IRM et Scanner cardiaques: Indications en pédiatrie

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Indications partagées

- **Anatomie**

  Intracardiaque:

  - Etude pre et post-operatoire

  - Tumeurs, thrombus, péricarde

  Extracardiaque

  - Gros vaisseaux
  - Shunts et montages chirurgicaux
  - Artères coronaires proximales

Scanner vs IRM

- **Scanner**
  - ✓ *Irradiant*
  - ✓ *Examen court*
  - ✓ *Haute disponibilité*
- **IRM**
  - ✓ *Non irradiant*
  - ✓ *Examen long*
  - ✓ *Disponibilité limitée*

Indications Scanner

Anatomie

- Analyse des artères coronaires
- Détails anatomiques dans les pathologies de gros vaisseaux et rapport avec les bronches
- Etude des collatérales aorto-pulmonaires
- Etude du parenchyme pulmonaire

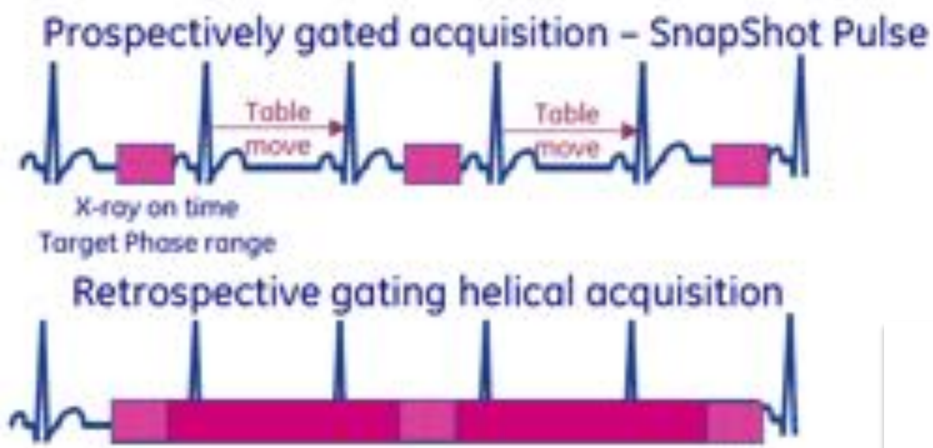
Indications Scanner

Analyse des artères coronaires

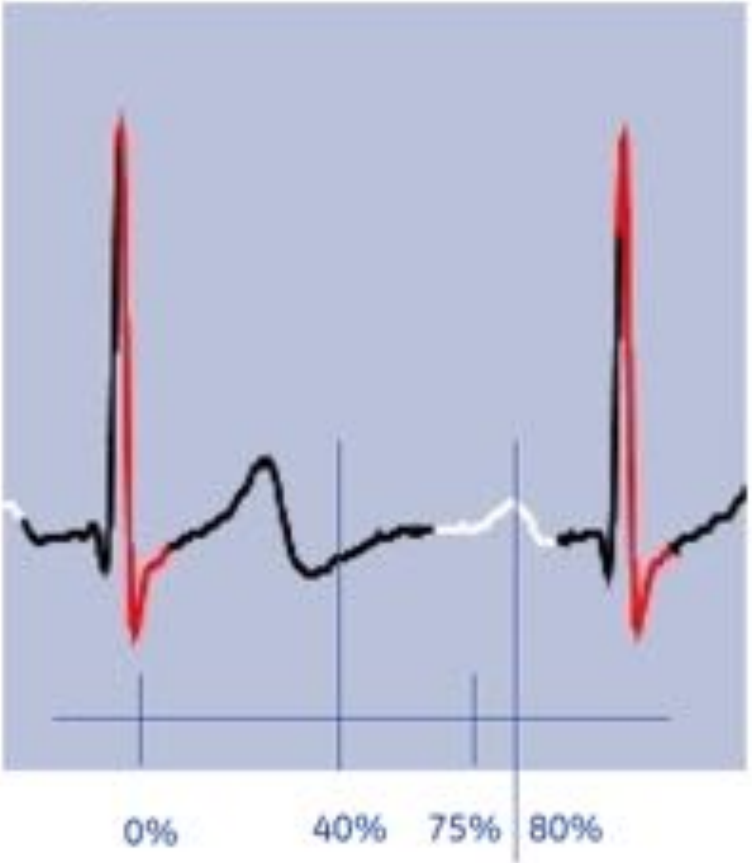
- ✓ Confirmer une anomalie coronaire vue à l'echo (ALCAPA, ARCAPA..)
- ✓ Contrôle post opératoire (anomalie coronaire, TGV)

SnapShot Pulse: How it works

- Prospective ECG gating Axial and Step & Shoot
- Real-time heart rate monitoring and gating
- Not a *single* phase; it is a phase *range*
- Dose and exposure time are heart rate independent



SnapShot Pulse: How it works



Best phases for coronary study

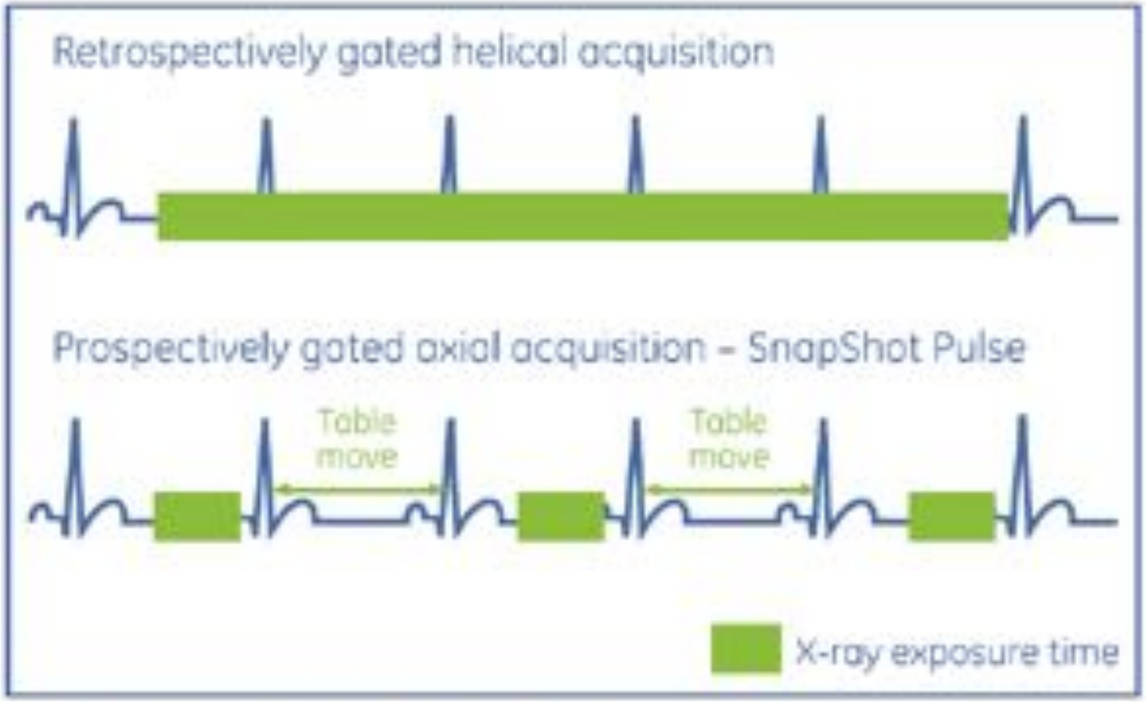
- If HR<65 bpm: best phase for RCA and LCA is 70%-80%
- If HR> 65 bpm: 80% for LCA

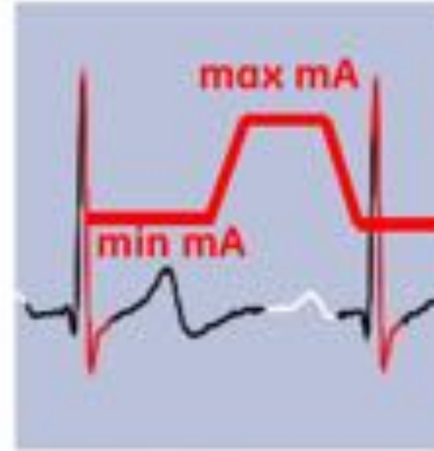
  40% for RCA

When HR is low, only diastolic phase is need for coronary artery assessment

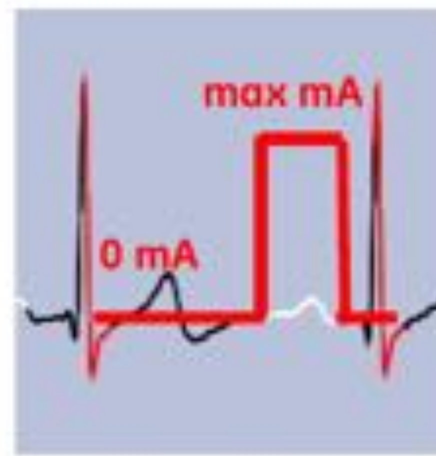
If HR is high, systolic phase is needed whatever the temporal resolution, this is physiological

