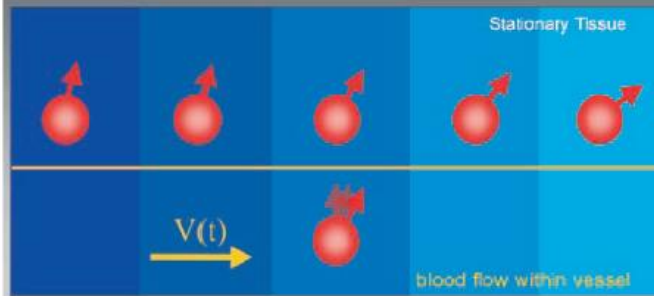
Constant Magnetic Field



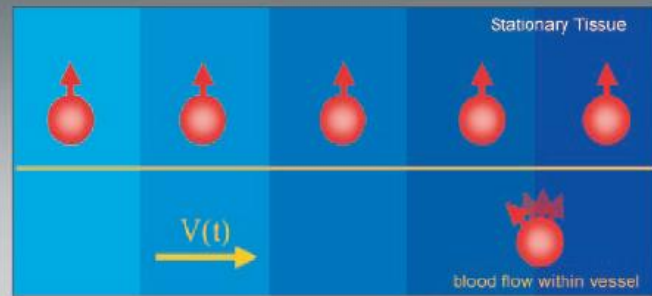
Magnetic Field Gradient applied \rightarrow



positive lobe applied \rightarrow



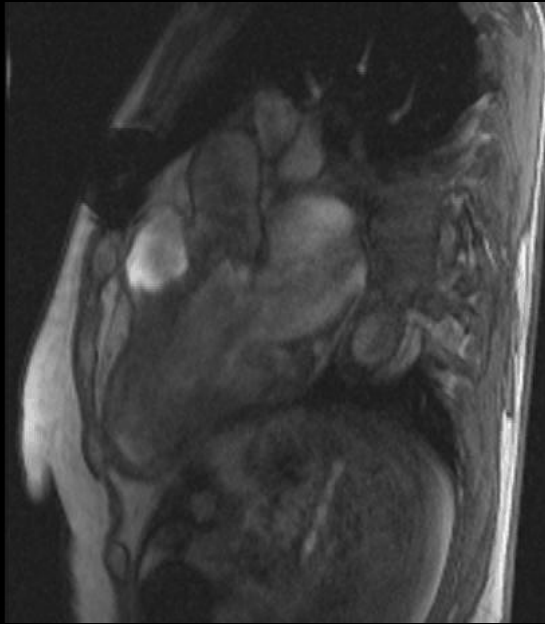
negative lobe applied \leftarrow



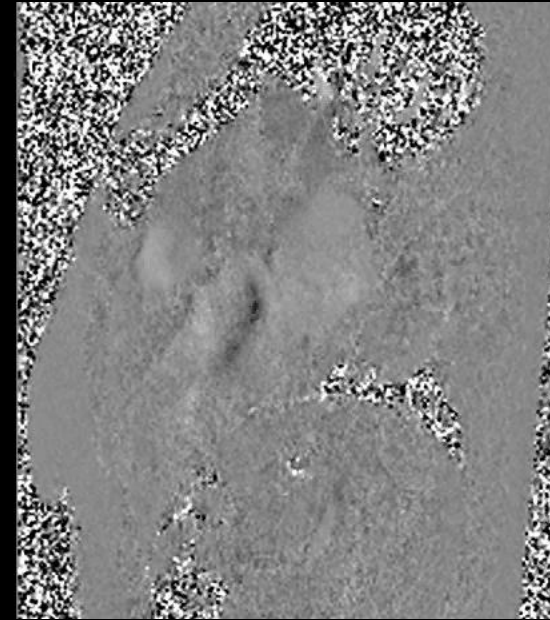
Bipolar Gradient 1

$t \rightarrow$

Bipolar Gradient 2



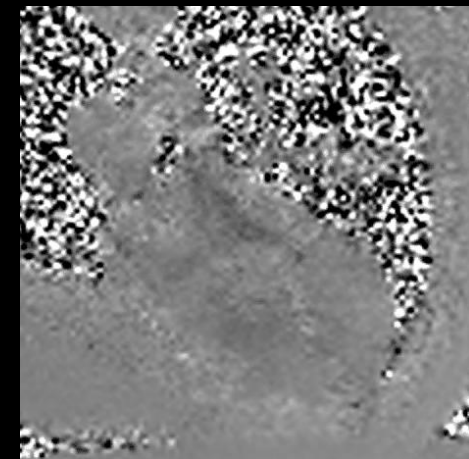
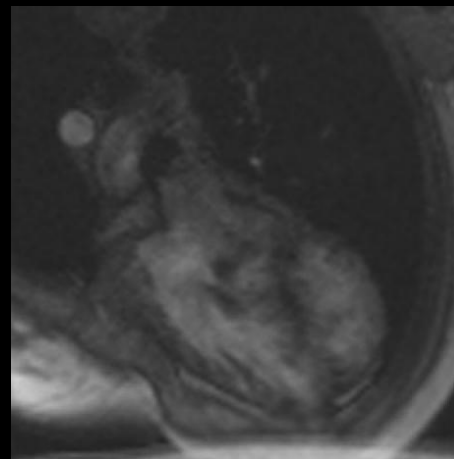
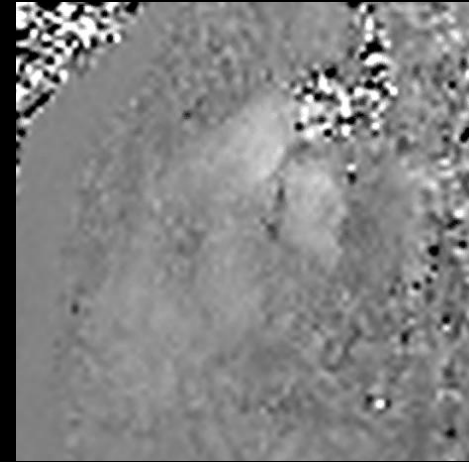
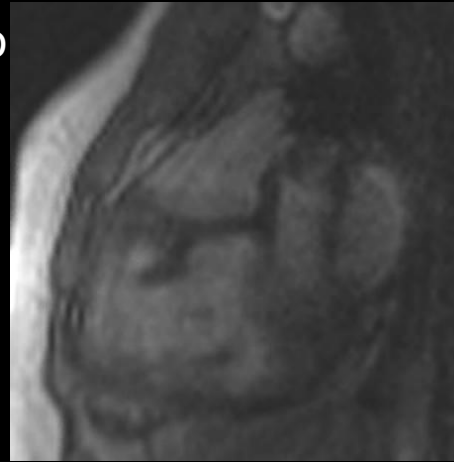
Magnitud



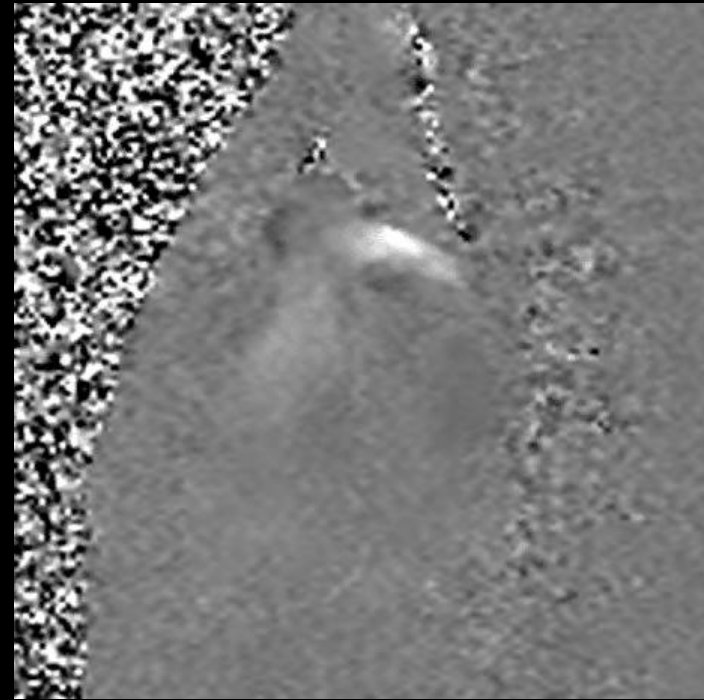
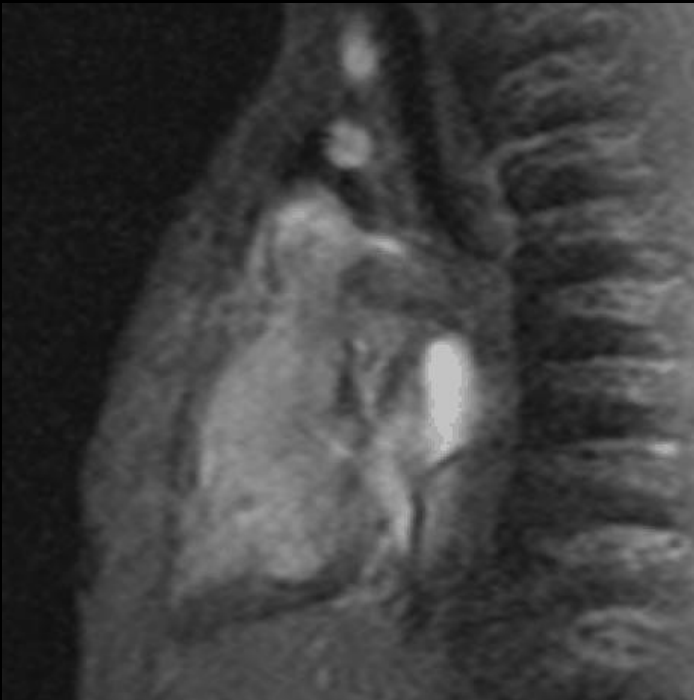
Velocidad – Fase

Protocolo de estudio

1. Anatomía y características del flujo
2. *In-plane* Vs. *Through-plane*
3. Apnea / respiración libre
4. FOV
5. ECG prospectivo / retrospectivo
6. Ajustar parámetros secuencia
7. Decidir *Venc*
8. Adquisición de imágenes
9. Comprobación
10. Análisis - cuantificación