Helical versus Pulse





Helical with ECG mod

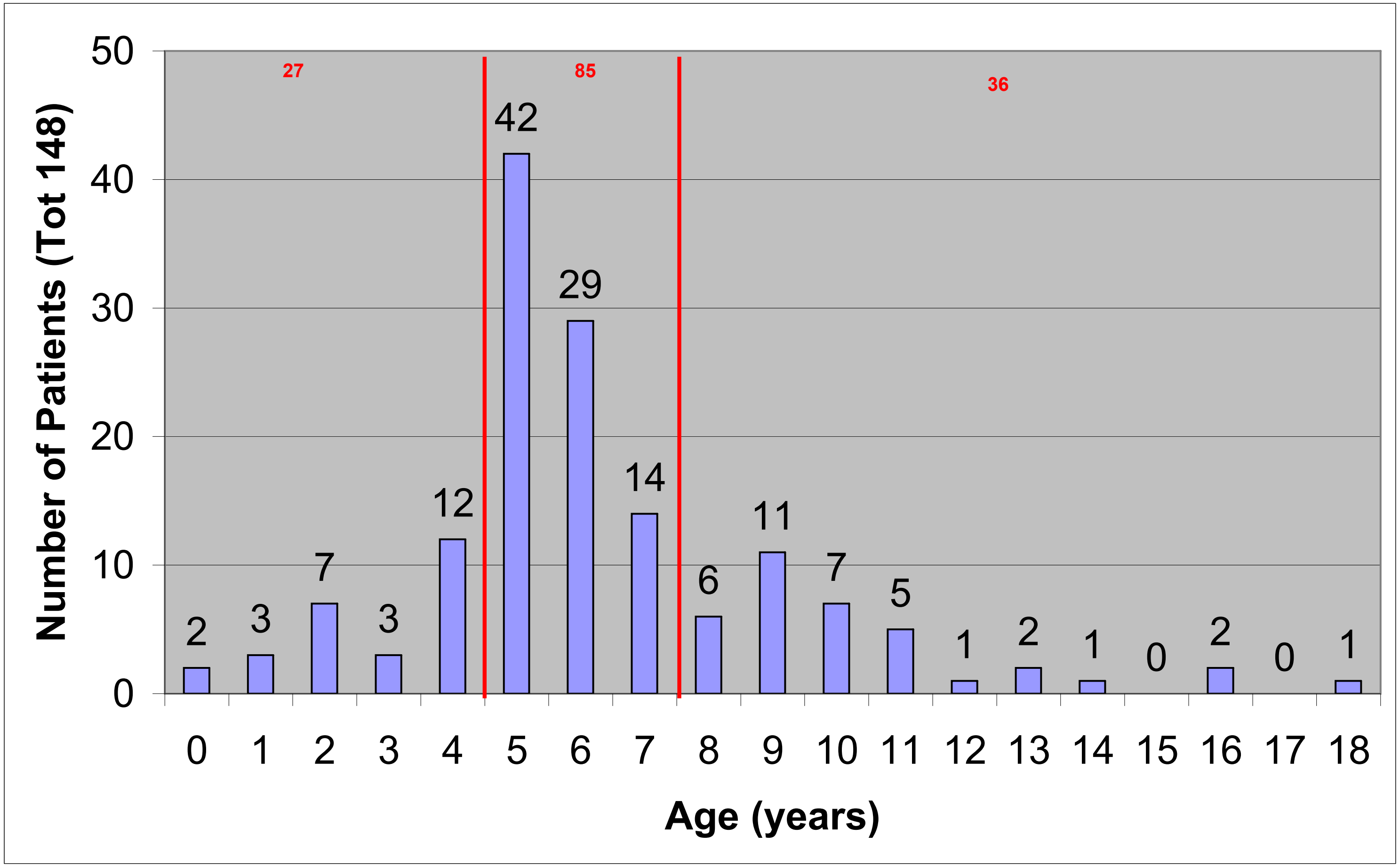


SnapShot Pulse

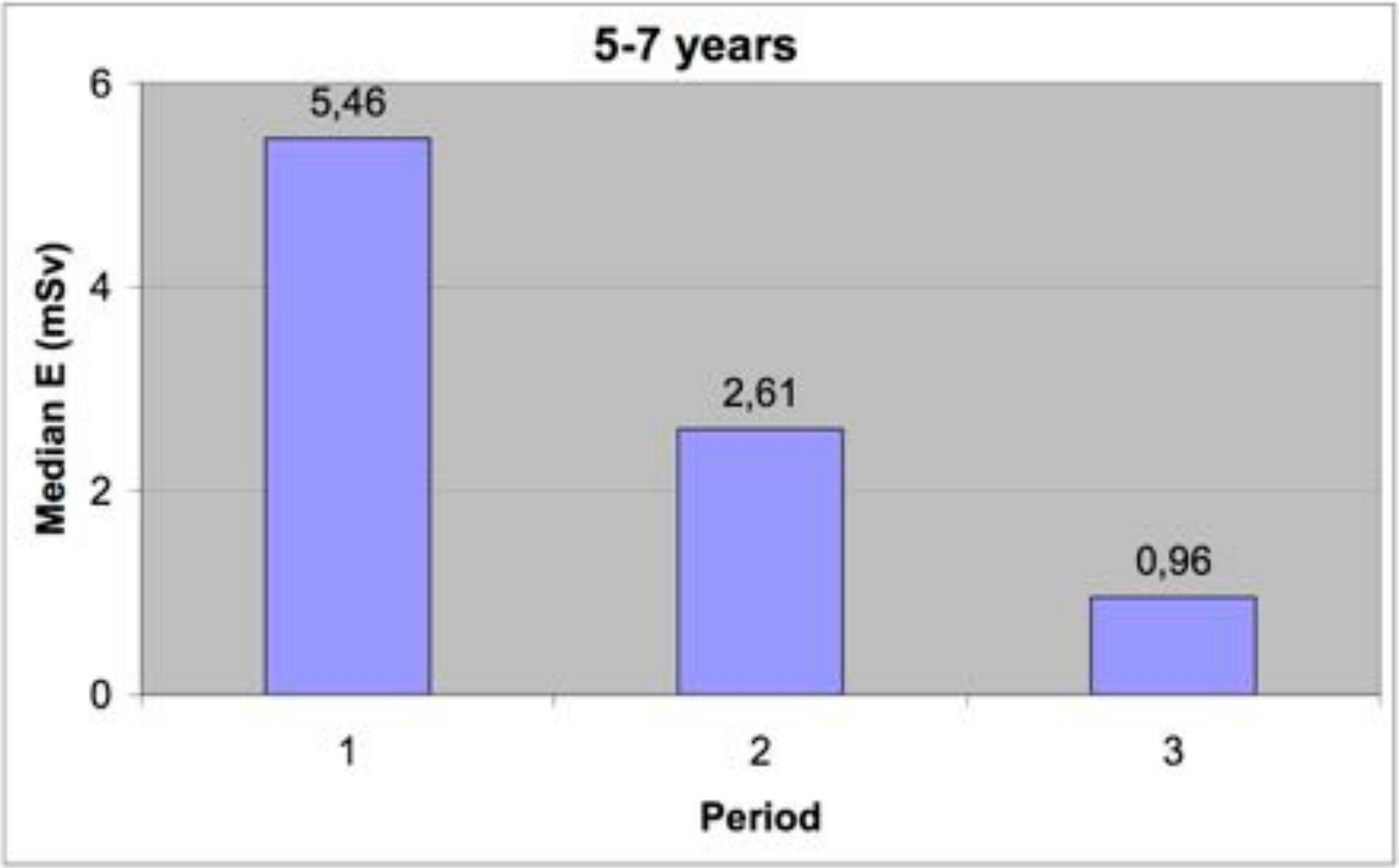
Helical: pitch 0.16-0.24 →overbeaming

S.Pulse: Axial: pitch 1→ No overbeaming

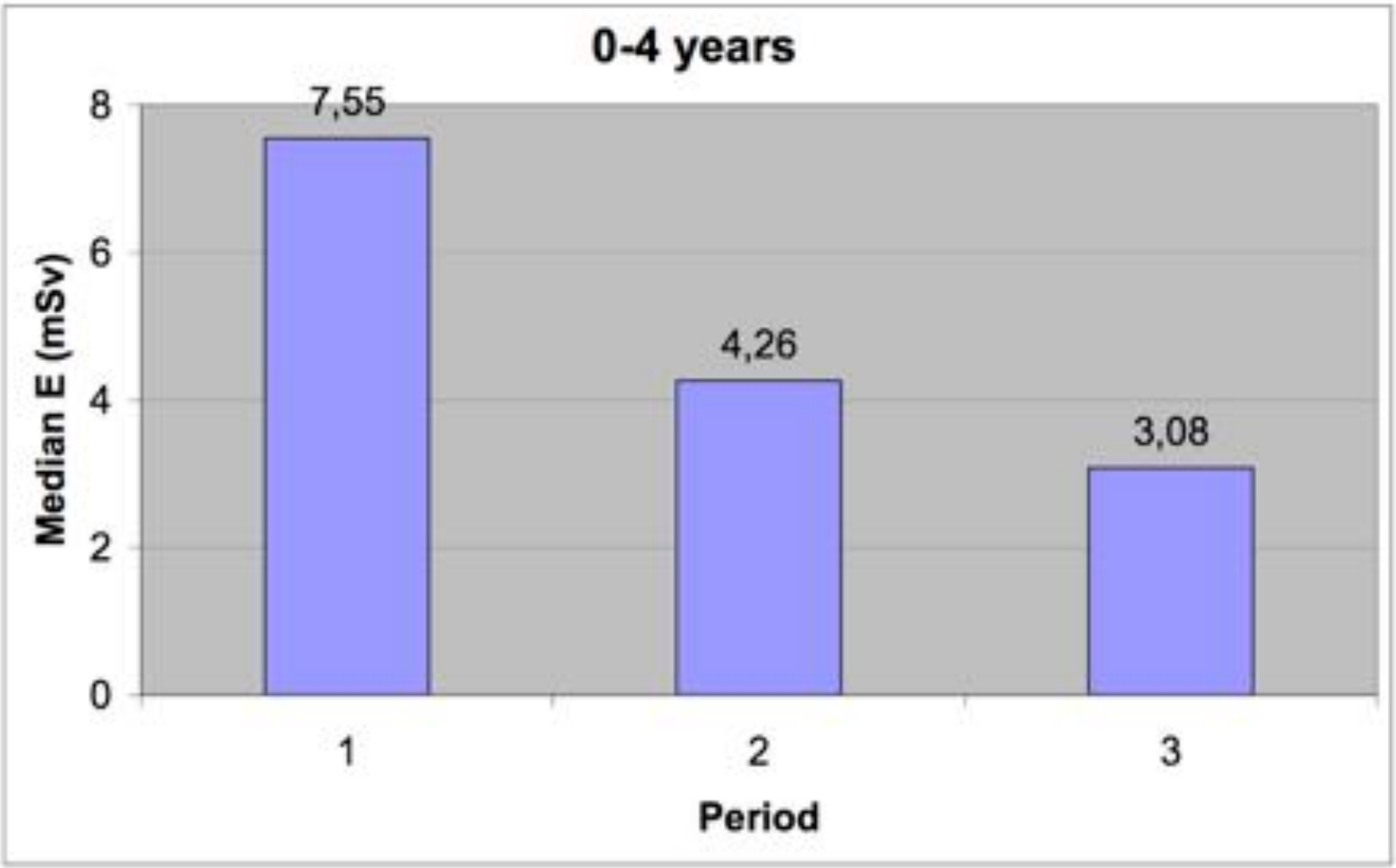
Scanner coronaire à Necker



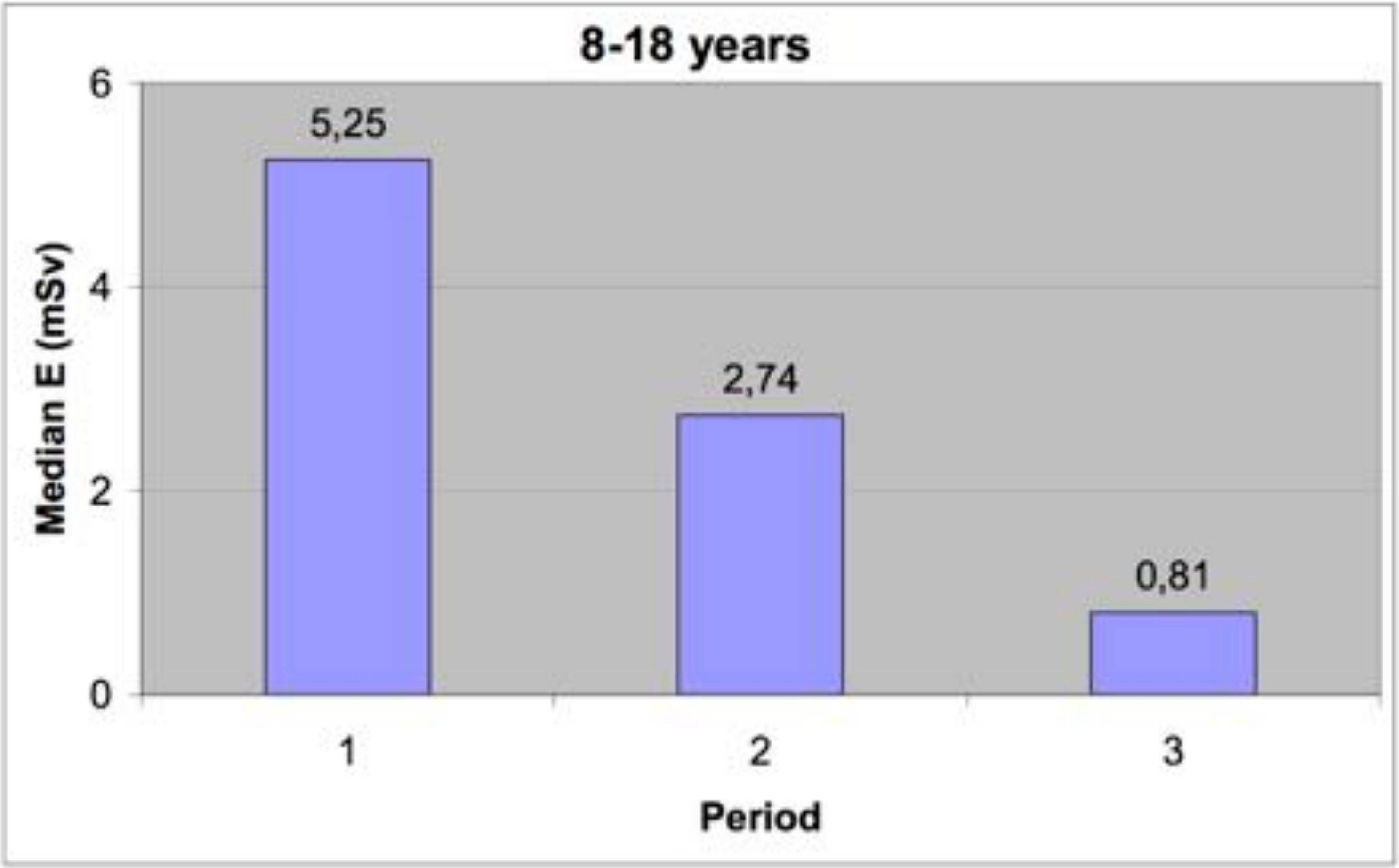
Scanner coronaire à Necker



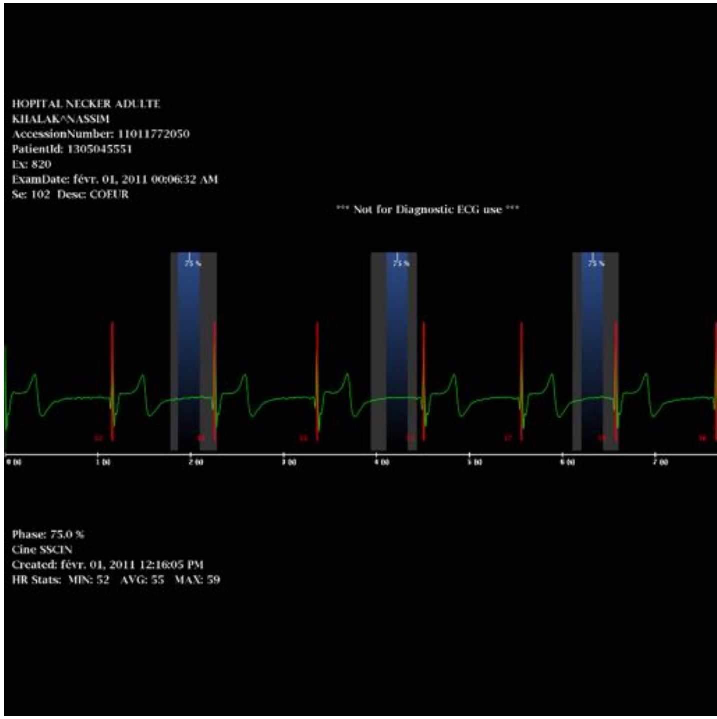
Scanner coronaire à Necker