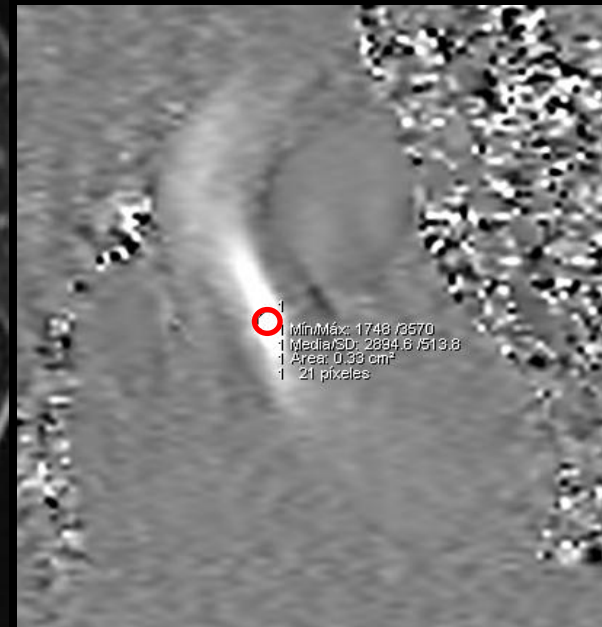
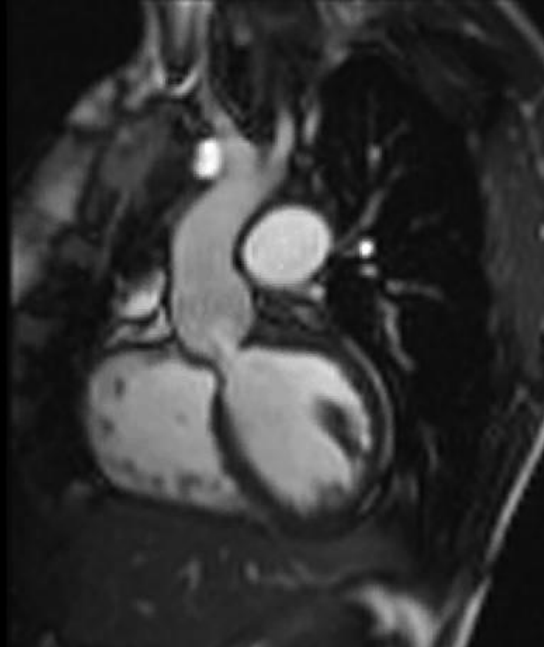
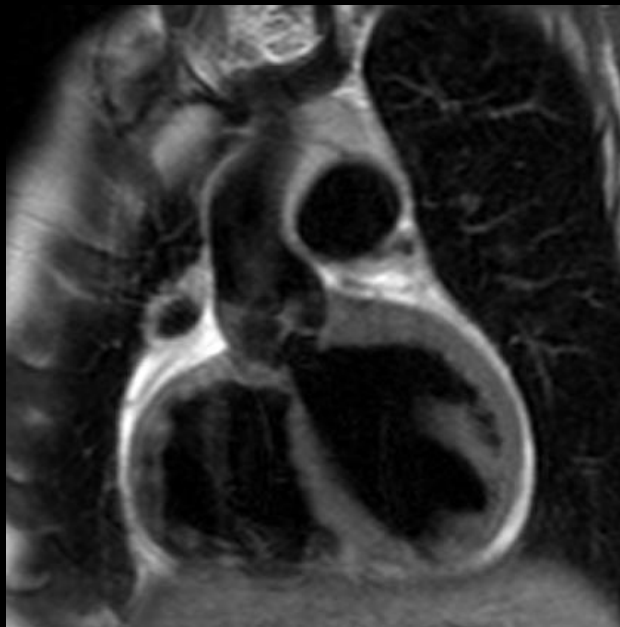


- Visualización del jet
- Codificación de la velocidad paralela a la dirección del flujo
 - Rotación del plano de adquisición
- Estimación de la **velocidad pico**

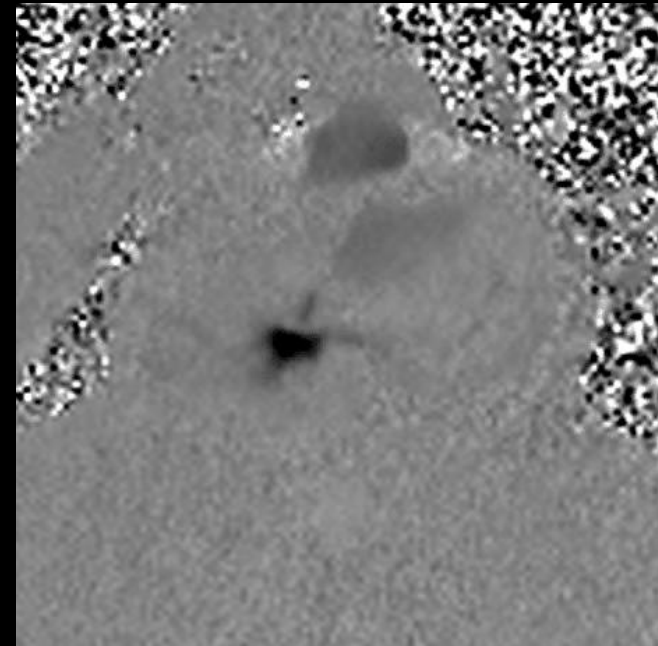
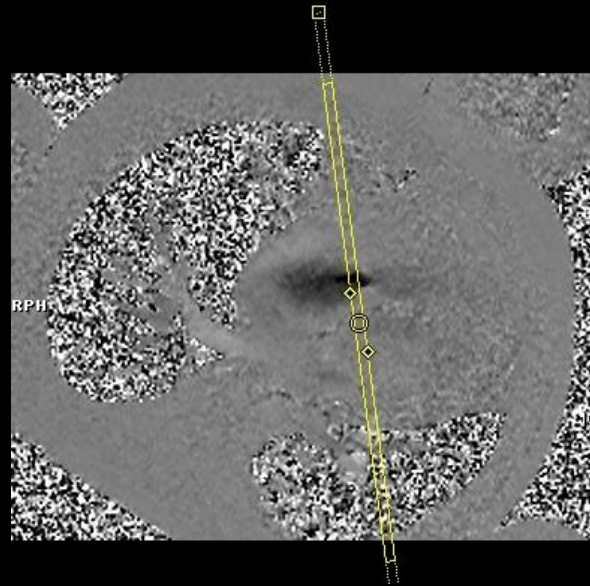
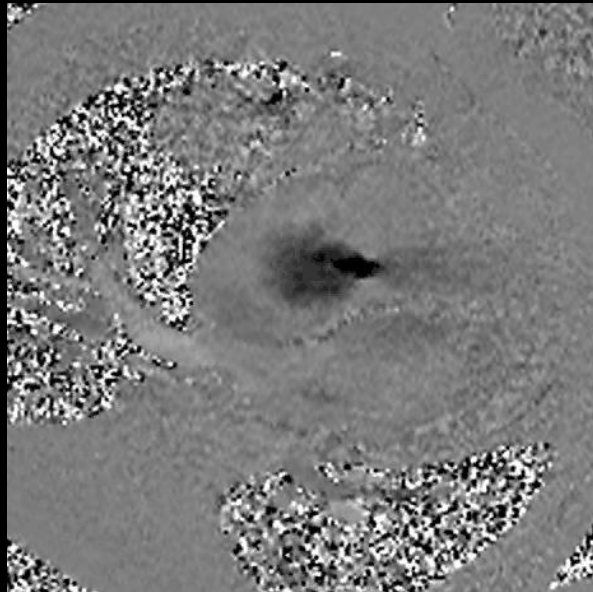


Cuantificación de la velocidad pico

- ROI pequeño es más exacto
- No incluir pixeles de los bordes (artefacto)
- Gradiente de presión ($\Delta P = 4 \cdot v^2$)

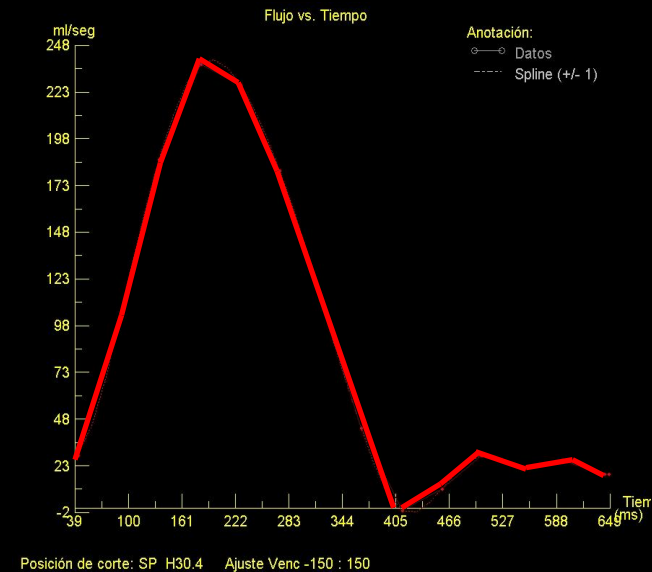
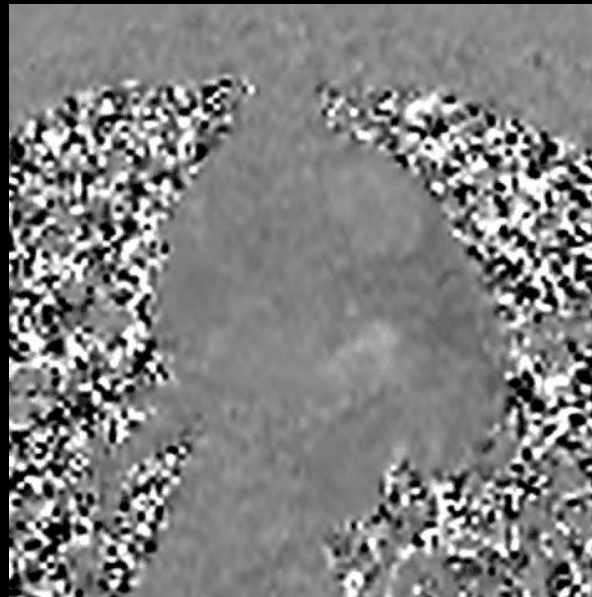
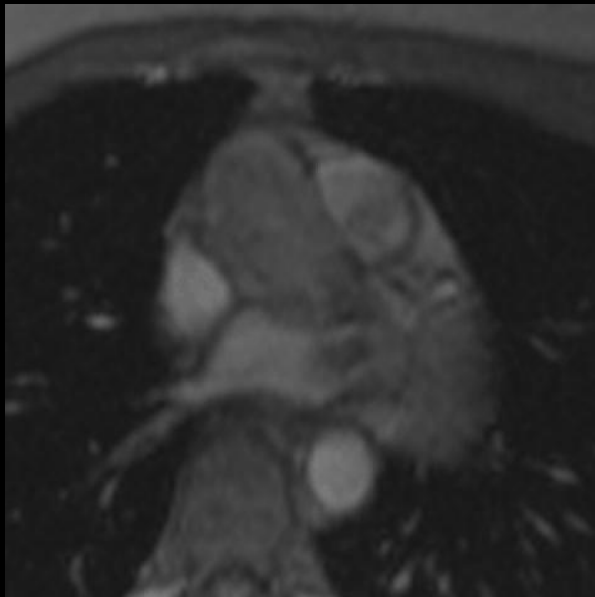


- Plano perpendicular al jet o vaso de interés
- Estimación de la velocidad
- **Cuantificación del flujo**



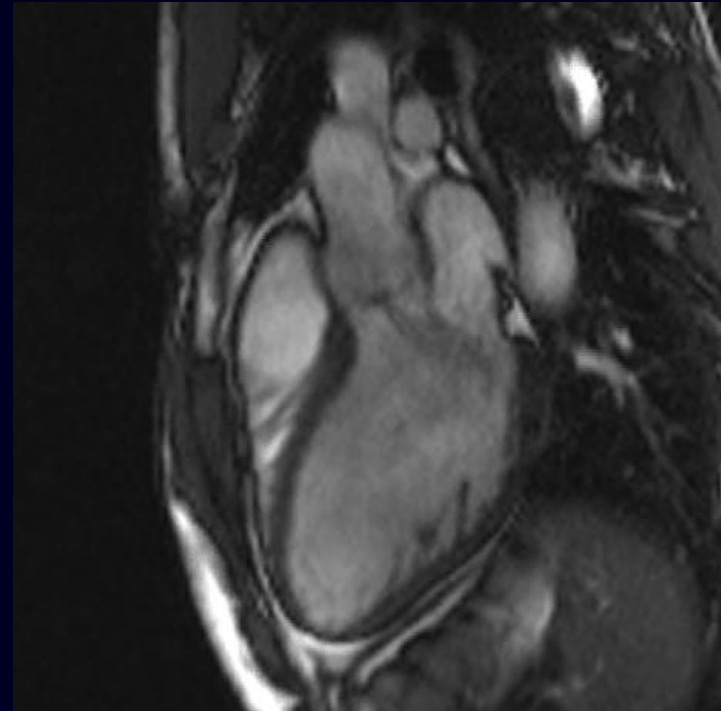
Cuantificación del flujo

- Codificación a través del plano (*through-plane*)
- Perpendicular al vaso o jet de interés
- No se permite una desviación $>15^{\circ}$ - 20° del plano perpendicular



CRM en las valvulopatías: ¿tiene utilidad clínica?

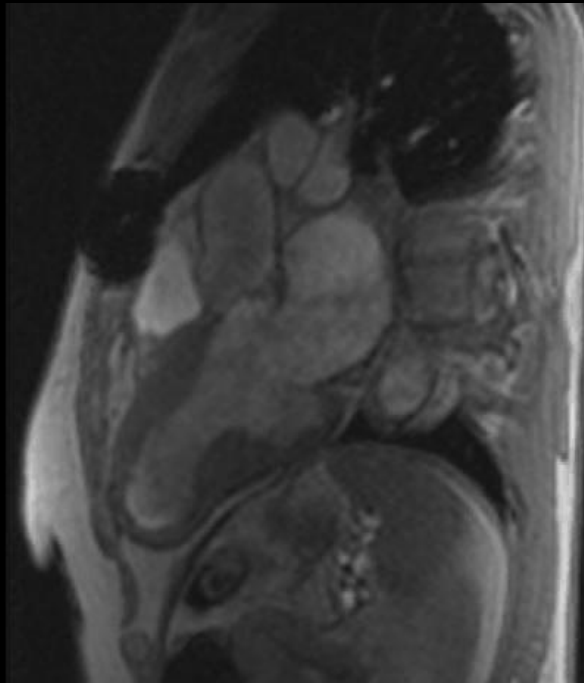
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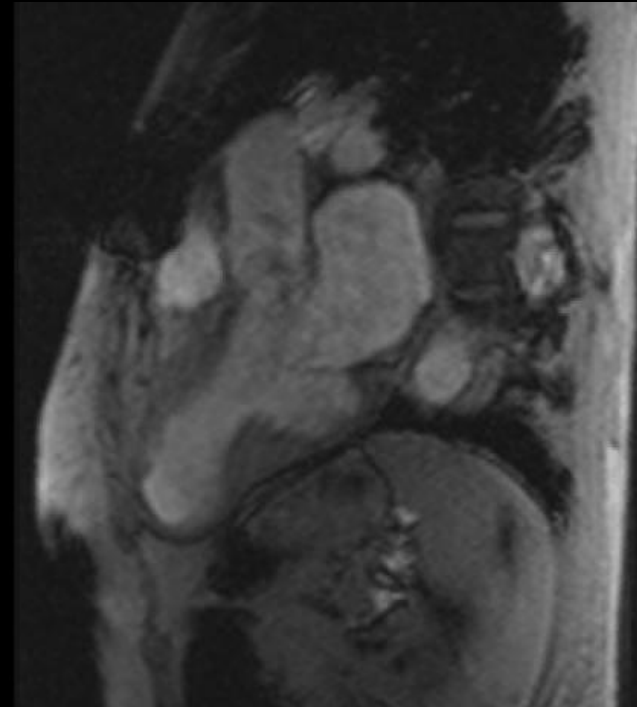
Análisis cualitativo

Muchas limitaciones

- Variable con flip angle, **TE**, TR, ancho de banda
- Tamaño pixel, grosor de corte
- Orificio de regurgitación y tamaño de cavidades



TE: 3,4



TE: 14

Análisis semicuantitativo

Medición del vacío de señal

– Métodos

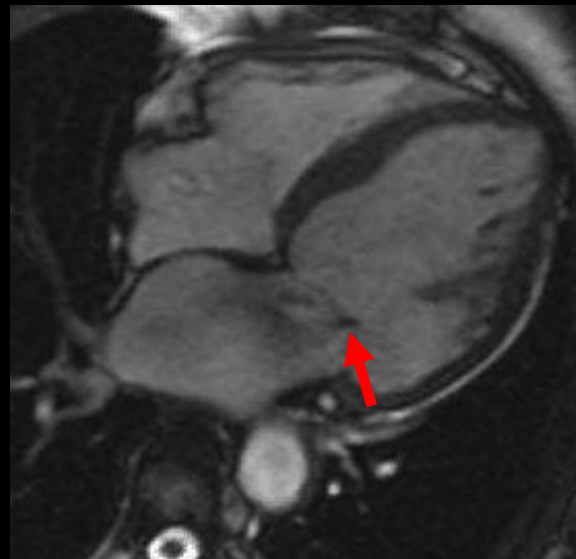
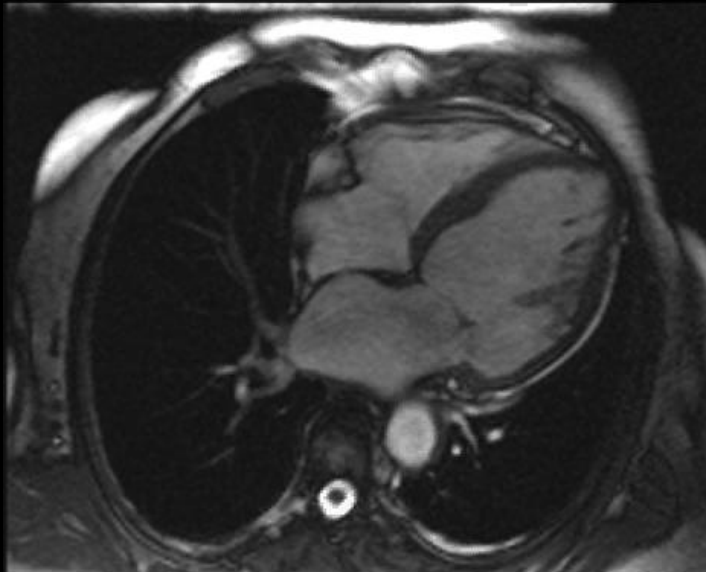
- Área o volumen del vacío de señal
- Longitud máxima del vacío de señal
- Relación área vacío de señal/área de la cavidad que recibe el jet

– Limitaciones

- TE
- Delineación manual
- Factores fisiopatológicos
- El jet regurgitante es tridimensional



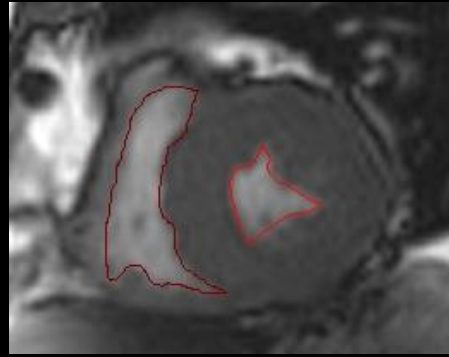
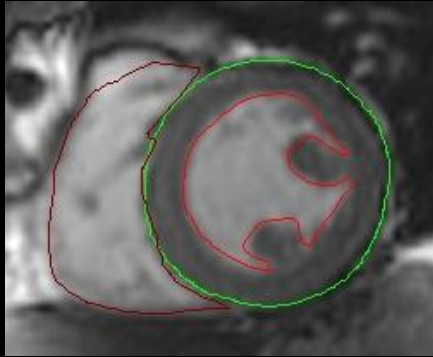
Área del vacío de
señal



Superficie proximal
de isovelocidad
(PISA)

Análisis cuantitativo

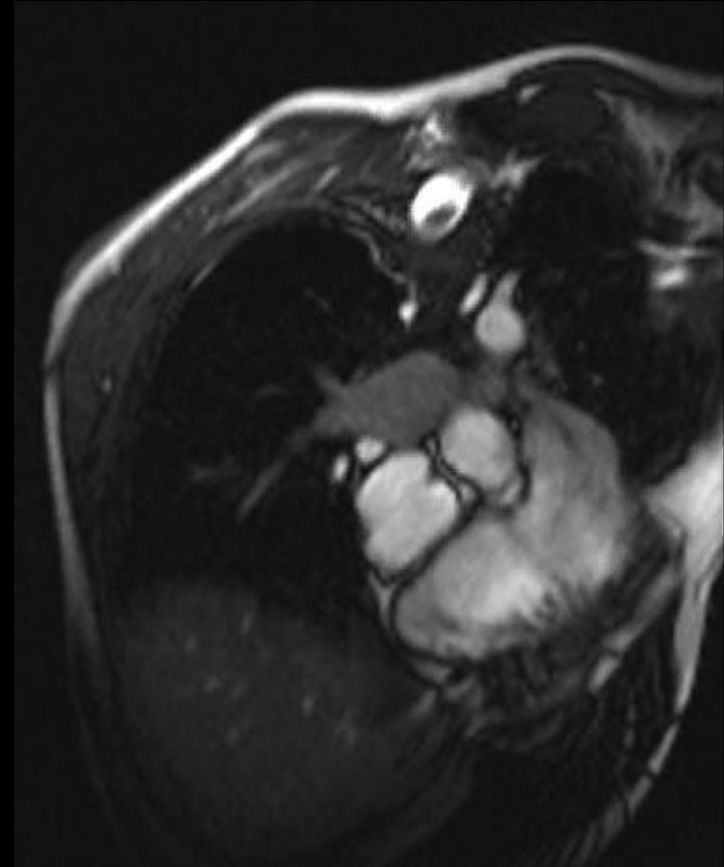
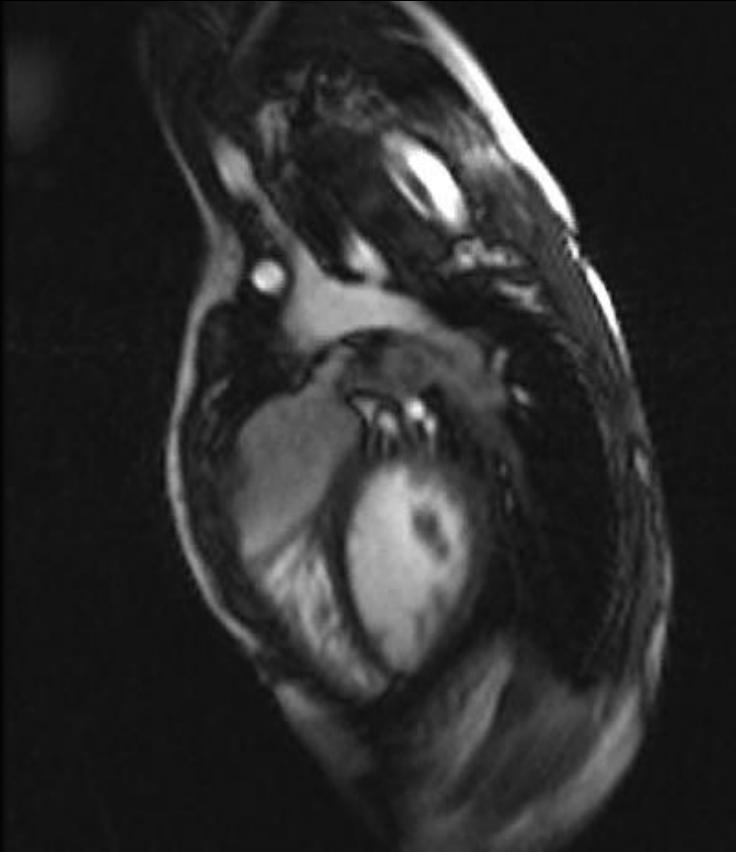
Diferencia de volúmenes ventriculares



$$VL = VTD - VTS$$

- Cálculo del volumen latido
 - Método Simpson
 - Secuencias de contraste de fase
- Únicamente válido si es una **valvulopatía aislada**
- Condiciones normales:

$$VL_{VI} = VL_{VD}$$



$$V_{reg} = V_{L_{VD}} - V_{L_{VI}}$$

$$F_{reg} = V_{reg} / V_{L_{VD}}$$

Insuficiencia

Leve: 15-20%

Moderada: 20-40%

Severa: >40%

Patient ID: 495323 Examination Date: 21/03/06
 Patient Height: ---- cm. Patient Weight: 20.00 kg. Heart Rate: 98 Beats/min

Right Ventricle - Absolute

Cardiac Function			Normal Range (F) (MRI)	Units
Ejection Fraction	EF	59.7	47.00 ... 80.00	%
End Diastolic Volume	EDV	91.1	58.00 ... 154.00	ml
End Systolic Volume	ESV	36.7	12.00 ... 68.00	ml
Stroke Volume	SV	54.3	35.00 ... 98.00	ml
Cardiac Output	CO	5.33	2.65 ... 5.98	l/min
Myocardial Mass (at ED)		47.1	24.00 ... 55.00	g
Myocardial Mass (Avg)		47.1 ± ----	24.00 ... 55.00	g