Scanner coronaire à Necker

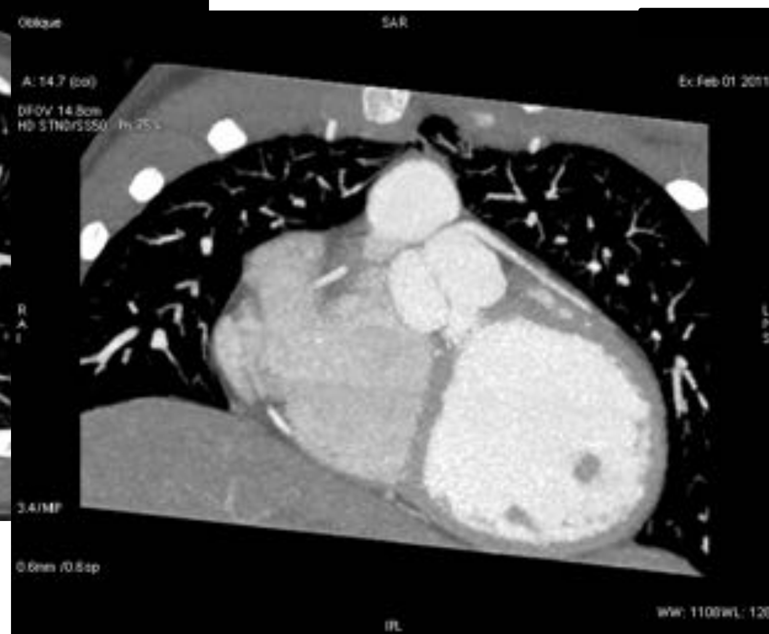


Scanner - Gating prospectif



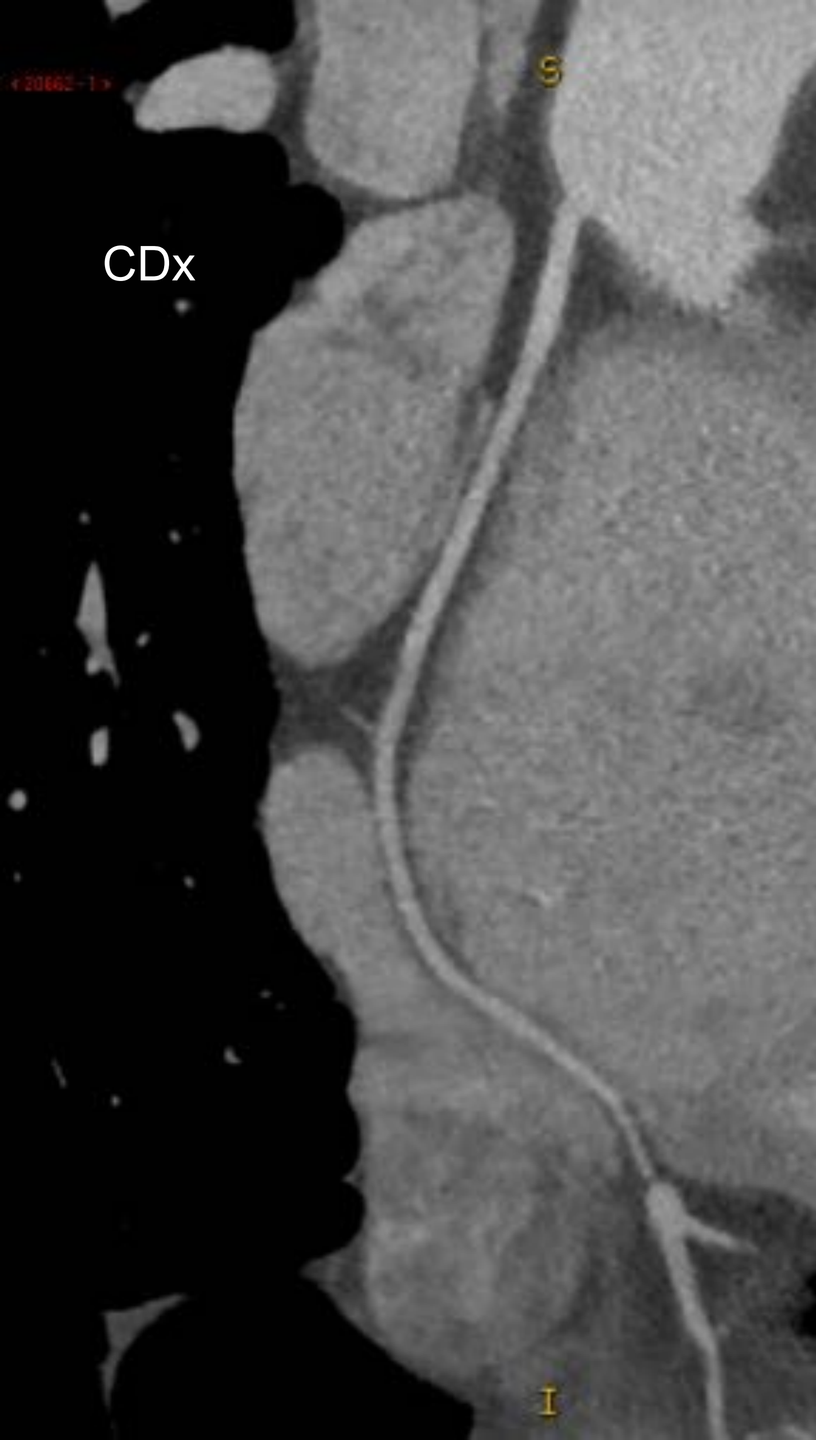
0,952 mSv


Axial
Ex:Feb 01 2011

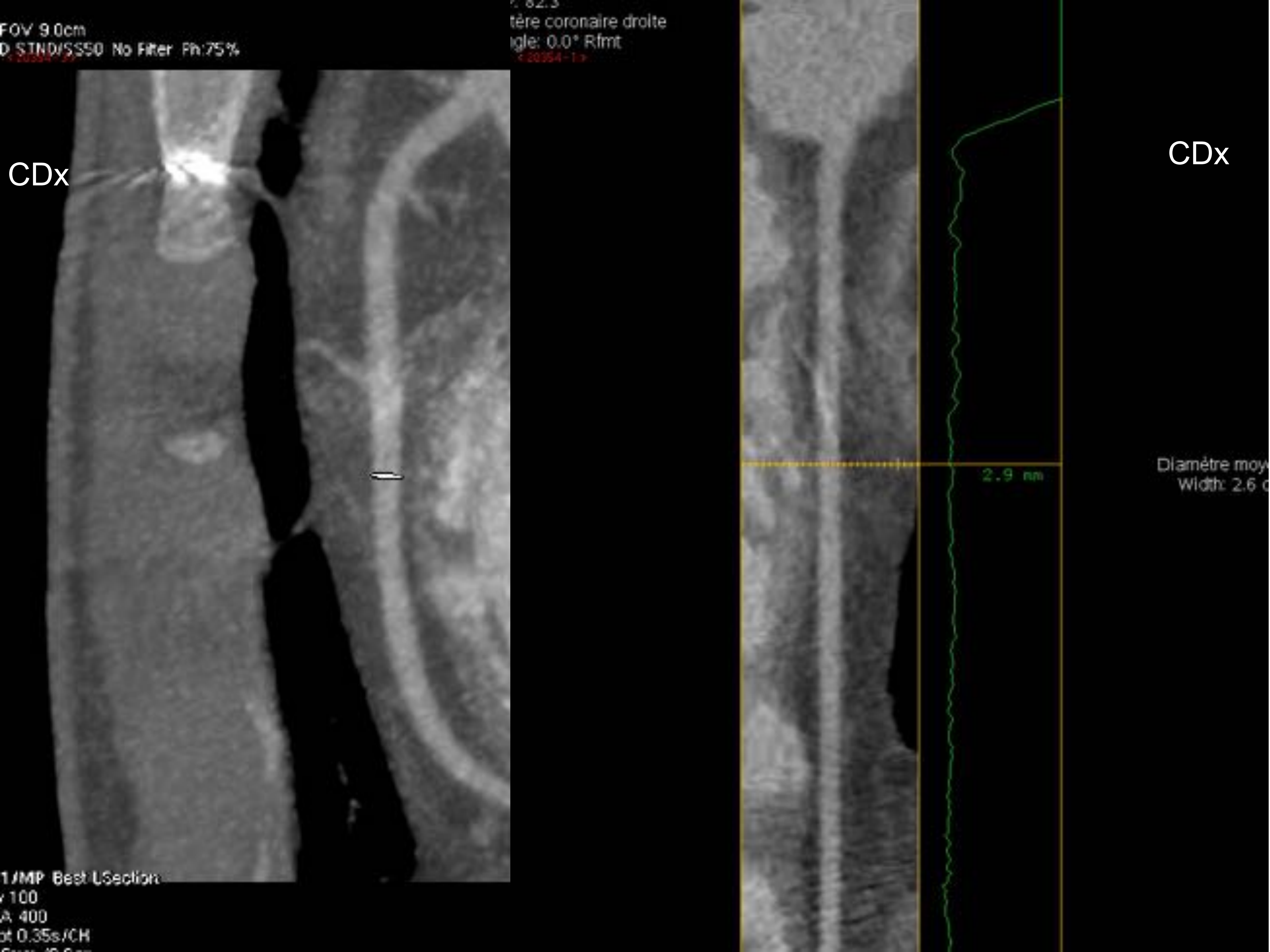

Oblique
SAR
Ex:Feb 01 2011
3.4/MIP
0.6mm /0.6sp
WW: 1100/WL: 120
IPR

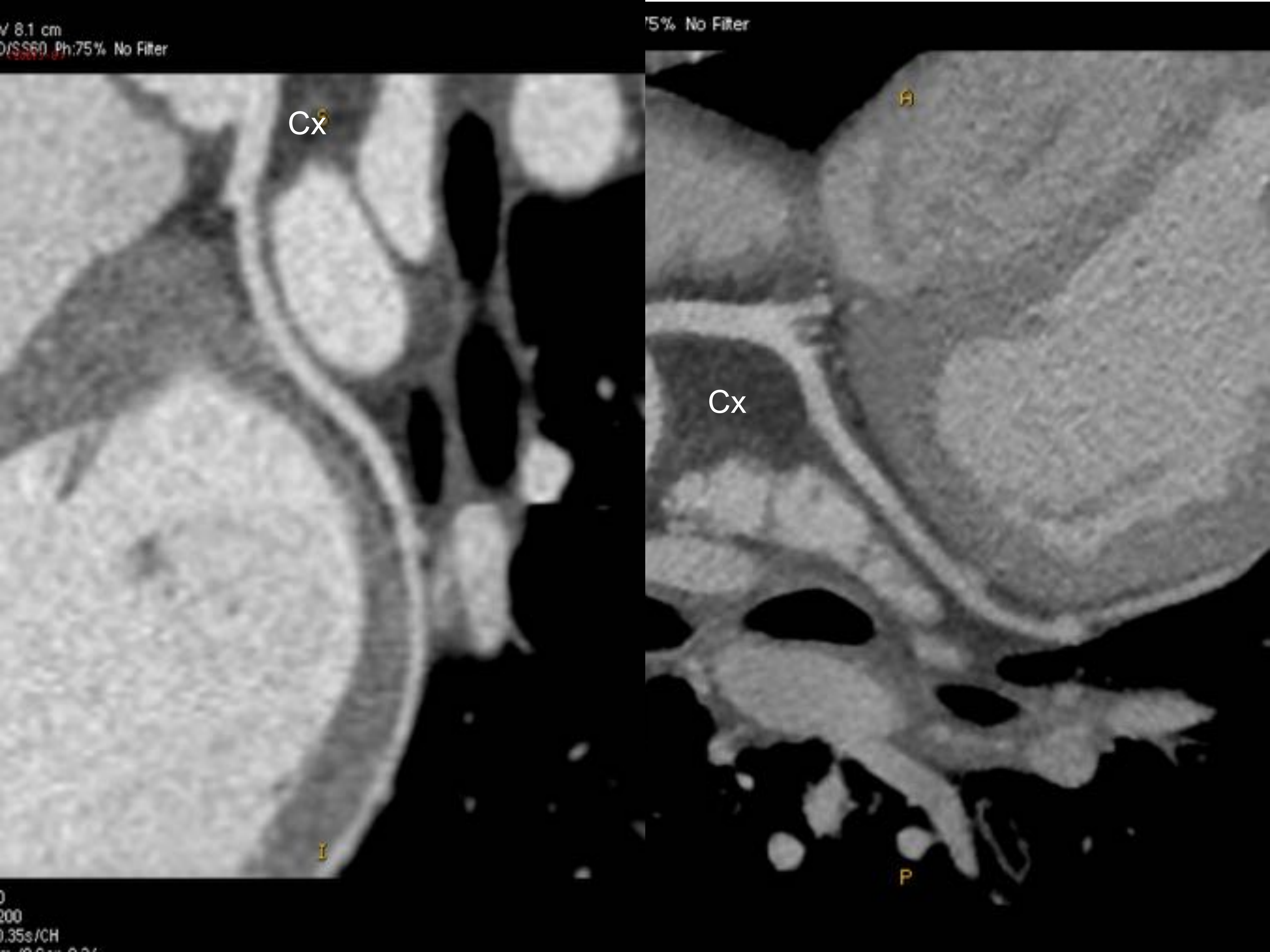

SAL
Ex:Feb 01 2011
4.4/MIP
0.6mm /0.6sp
WW: 1100/WL: 120
IPR

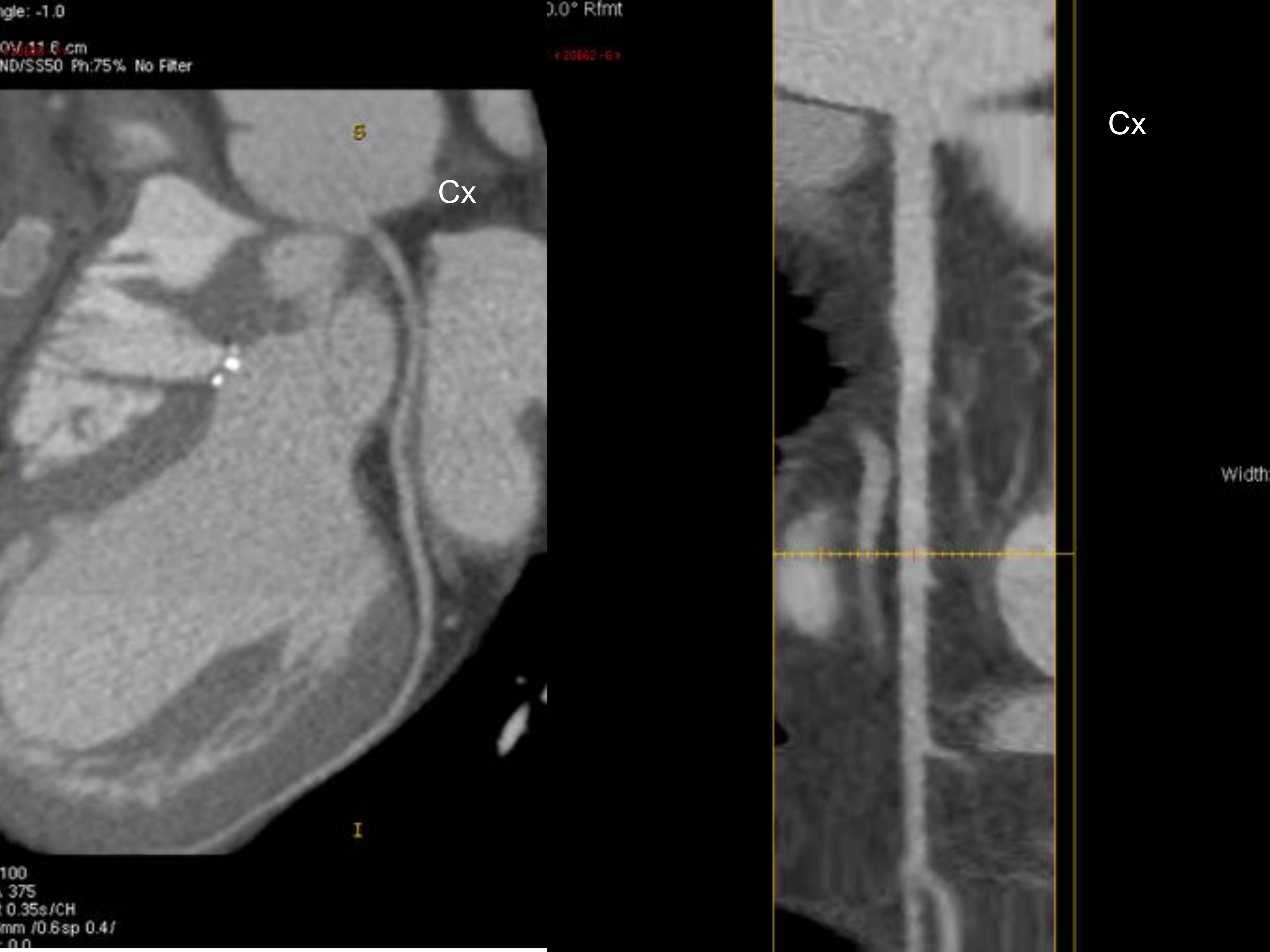
0,952 mSv


CDx
S
I


CDx

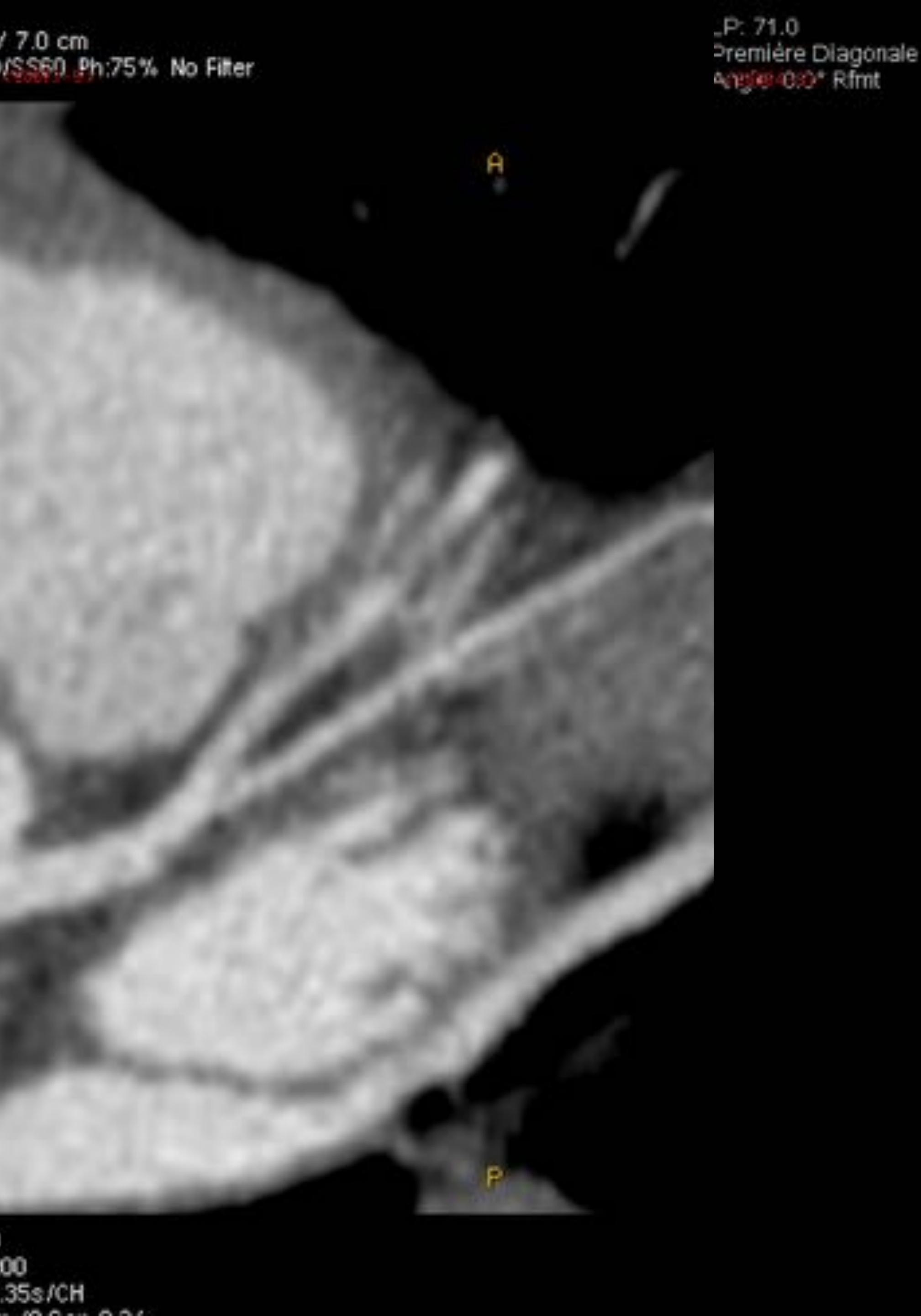

FOV 9.0cm
D STND/SS50 No Filter Ph:75%
tère coronaire droite
gle: 0.0° Rfmt
CDx
CDx
2.9 mm
Diamétre moy
Width: 2.6 c
1/MIP Best USection
v 100
A 400
ot 0.35s/CH

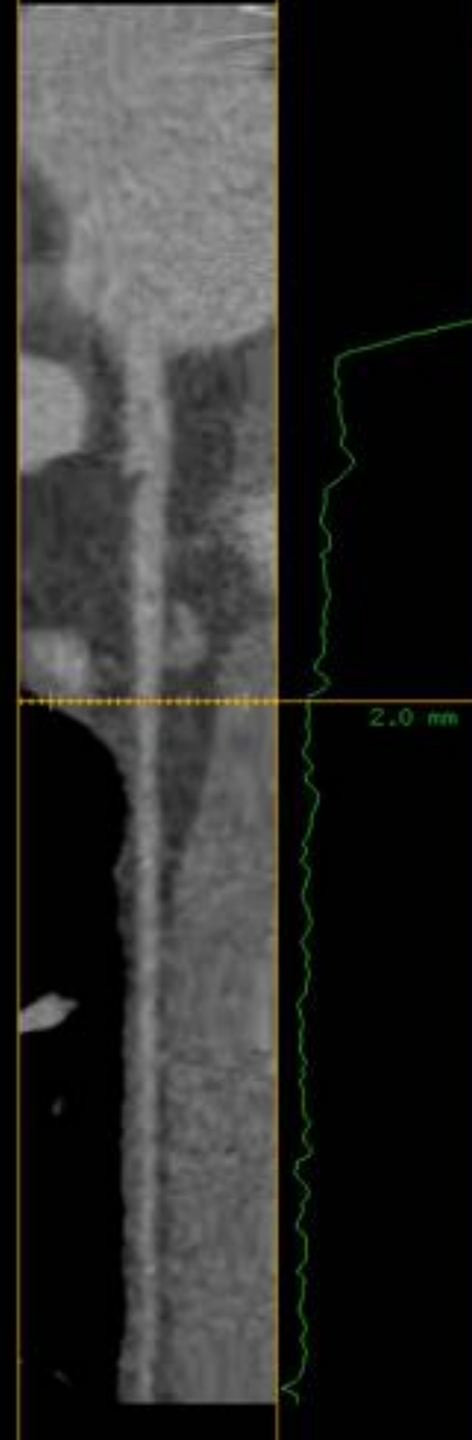

V 8.1 cm
D/SS60 Ph:75% No Filter
Cx
I
200
0.35s/CH
5% No Filter
A
Cx
P



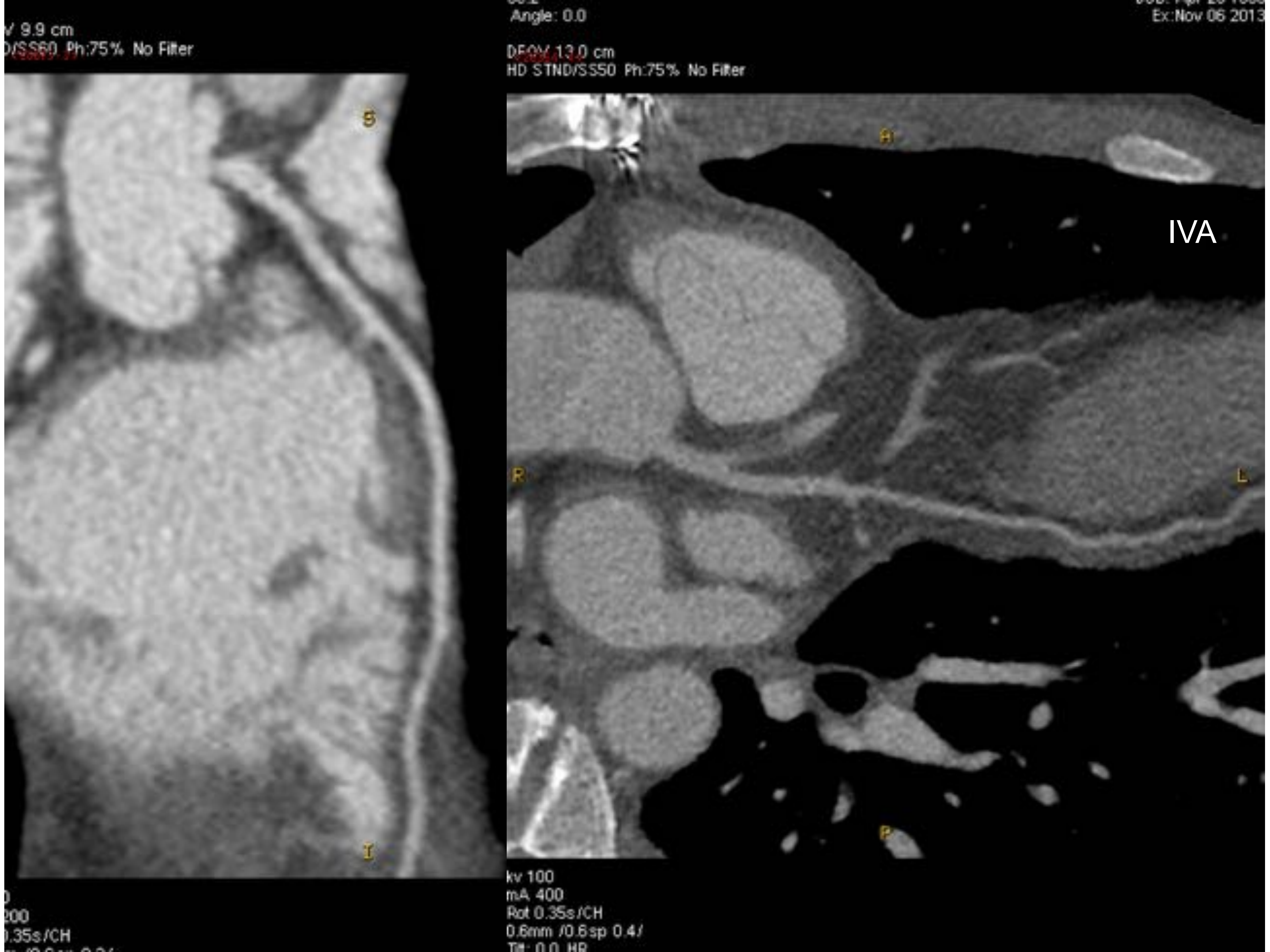
ND/SS50 Ph:75% No Filter
S
Cx
I
0.35s/CH
mm /0.6sp 0.4/
0.0° Rfmt
Cx
Width