Filling and Ejection Data

Peak Ejection Rate	----	n.a.	ml/sec
Peak Ejection Time	----	n.a.	msec
Peak Filling Rate	----	n.a.	ml/sec
Peak Filling Time from ES	----	n.a.	msec

Patient ID: 495323 Examination Date: 21/03/06
 Patient Height: ---- cm. Patient Weight: 20.00 kg. Heart Rate: 98 Beats/min

Left Ventricle - Absolute

Cardiac Function			Normal Range (F) (MRI)	Units
Ejection Fraction	EF	68.4	56.00 ... 78.00	%
End Diastolic Volume	EDV	58.3	52.00 ... 141.00	ml
End Systolic Volume	ESV	18.4	13.00 ... 51.00	ml
Stroke Volume	SV	39.8	33.00 ... 97.00	ml
Cardiac Output	CO	3.90	2.65 ... 5.98	l/min
Myocardial Mass (at ED)		41.5	75.00 ... 175.00	g
Myocardial Mass (Avg)		41.5 ± ----	75.00 ... 175.00	g

Filling and Ejection Data

Peak Ejection Rate	----	n.a.	ml/sec
Peak Ejection Time	----	n.a.	msec
Peak Filling Rate	----	n.a.	ml/sec
Peak Filling Time from ES	----	n.a.	msec

$$V_{reg} = VLVD - VLVI$$

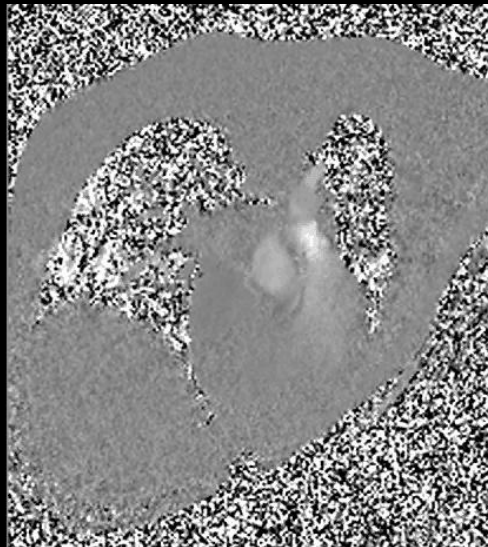
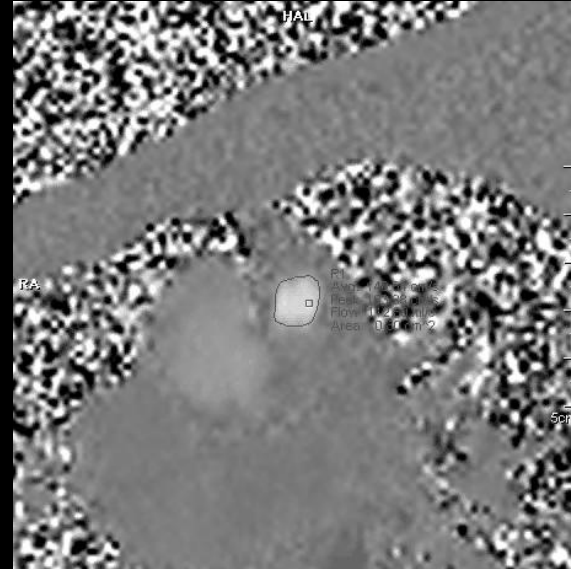
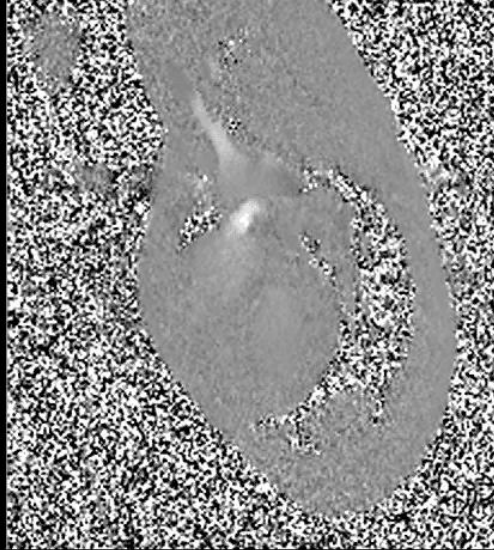
$$V_{reg}: 54,3 - 39,8 = 14,5 \text{ ml}$$

$$F_{reg} = V_{reg} / VLVD$$

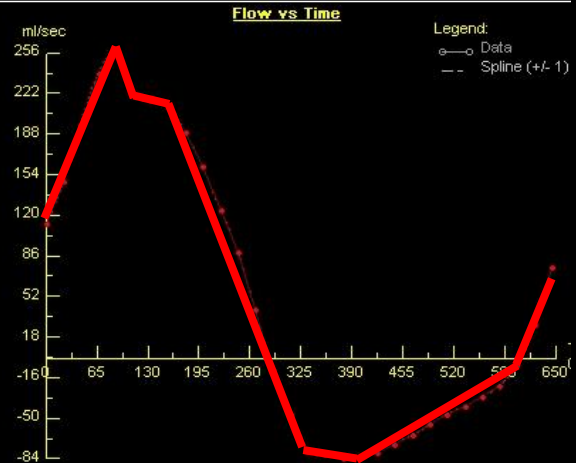
$$F_{reg}: 14,5 / 54,3 = 26,7\%$$

Análisis cuantitativo

Cuantificación de flujo



Patient ID: 495323 Examination Date: 21/03/06
Patient Height: ---- cm. Patient Weight: 20.00 kg. Heart Rate: 89 Bp



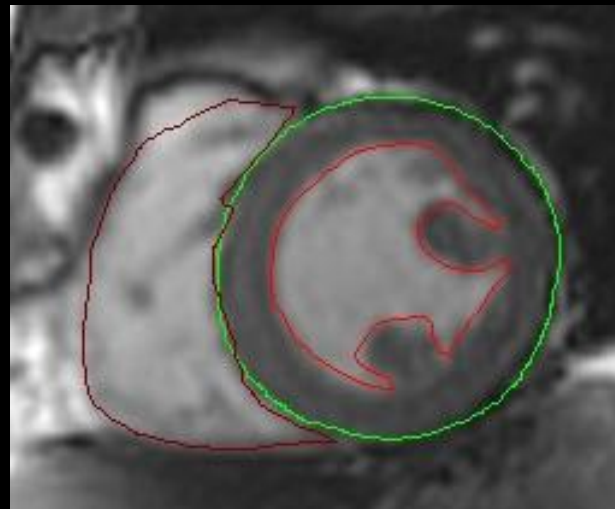
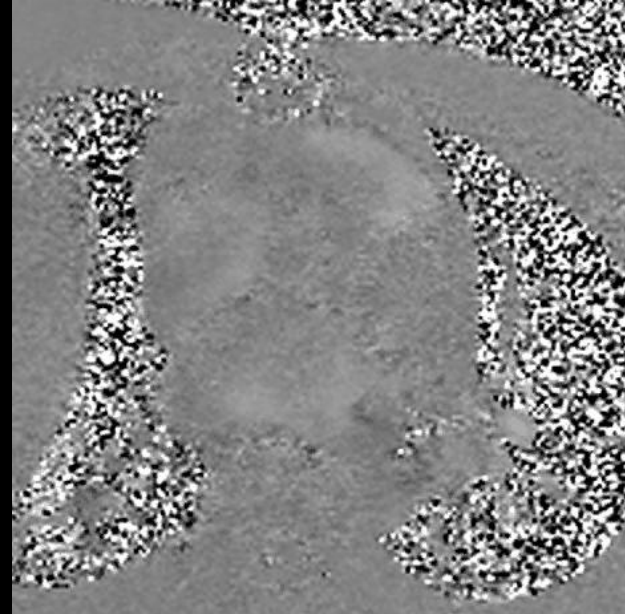
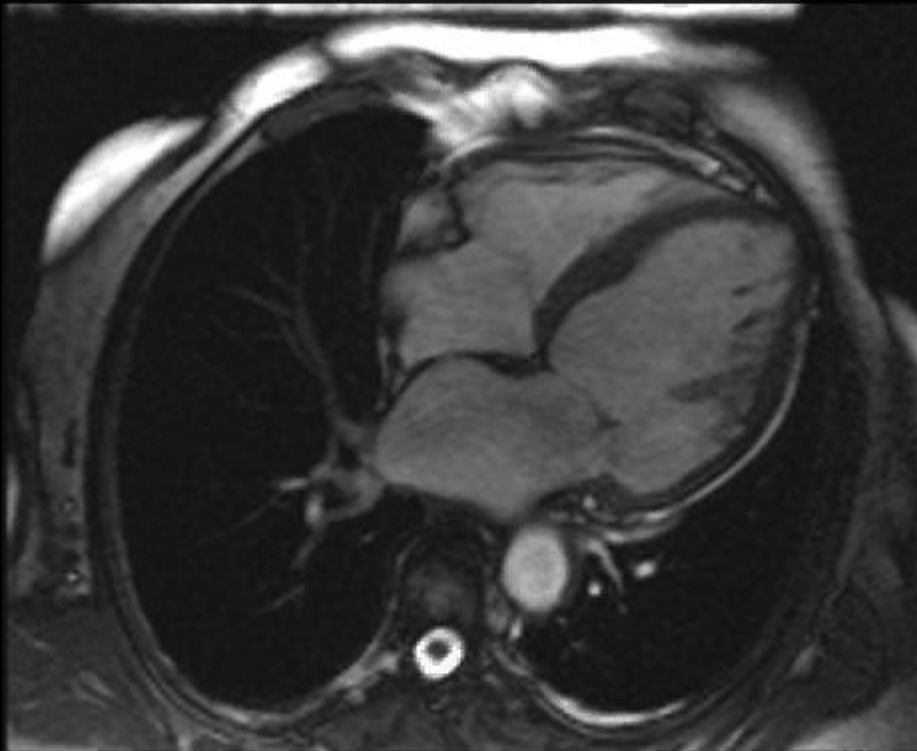
Freg= 28%

Análisis cuantitativo

Método mixto

un

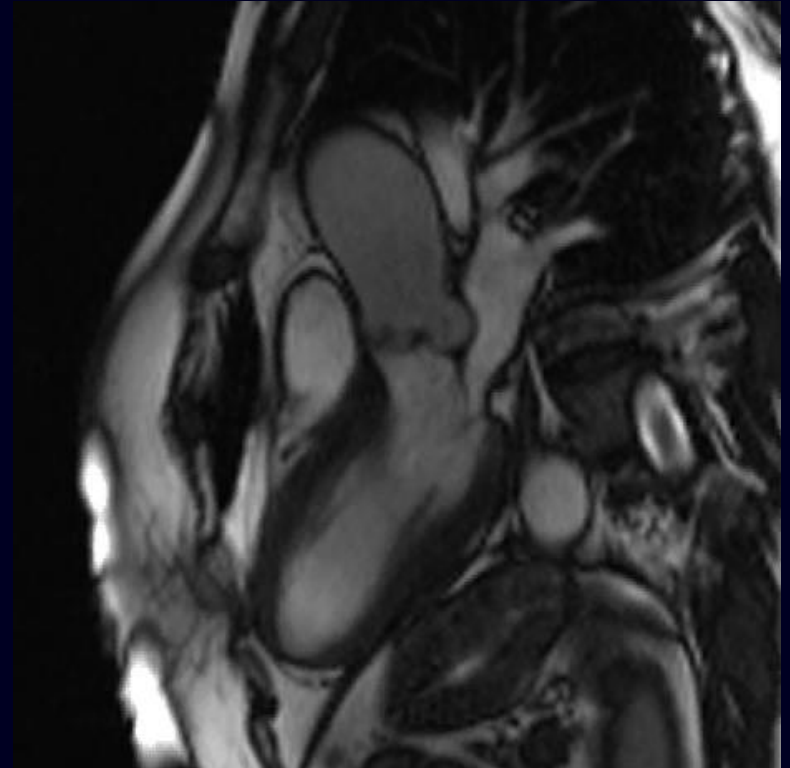
Insuficiencia



$$V_{\text{reg mitral}} = VL_{\text{cfAo}} - VL_{\text{VISimpson}}$$

CRM en las valvulopatías: ¿tiene utilidad clínica?