Diagonale

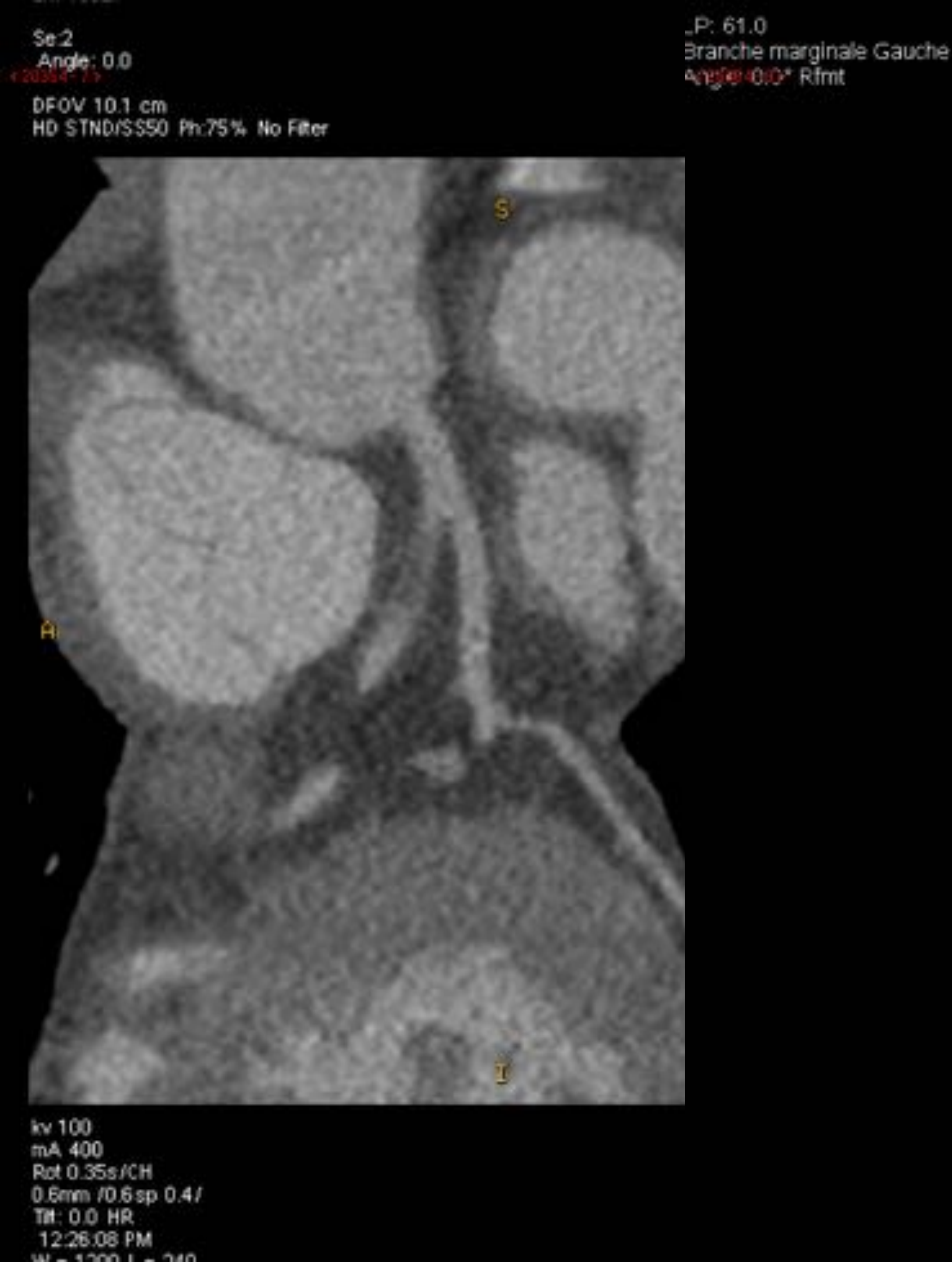


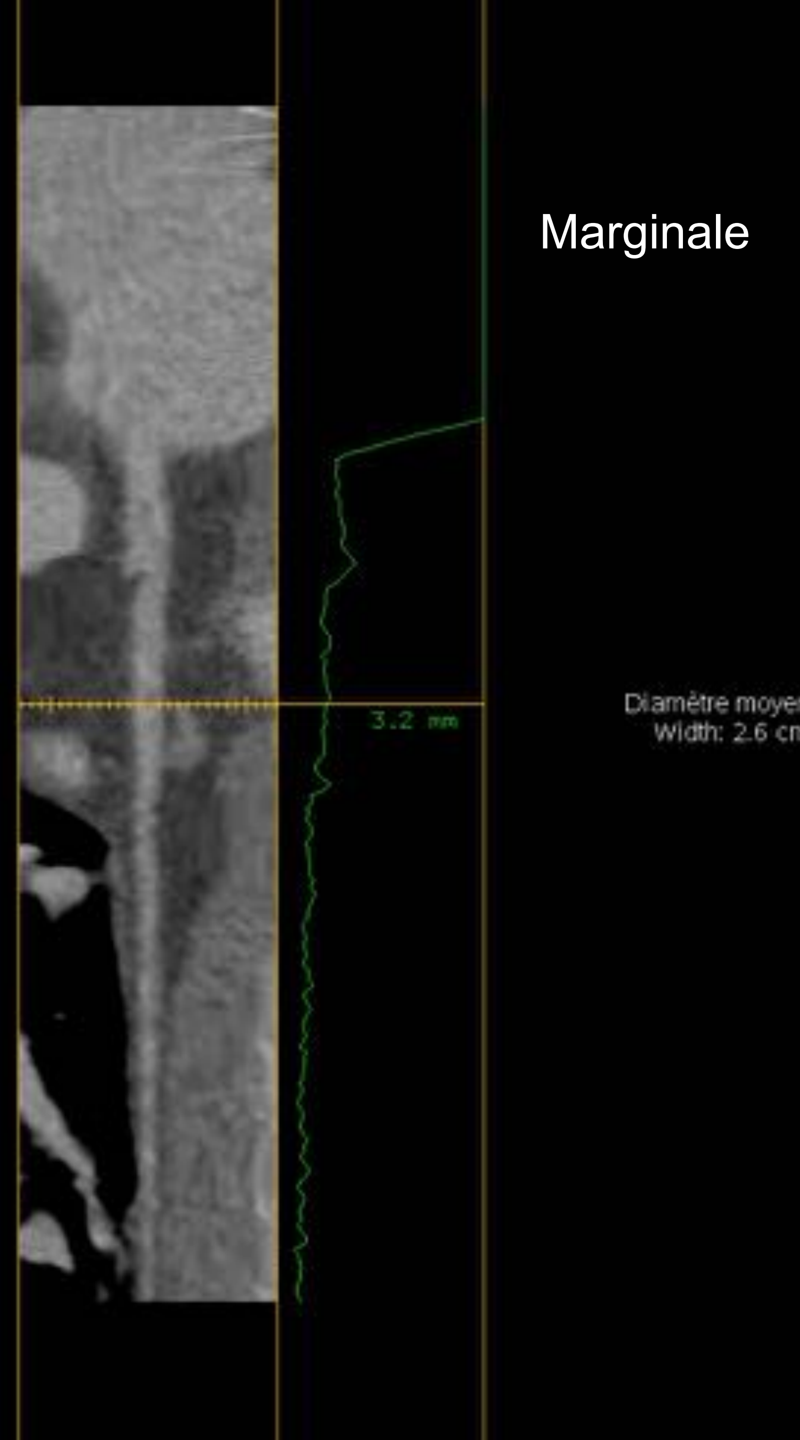


Diamètre moye
Width: 2.6 c


V 9.9 cm
D/SS60 Ph:75% No Filter
S
I
200
0.35s/CH
Angle: 0.0
Ex:Nov 06 2013
DFOV 13.0 cm
HD STND/SS50 Ph:75% No Filter
A
IVA
R
L
P
kv 100
mA 400
Rot 0.35s/CH
0.6mm /0.6sp 0.4/
Tilt: 0.0 HR

Marginale


Se:2
Angle: 0.0
DFOV 10.1 cm
HD STND/SS50 Ph:75% No Filter
S
A
I
kv 100
mA 400
Rot 0.35s/CH
0.6mm /0.6sp 0.4/
Tilt: 0.0 HR
12:26:08 PM
LP: 61.0
Branche marginale Gauche
Rfmt


3.2 mm
Diamètre moye
Width: 2.6 cn


TC
CD+Cx


302
Ex: 219
Se: 3 +c
Volume Rendering No cut
DFOV 20.0cm
STND Ph.75% (No Filt.)
SPR
HOPITAL NECKER ENFANT
R
A
S
L
P
I
No VOI
kv 120
mA 499
Rot 0.35s/CH 10.4mm/rot
0.6mm 0.261:1/0.6sp
Tilt: 0.0
12:01:12 PM
W = 4095 L = 2048
IAL

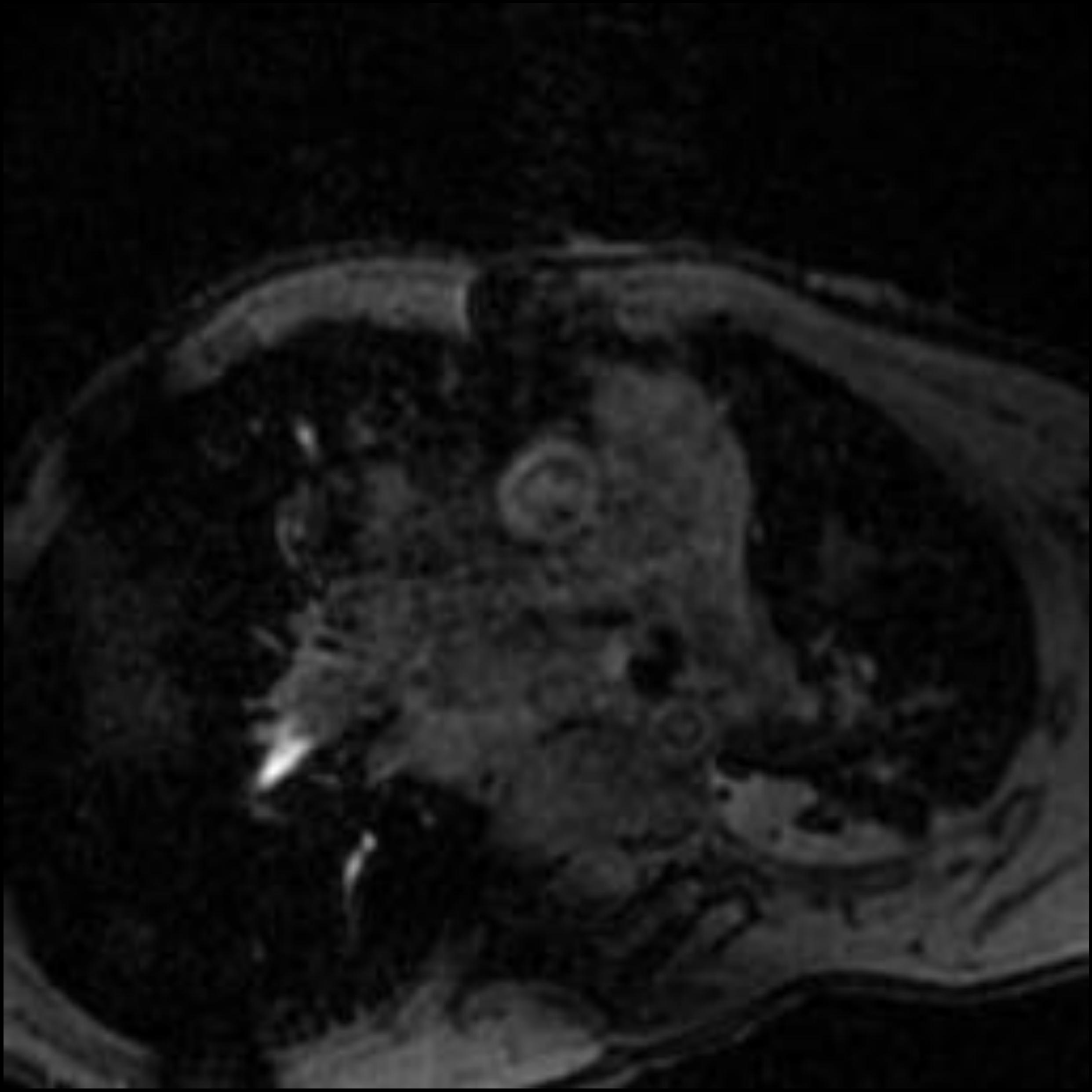
7.7 mSv

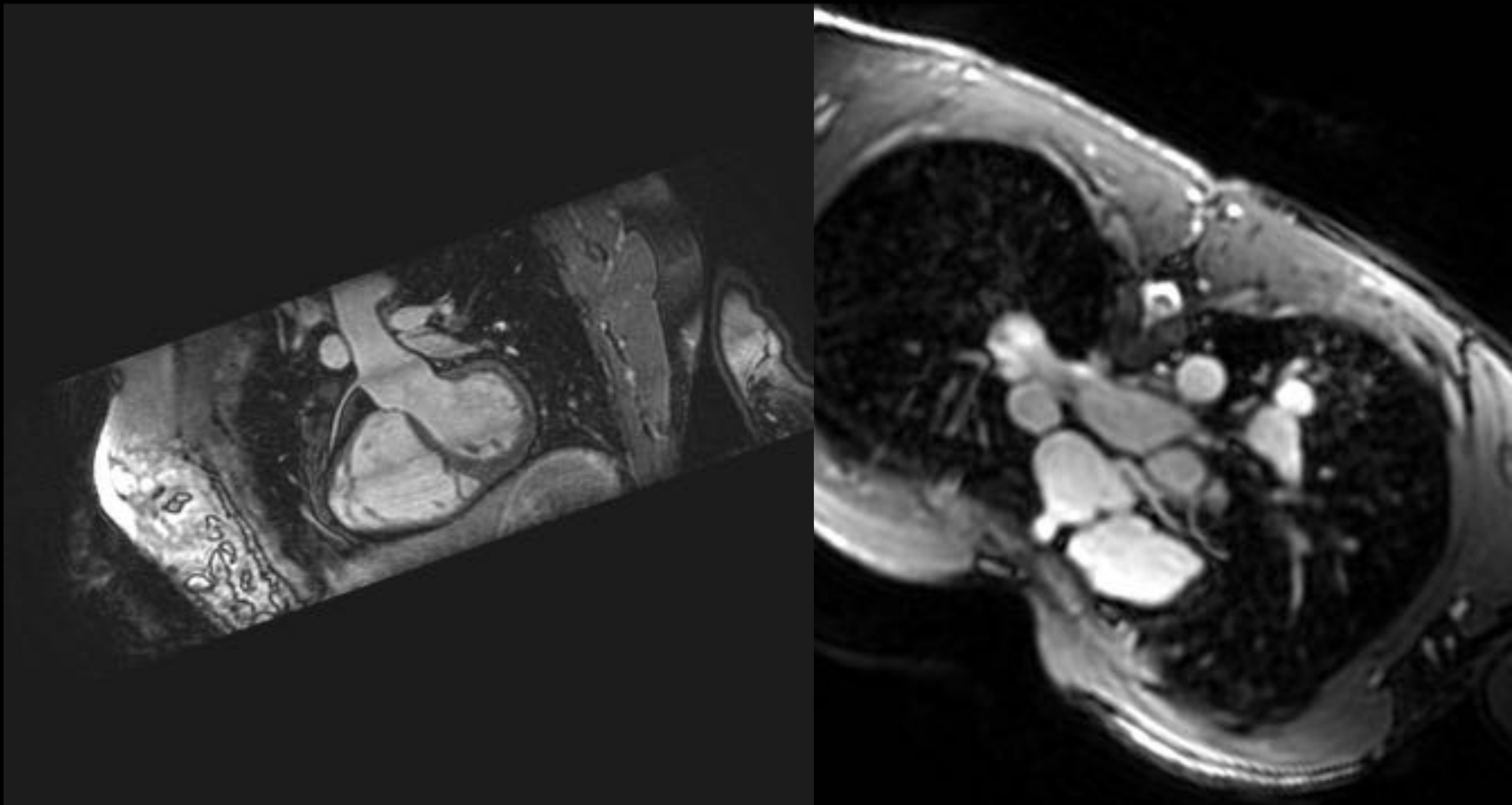
0.5 mSv

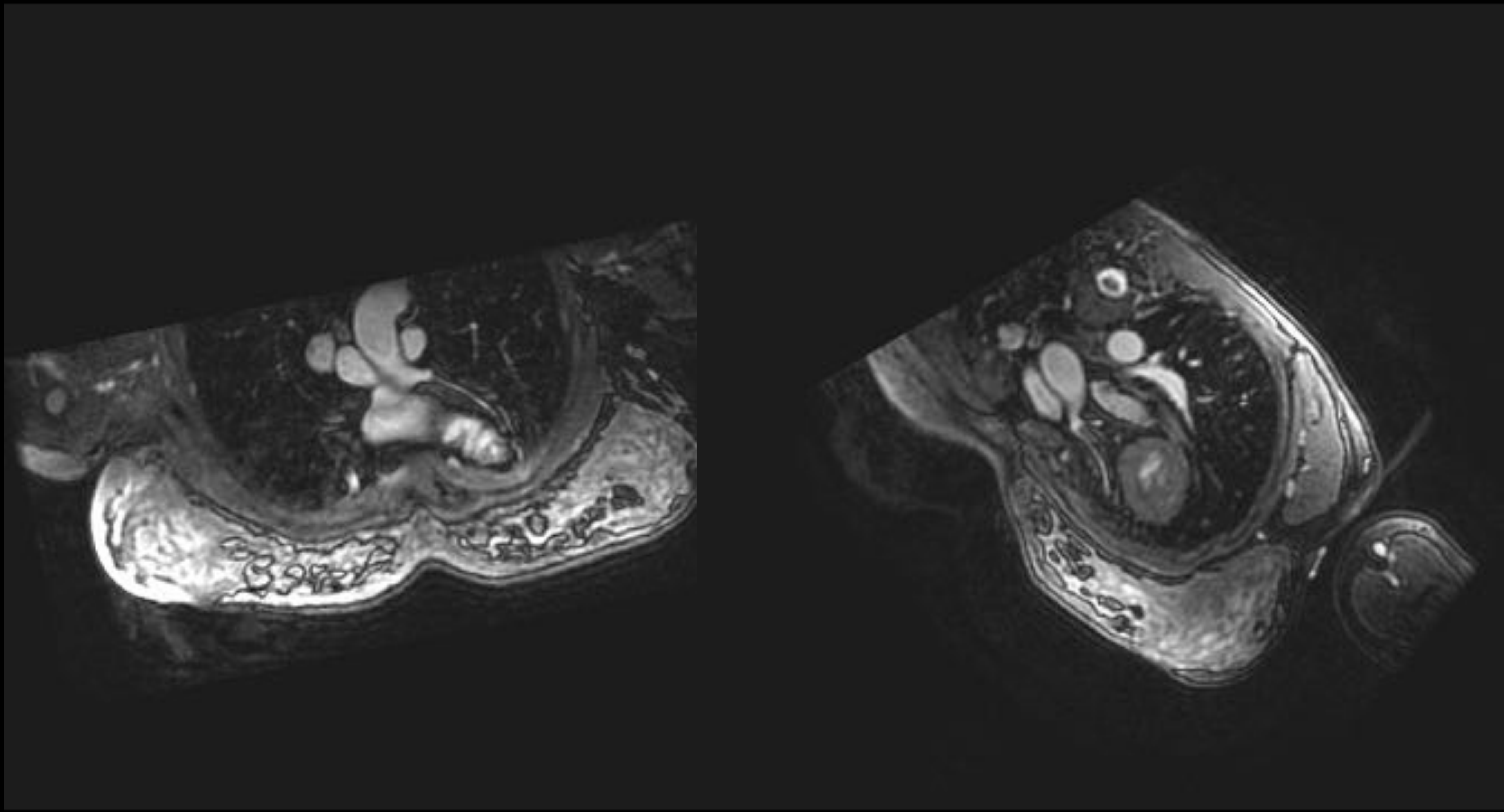
0.5 mSV

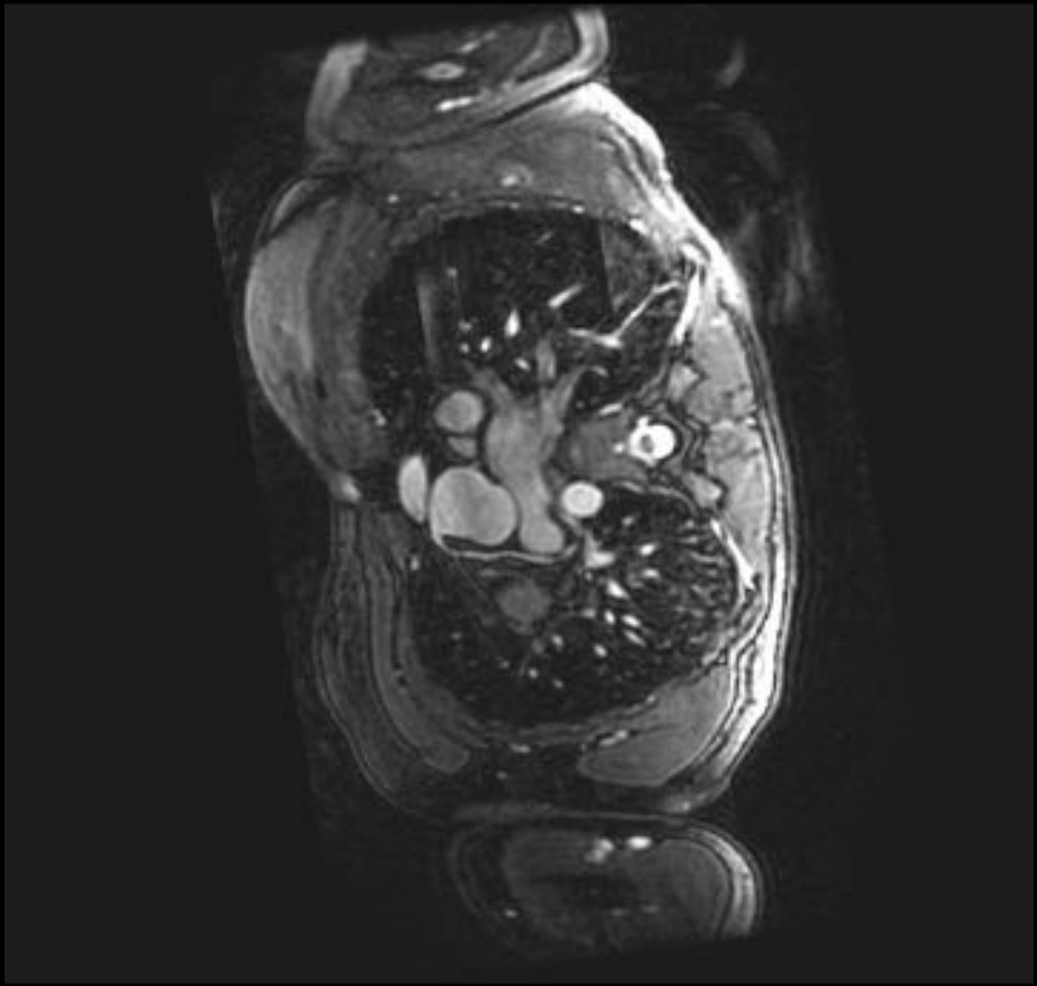
Oblique
Ex: 38029
Se: 2
SLA
HOPITAL NECKER ENFANT
DESBONNES NAYA SHAKTI
F 3 W 1911062220
DoB: Aug 27 2011
Ex: Sep 30 2011
DFOV 10.0cm
STND+
IRP