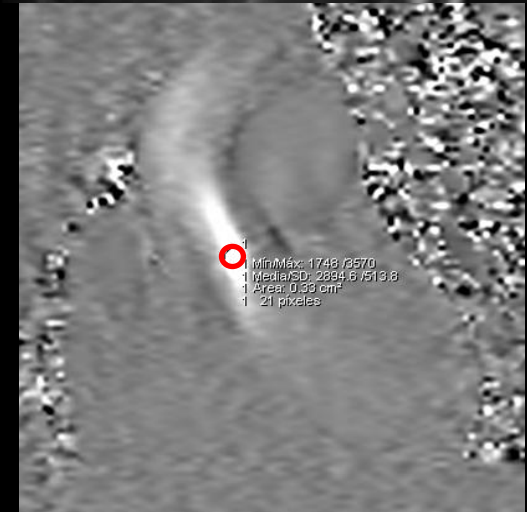
- Indicaciones CRM
- Protocolo de estudio
- Cuantificación
 - Insuficiencia valvular
 - Estenosis valvular
- TCMC en las valvulopatías



- En cualquier dirección del espacio
- Ecuación de Bernouilli modificada

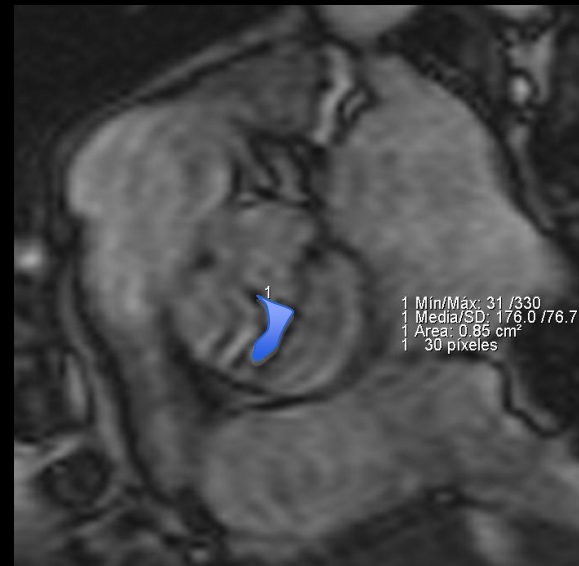
$$\Delta P = 4 \cdot v^2$$

- Buena correlación con eco-Doppler



Área valvular

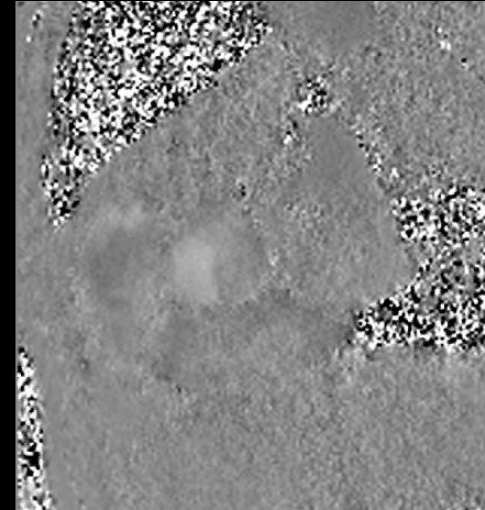
	Ecocardiografía	Cateterismo
Aórtica	Buena correlación	Mala correlación
Mitral	Sobreestima	Buena correlación



CRM en las valvulopatías: ¿tiene utilidad clínica?

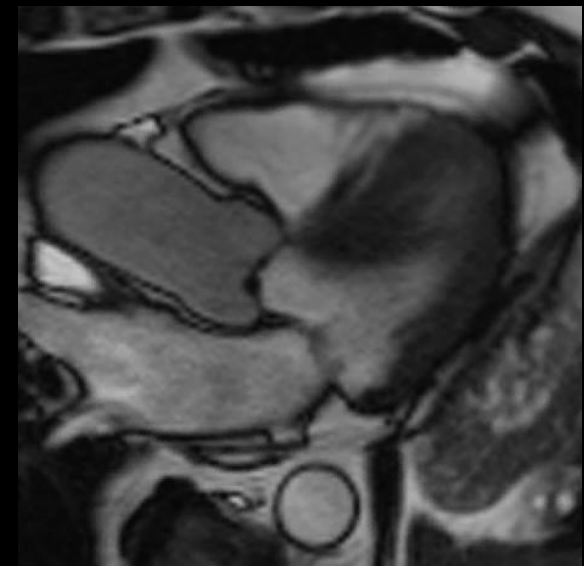
- Insuficiencia valvular

- Medición del área de vacío de señal
- Cálculo de la fracción de regurgitación mediante la medición de volúmenes ventriculares
- Contraste de fase



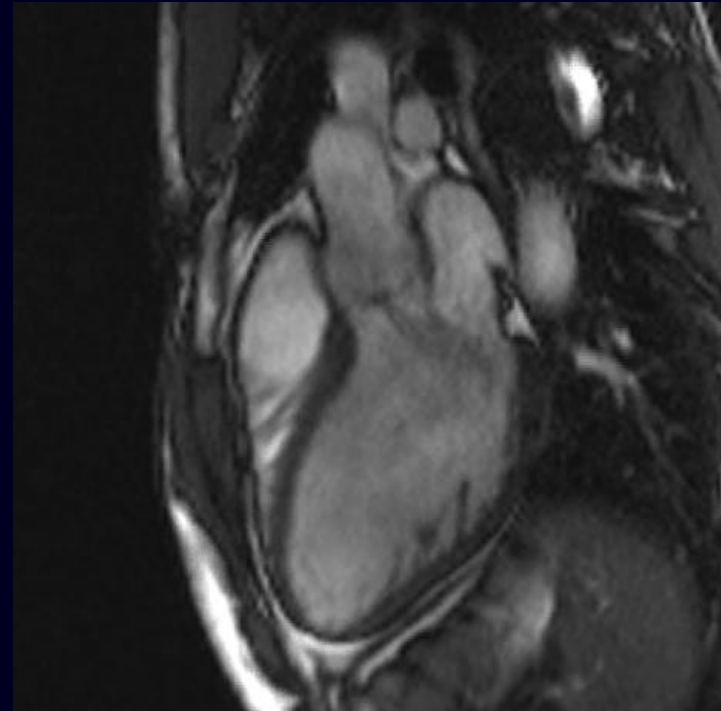
- Estenosis valvular

- Visualización del jet y hallazgos asociados
- Contraste de fase
 - Área valvular
 - Gradiente de presión transvalvular



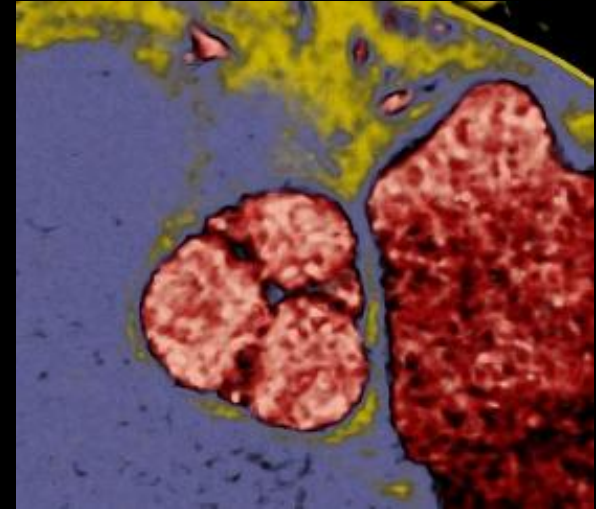
CRM en las valvulopatías: ¿tiene utilidad clínica?

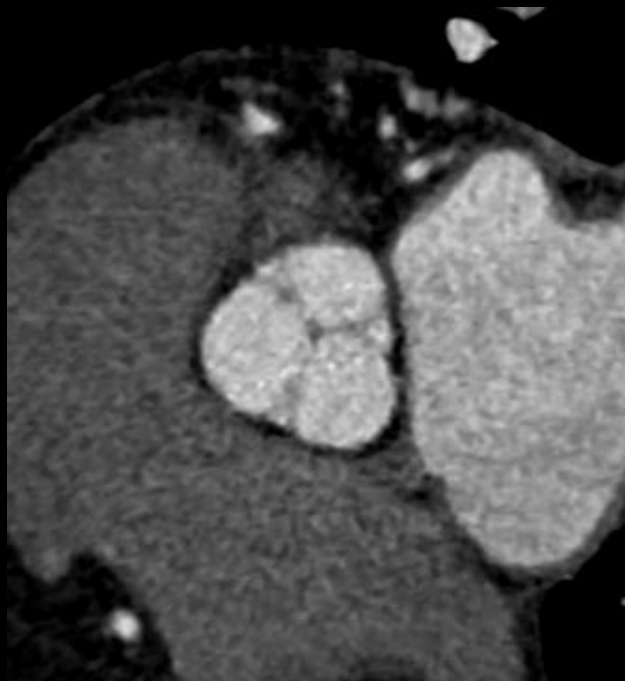
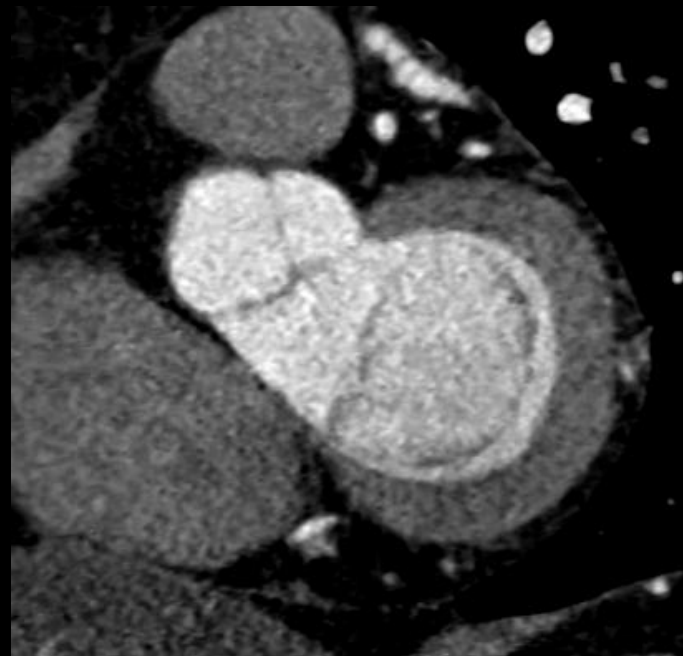
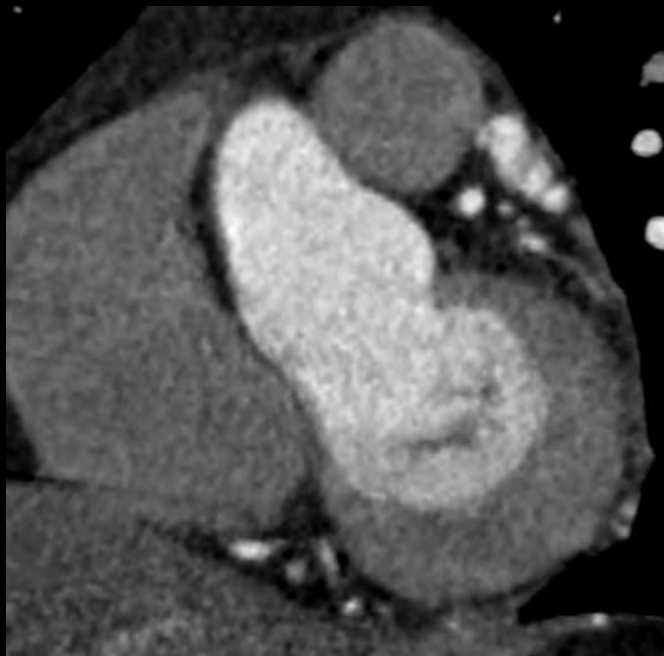
- Indicaciones CRM
- Protocolo de estudio
- Cuantificación
 - Insuficiencia valvular
 - Estenosis valvular
- TCMC en las valvulopatías



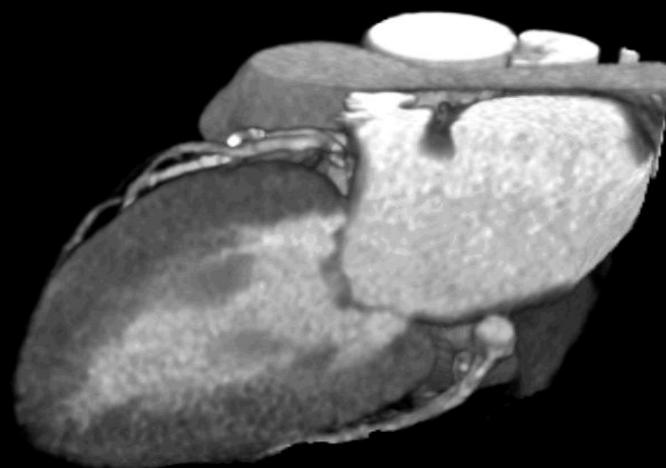
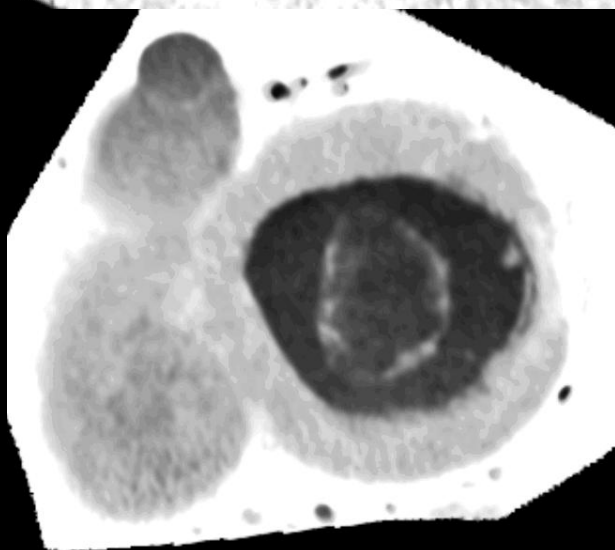
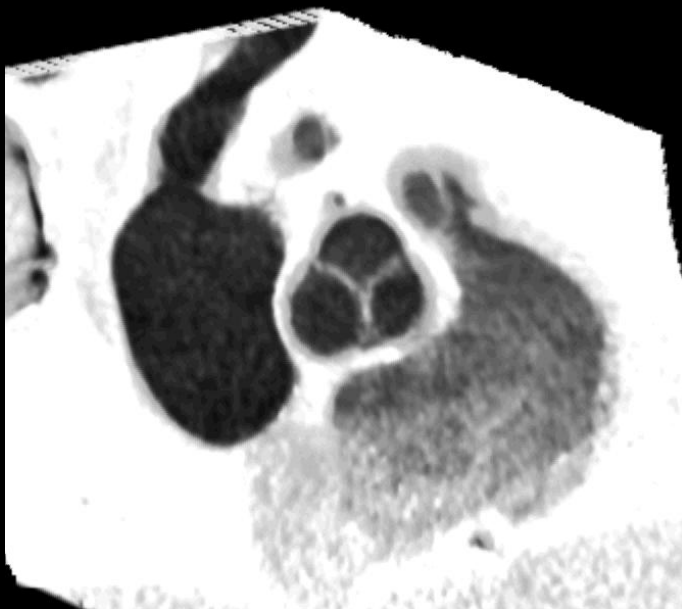
Valvulopatías y TCMC

- Número de valvas
- Grosor de las valvas
- Apertura y cierre valvular
- Calcificación de la válvula / anillo valvular





Válvulas cardíacas

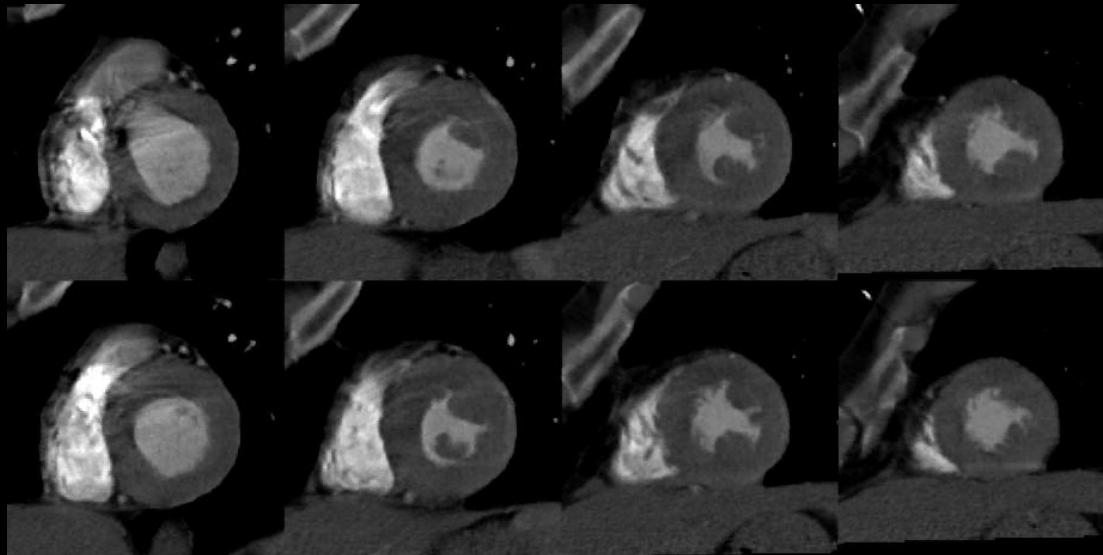


Calcificación valvular aórtica

- Calcificaciones degenerativas en > 65 años
- La calcificación se asocia a disfunción valvular
 - Monitorización de la historia natural
 - Valoración de las características morfológicas de la válvula
 - Estudio de la motilidad
- La cuantificación de la calcificación de la válvula aórtica en estudio postcontraste no es exacta



- Hipertrofia ventricular izquierda
- Dilatación de aorta ascendente
- Calcificación de la válvula aórtica
- Motilidad limitada de la válvula
- Disminución del área de apertura valvular



Cuantificación de valvulopatía mediante TCMC

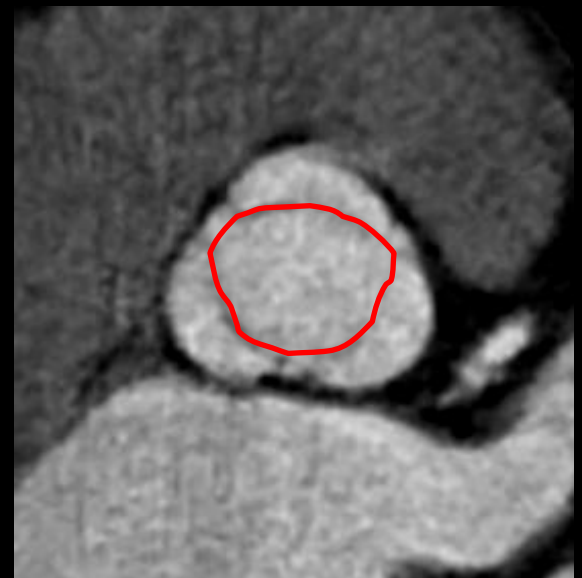
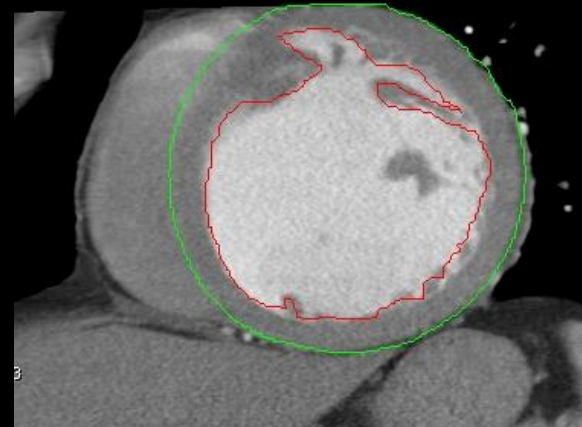
Cuantificación

- Volumen regurgitante
 - Si disfunción valvular única
 - Por diferencia del volumen latido

- Estenosis valvular
 - Área de apertura valvular

343

17



Appropriate Use Criteria

ACCF/SCCT/ACR/AHA/ASE/ASNC/SCAI/SCMR 2010

Appropriate Use Criteria for Cardiac Computed Tomography

A Report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, the Society of Cardiovascular Computed Tomography, the American College of Radiology, the American Heart Association, the American Society of Echocardiography, the American Society of Nuclear Cardiology, the Society for Cardiovascular Angiography and Interventions, and the Society for Cardiovascular Magnetic Resonance

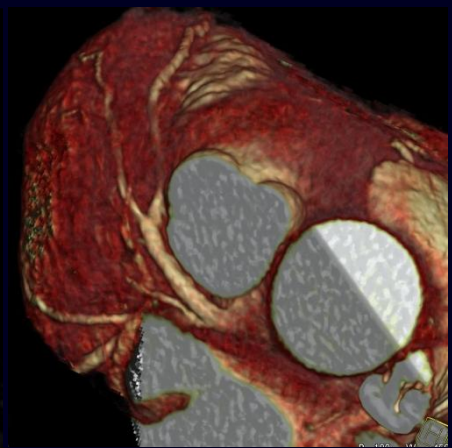
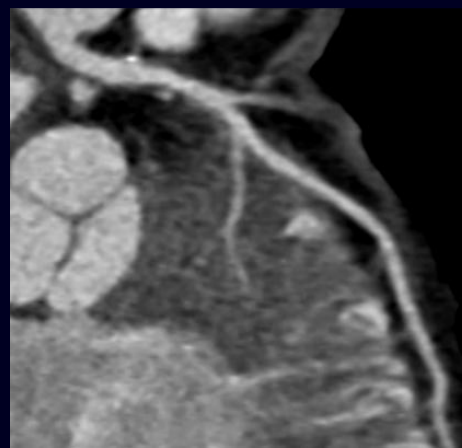


Table 8. Appropriate Indications (Median Score 7-9)