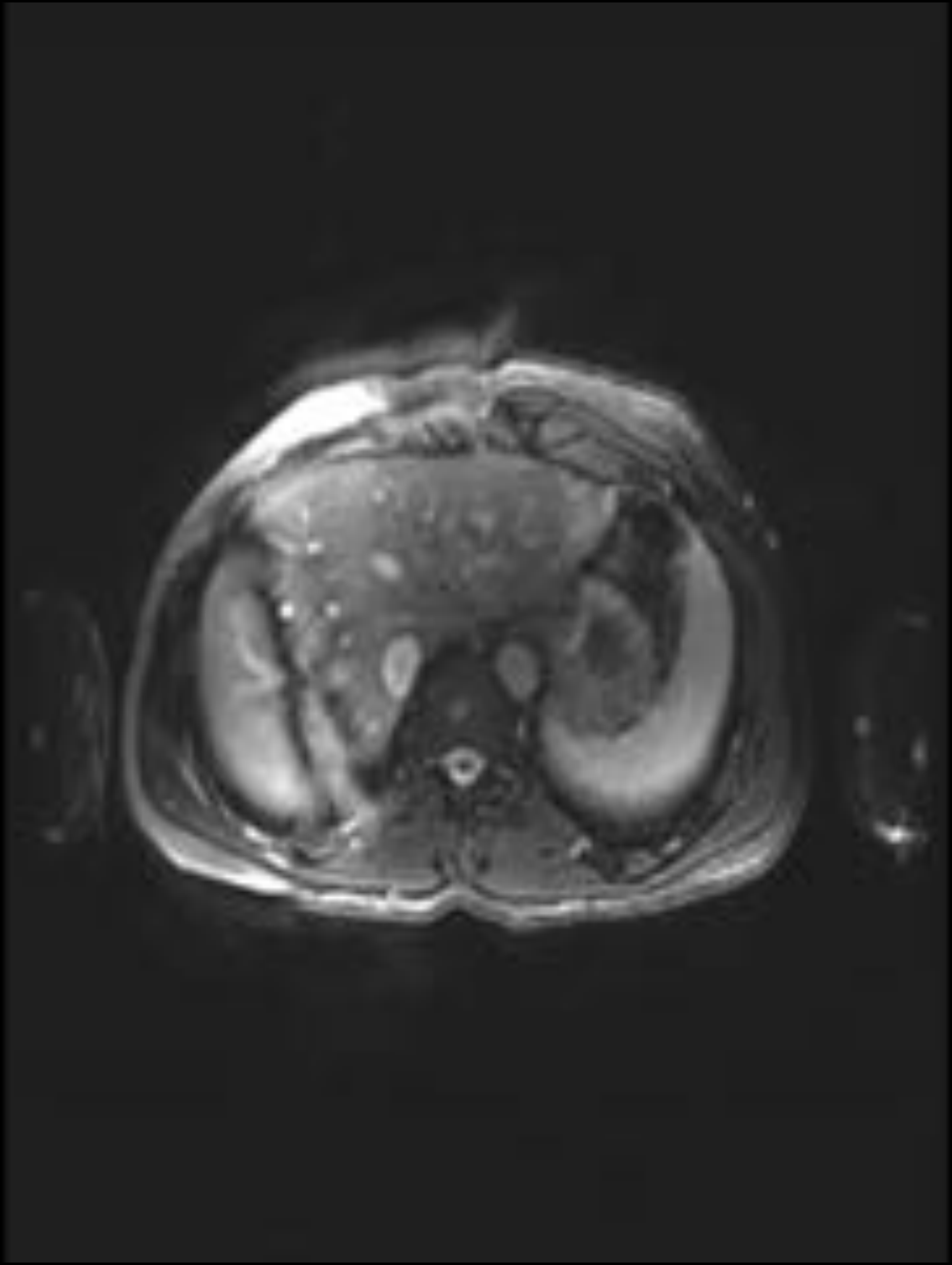
IRM - 3D avec double gating



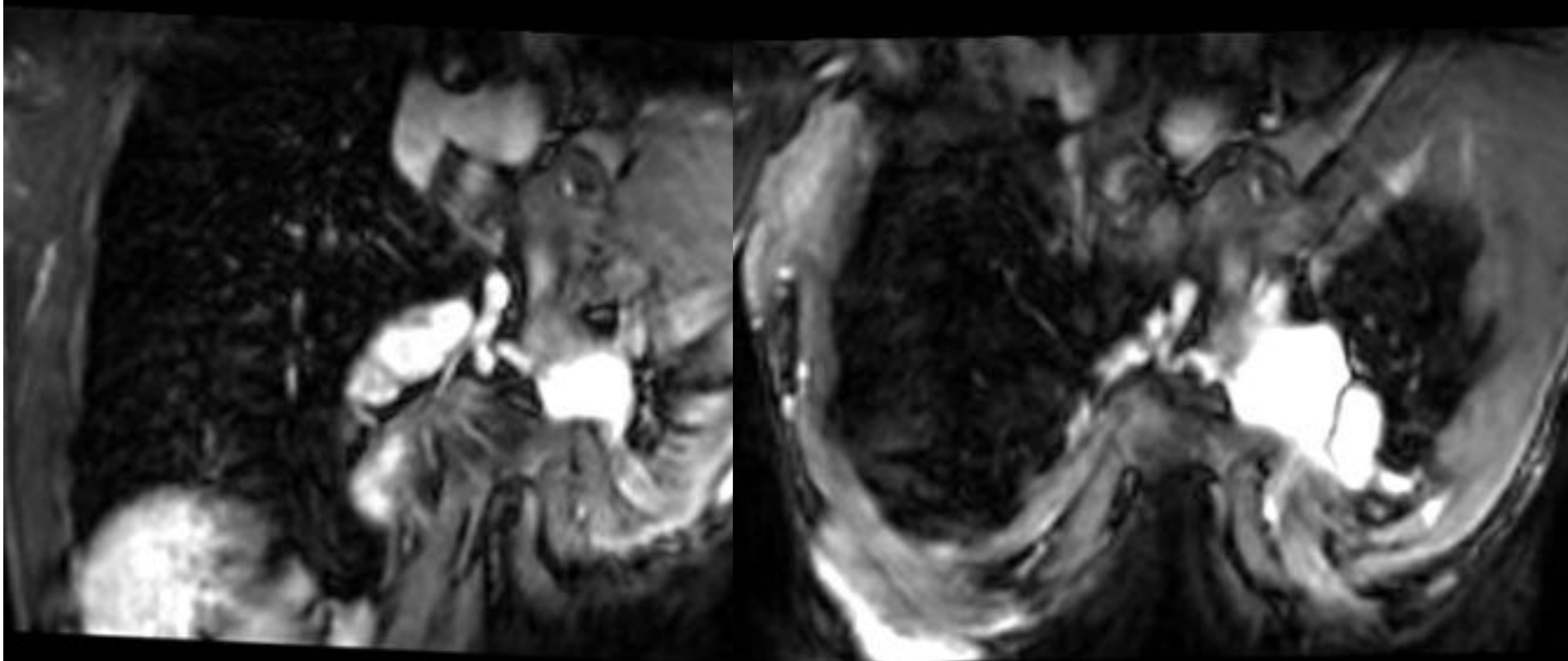


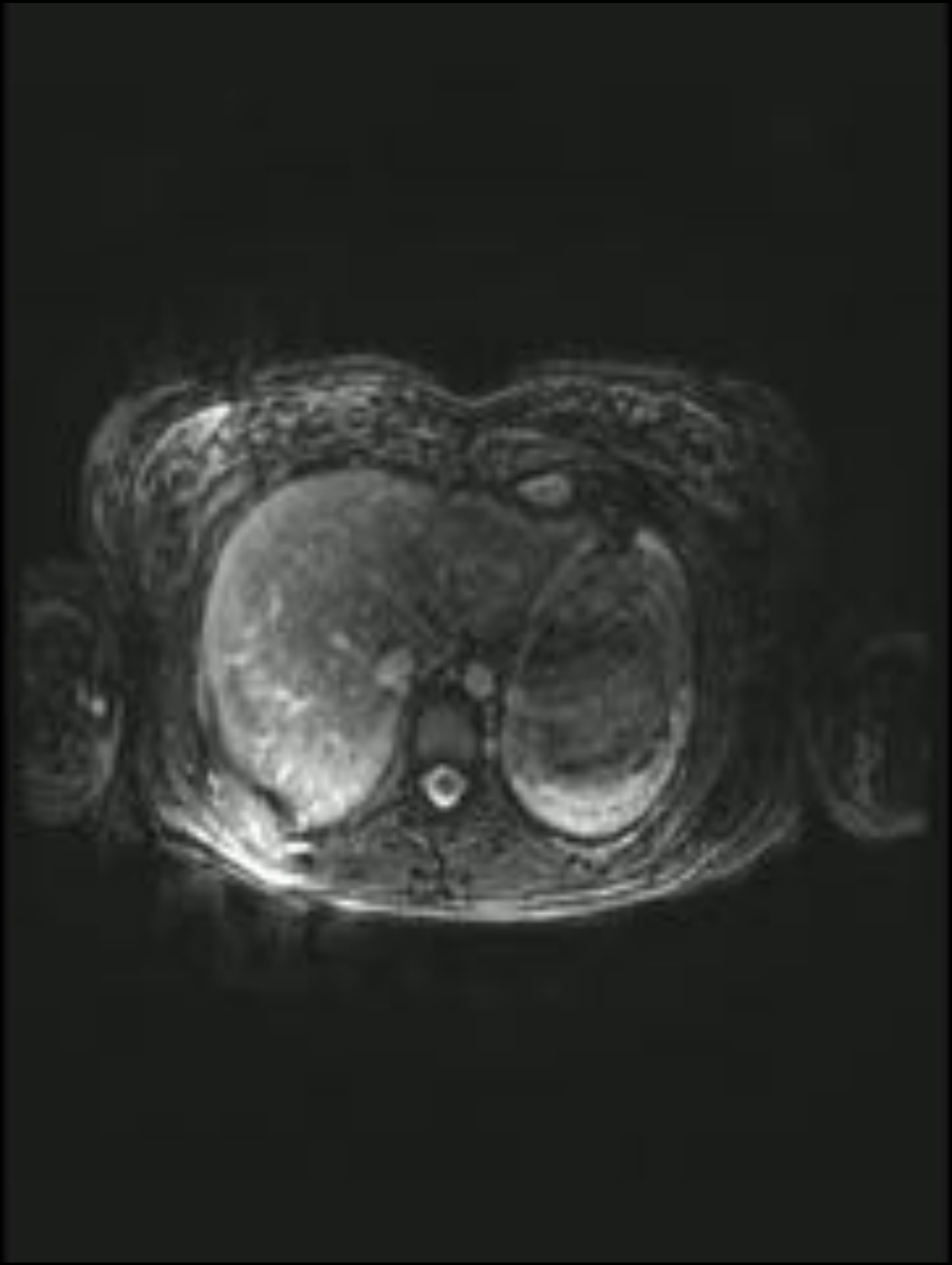






A 221
P 219



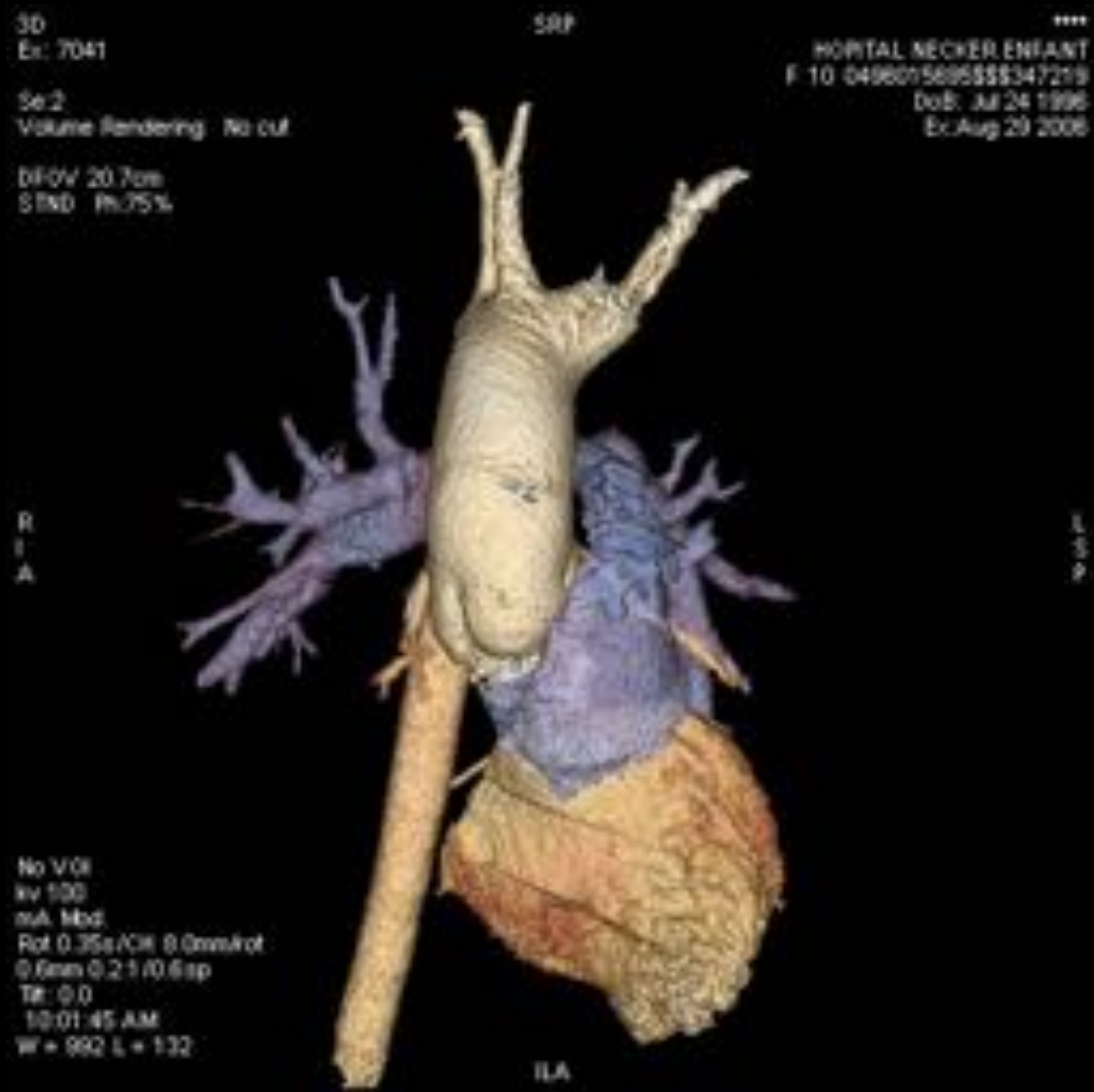


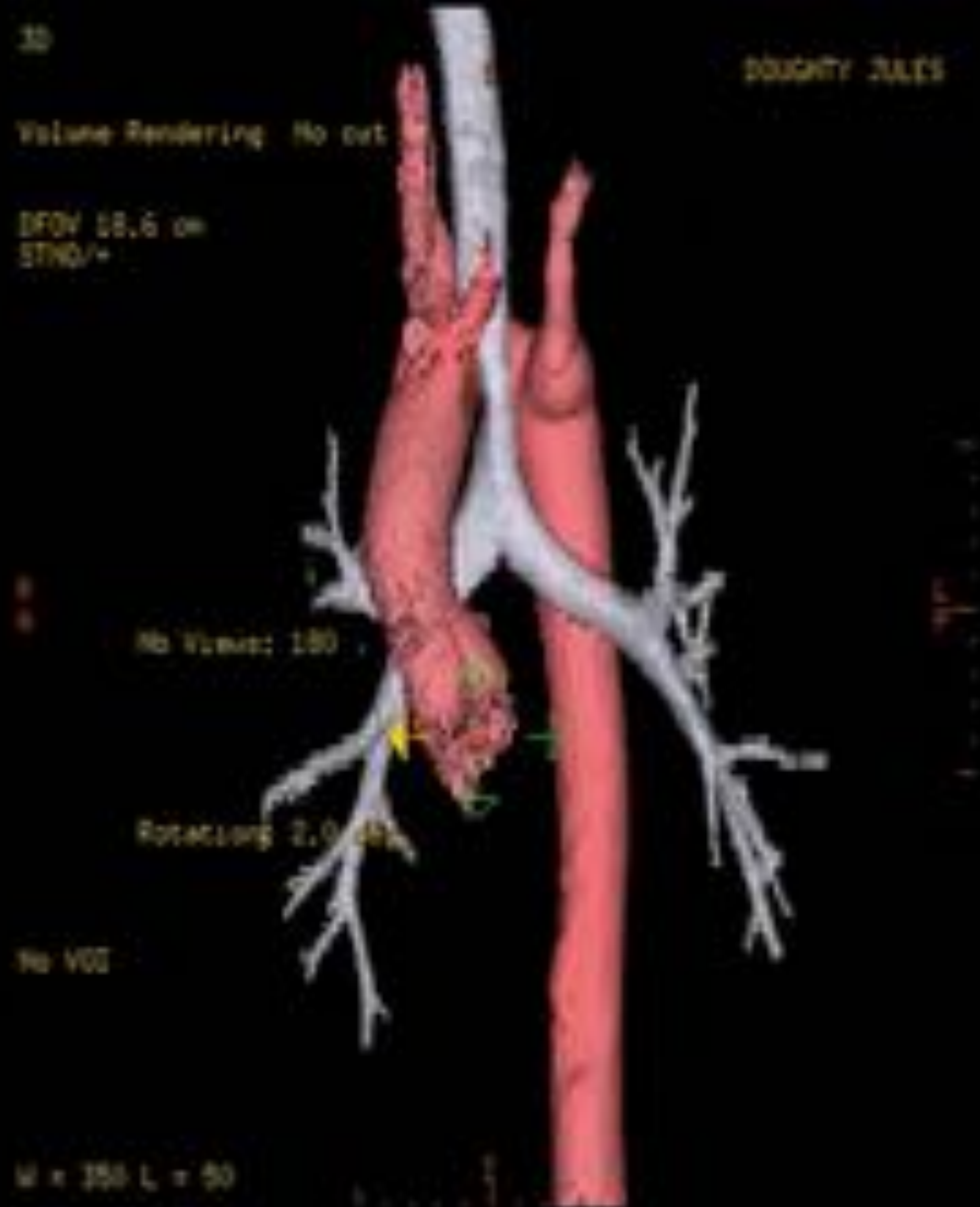
Indications Scanner

Anatomie

- Détails anatomiques dans les pathologies des gros vaisseaux et rapport avec les bronches


e Rendering No cut
DoB: Sep 18
Ex:Nov 06
14.0 cm
SS50 No Filter
I
9
.40s/HE+ 55.0mm/rot
1.375:1/0.6sp


3D
Ex: 7041
Se:2
Volume Rendering No cut
DFOV 20.7cm