Indication	Appropriate Use Score (1-9)
Detection of CAD in Symptomatic Patients Without Known Heart Disease	
Symptomatic—Nonacute Symptoms Possibly Representing an Ischemic Equivalent	
1. • ECG interpretable AND • Able to exercise • Intermediate pretest probability of CAD	A (7)
2. • ECG uninterpretable or unable to exercise • Low pretest probability of CAD	A (7)
2. • ECG uninterpretable or unable to exercise • Intermediate pretest probability of CAD	A (8)
Detection of CAD in Symptomatic Patients Without Known Heart Disease	
Symptomatic—Acute Symptoms With Suspicion of ACS (Urgent Presentation)	
6. • Normal ECG and cardiac biomarkers • Low pretest probability of CAD	A (7)
6. • Normal ECG and cardiac biomarkers • Intermediate pretest probability of CAD	A (7)
7. • ECG uninterpretable • Low pretest probability of CAD	A (7)
7. • ECG uninterpretable • Intermediate pretest probability of CAD	A (7)
8. • Nondiagnostic ECG or equivocal cardiac biomarkers • Low pretest probability of CAD	A (7)
8. • Nondiagnostic ECG or equivocal cardiac biomarkers • Intermediate pretest probability of CAD	A (7)
Detection of CAD/Risk Assessment in Asymptomatic Individuals Without Known CAD—Noncontrast CT for CCS	
9. • Family history of premature CHD • Low global CHD risk estimate	A (7)
10. • Asymptomatic • No known CAD • Intermediate global CHD risk estimate	A (7)
Detection of CAD in Other Clinical Scenarios—New-Onset or Newly Diagnosed Clinical HF and No Prior CAD	
13. • Reduced left ventricular ejection fraction • Low pretest probability of CAD	A (7)
13. • Reduced left ventricular ejection fraction • Intermediate pretest probability of CAD	A (7)
Detection of CAD in Other Clinical Scenarios—Preoperative Coronary Assessment Prior to Noncoronary Cardiac Surgery	
15. • Coronary evaluation before noncoronary cardiac surgery • Intermediate pretest probability of CAD	A (7)
Use of CTA in the Setting of Prior Test Results—Prior ECG Exercise Testing	
20. • Normal ECG exercise test • Continued symptoms	A (7)
21. • Prior ECG exercise testing • Duke Treadmill Score—Intermediate risk findings	A (7)
Use of CTA in the Setting of Prior Test Results—Sequential Testing After Stress Imaging Procedures	
22. • Discordant ECG exercise and imaging results	A (8)
23. • Stress imaging results: equivocal	A (8)
Use of CTA in the Setting of Prior Test Results—Prior CCS	
26. • Diagnostic impact of coronary calcium on the decision to perform contrast CTA in asymptomatic patients • CCS <100	A (8)
26. • Diagnostic impact of coronary calcium on the decision to perform contrast CTA in symptomatic patients • CCS 100-400	A (8)
Use of CTA in the Setting of Prior Test Results—Evaluation of New or Worsening Symptoms in the Setting of Past Stress Imaging Study	
29. • Previous stress imaging study normal	A (8)
Risk Assessment Postrevascularization (PCI or CABG)—Symptomatic (Ischemic Equivalent)	
39. • Evaluation of graft patency after CABG	A (8)



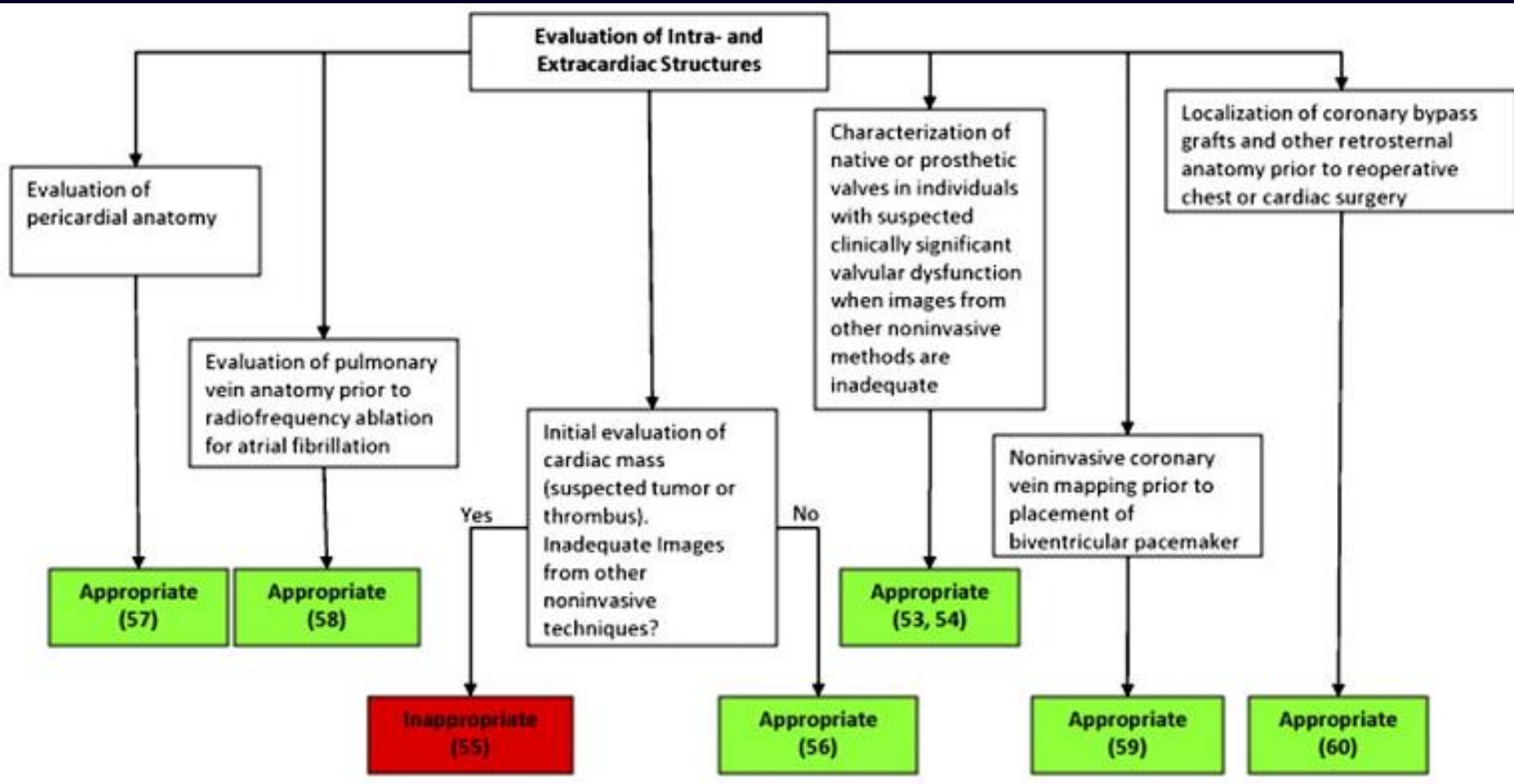
Table 8. Continued

Indication	Appropriate Use Score (1-9)
Risk Assessment Postrevascularization (PCI or CABG)—Asymptomatic—Prior Coronary Stenting	
43. • Prior left main coronary stent with stent diameter ≥ 3 mm	A (7)
Evaluation of Cardiac Structure and Function—Adult Congenital Heart Disease	
46. • Assessment of anomalies of coronary arterial and other thoracic arteriovenous vessels	A (9)
47. • Assessment of complex adult congenital heart disease	A (8)
Evaluation of Cardiac Structure and Function—Evaluation of Ventricular Morphology and Systolic Function	
49. • Evaluation of left ventricular function • Following acute MI or in HF patients • Inadequate images from other noninvasive methods • Quantitative evaluation of right ventricular function	A (7)
50. • Quantitative evaluation of right ventricular function	A (7)
51. • Assessment of right ventricular morphology • Suspected arrhythmogenic right ventricular dysplasia	A (7)
Evaluation of Cardiac Structure and Function—Evaluation of Intra- and Extracardiac Structures	
53. • Characterization of native cardiac valves • Suspected clinically significant valvular dysfunction • Inadequate images from other noninvasive methods	A (8)
54. • Characterization of prosthetic cardiac valves • Suspected clinically significant valvular dysfunction • Inadequate images from other noninvasive methods	A (8)
56. • Evaluation of cardiac mass (suspected tumor or thrombus) • Inadequate images from other noninvasive methods	A (8)
57. • Evaluation of pericardial anatomy	A (8)
58. • Evaluation of pulmonary vein anatomy • Prior to radiofrequency ablation for atrial fibrillation	A (8)
59. • Invasive coronary vein mapping • Prior to placement of biventricular pacemaker	A (8)
60. • Localization of coronary bypass grafts and other retrosternal anatomy • Prior to reoperative chest or cardiac surgery	A (8)

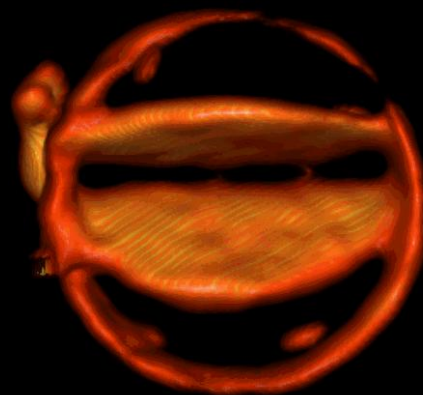


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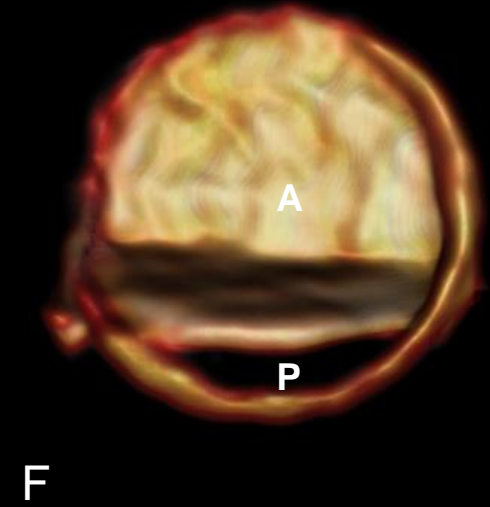
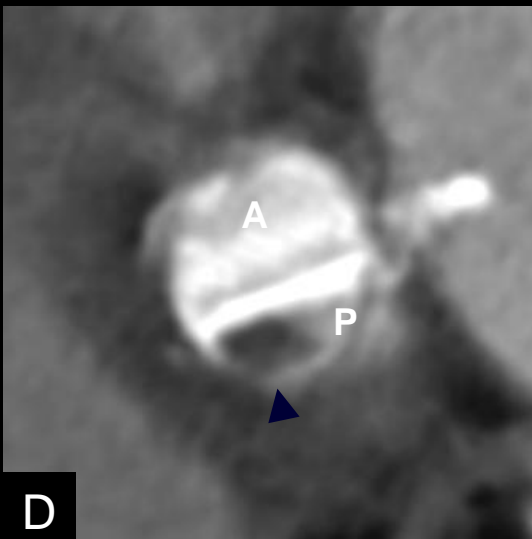
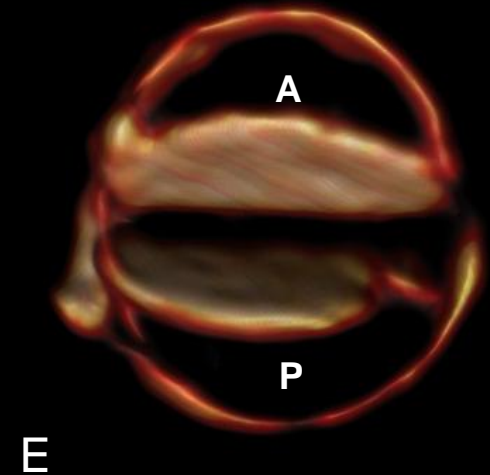
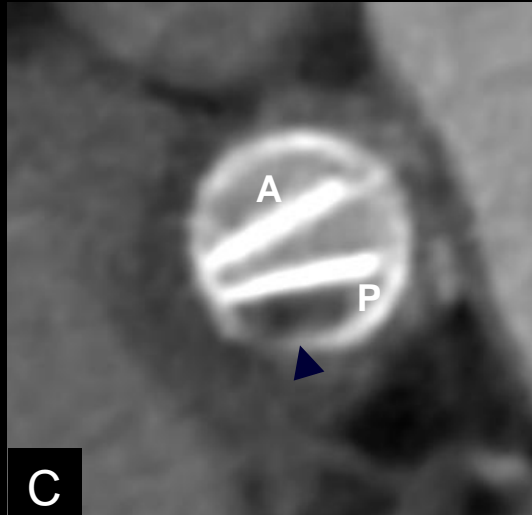
Evaluation of cardiac structure and function



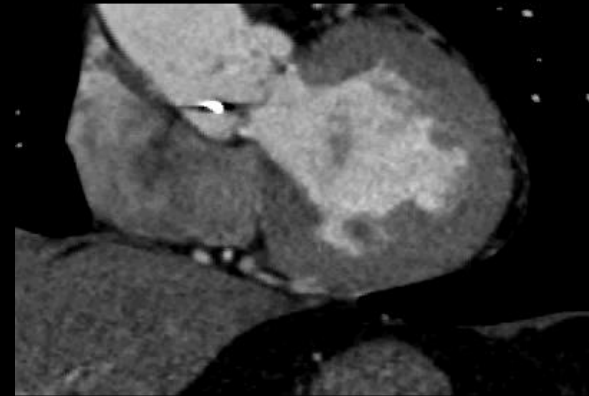
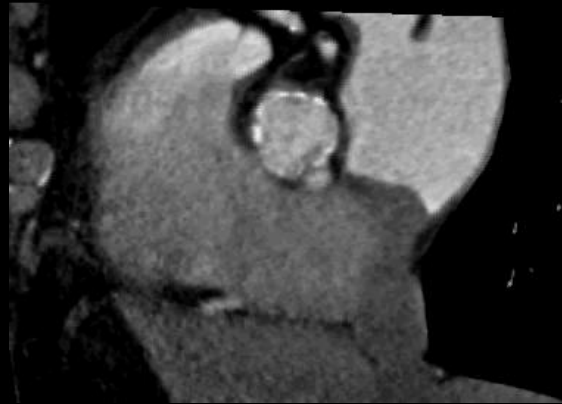
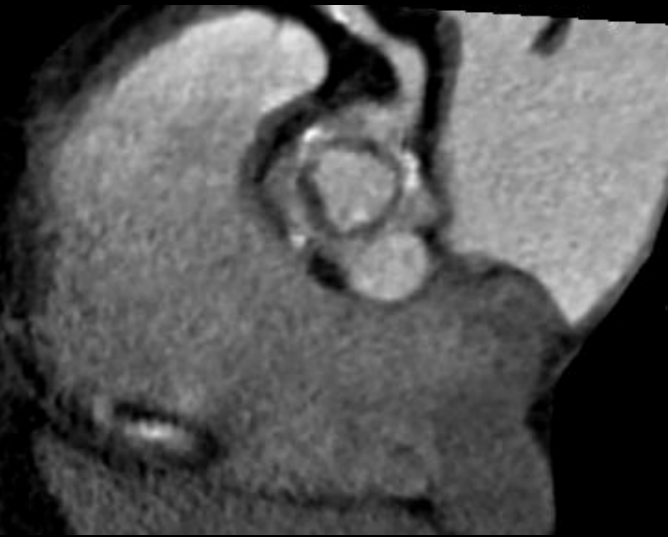
Valvulopatía



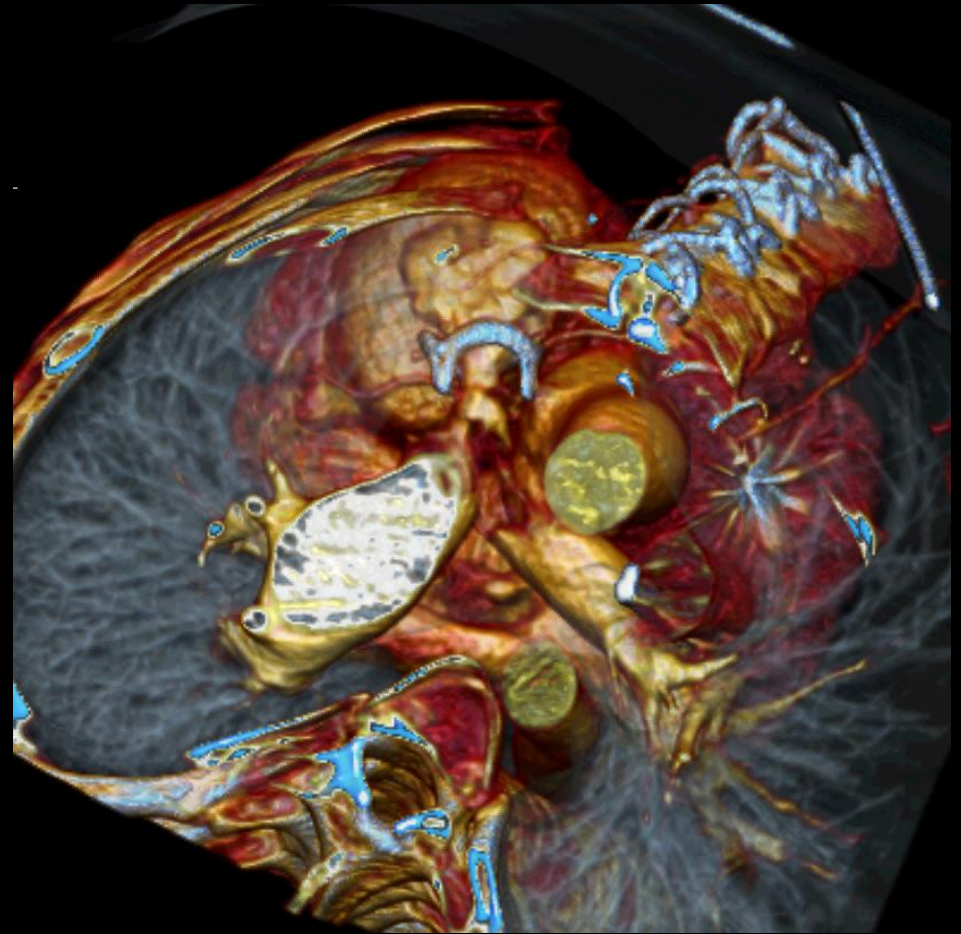
Prótesis valvular



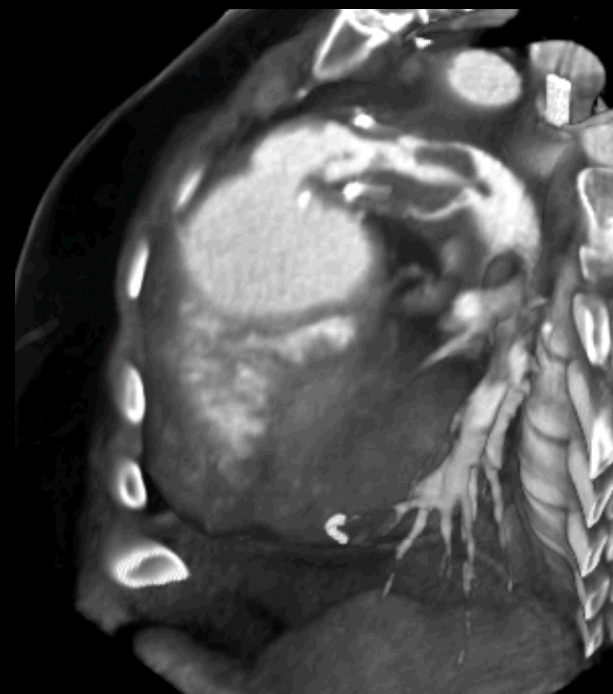
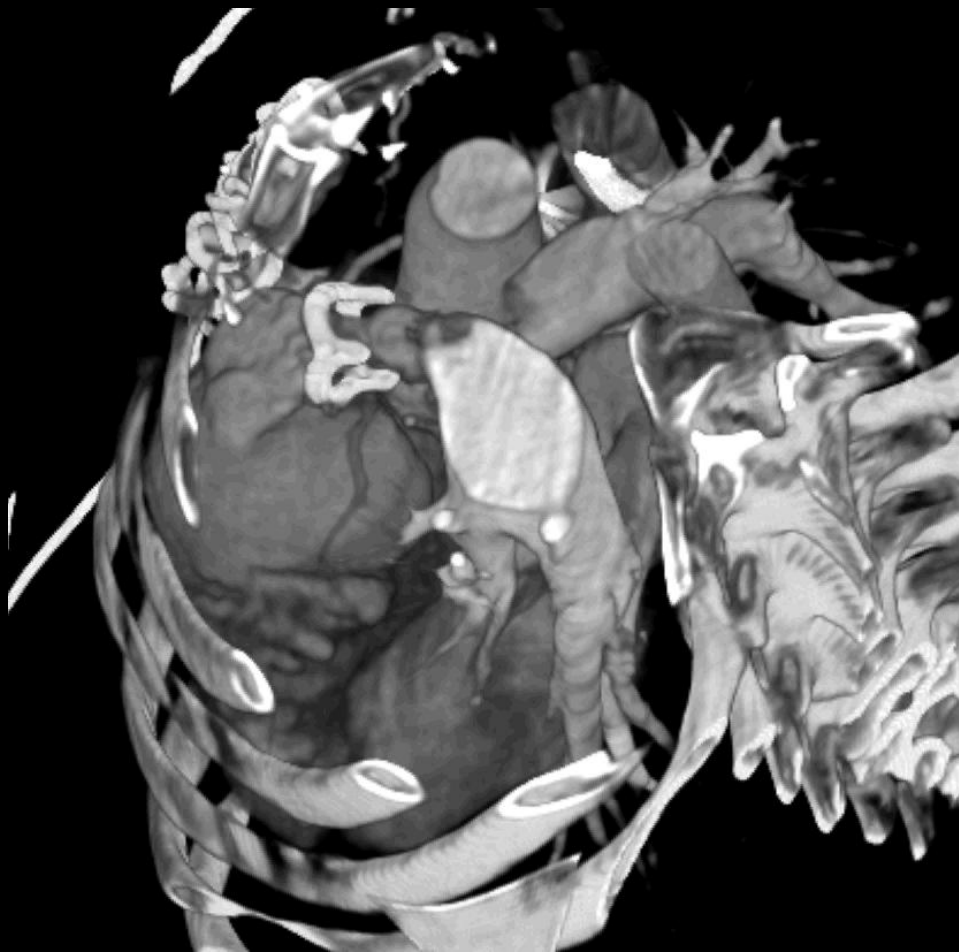
Valvulopatía



Trombosis – endocarditis



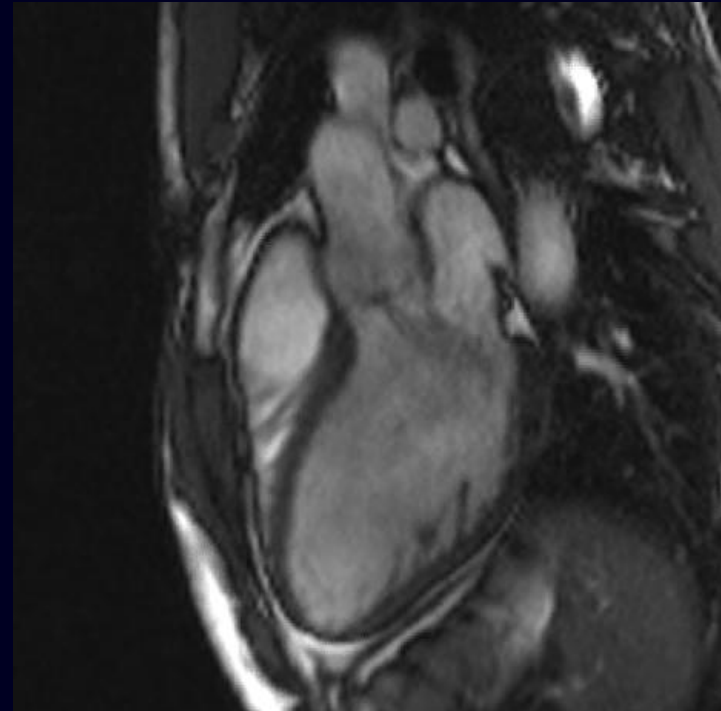
Trombosis – endocarditis



Parámetros	TCMC	RM
Resolución espacial	0,4 – 0,6 mm	1 – 2 mm
Resolución temporal	83 – 65 ms	30 – 60 ms
Anatomía valvular	Excelente	Buena
Función valvular	Semicuantitativo	Cualitativo, semicuantitativo y cuantitativo
Tiempo de adquisición	8 -10 s	<i>In plane:</i> 17 s <i>Through plane:</i> 3 min
Visualización	Contraste iv	SSFP
Limitaciones	Arritmia Alergia contraste Insuficiencia renal	Claustrofobia Apnea Marcapasos, etc.
Interpretación	10 minutos	7 minutos
Radiación	Sí	No

CRM en las valvulopatías: ¿tiene utilidad clínica?

- Indicaciones CRM
- Protocolo de estudio
- Cuantificación
 - Insuficiencia valvular
 - Estenosis valvular
- TCMC en las valvulopatías



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