STND Ph:75%
SRP
HOPITAL NECKER ENFANT
DoB: Jul 24 1996
Ex:Aug 29 2006
R
I
A
L
S
P
No VOI
kv 100
mA Mod
Rot 0.35s/CH 8.0mm/rot
0.6mm 0.2:1/0.6sp
Tilt: 0.0
10:01:45 AM
W = 992 L = 132
ILA


3D
DOUGHTY JULES
Volume Rendering No cut
DFOV 18.6 cm
STND/+
No Views: 180
Rotation: 2.0
No VOI
W = 350 L = 50

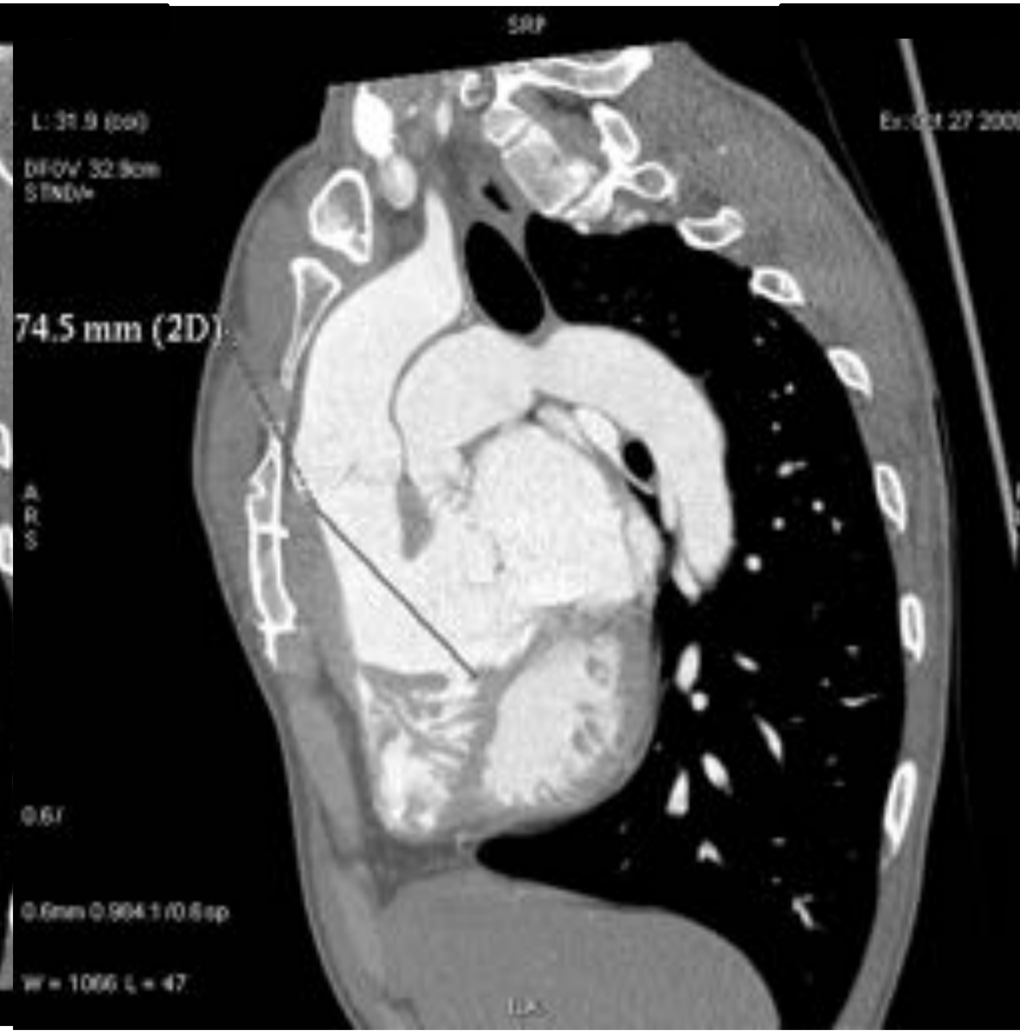
Indications Scanner

Anatomie

- Etude des collatérales aorto-pulmonaires dans l'APSO

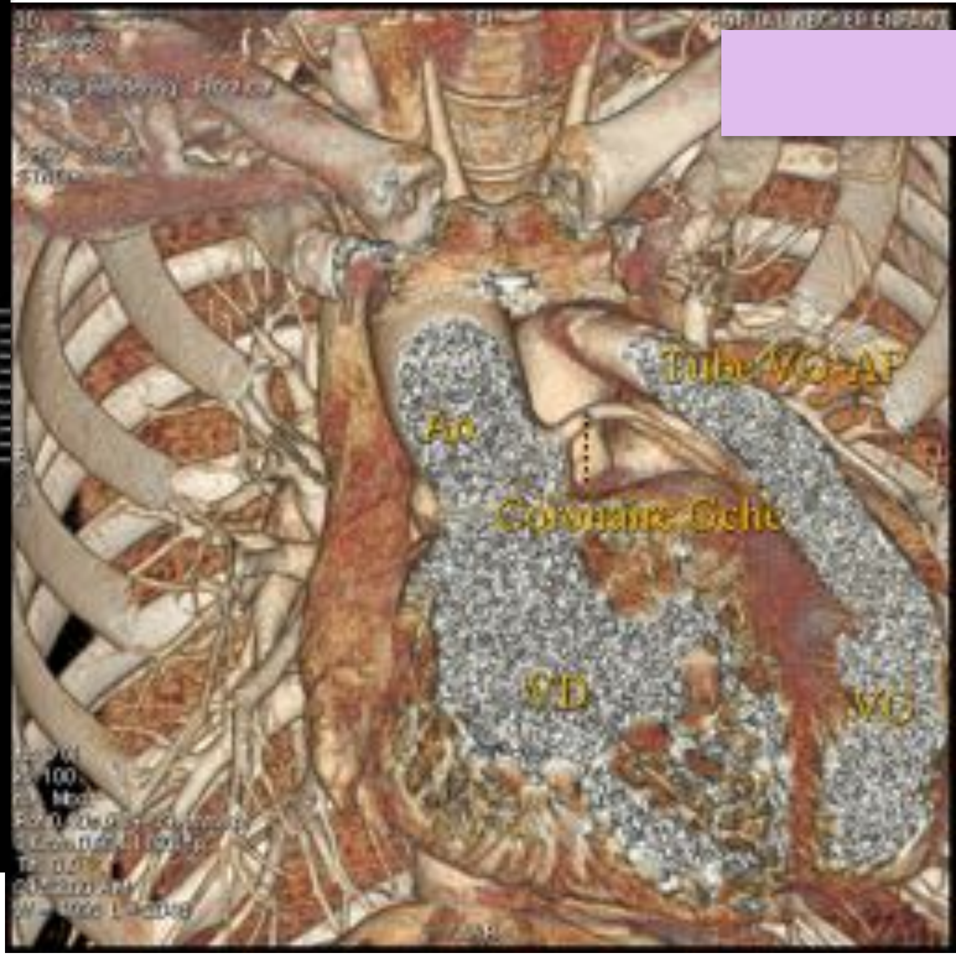
Anatomie complexe

Anatomie complexe

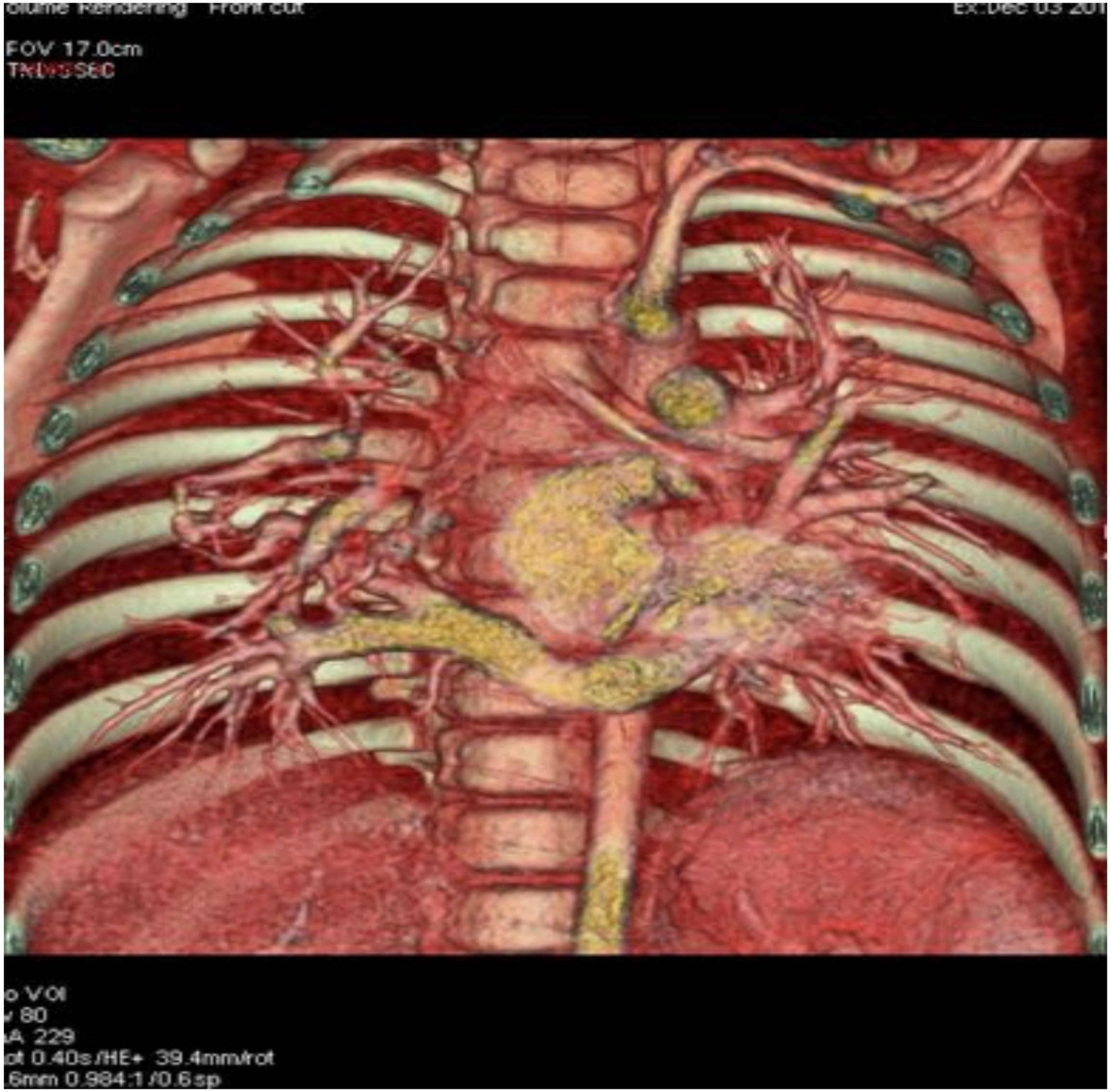


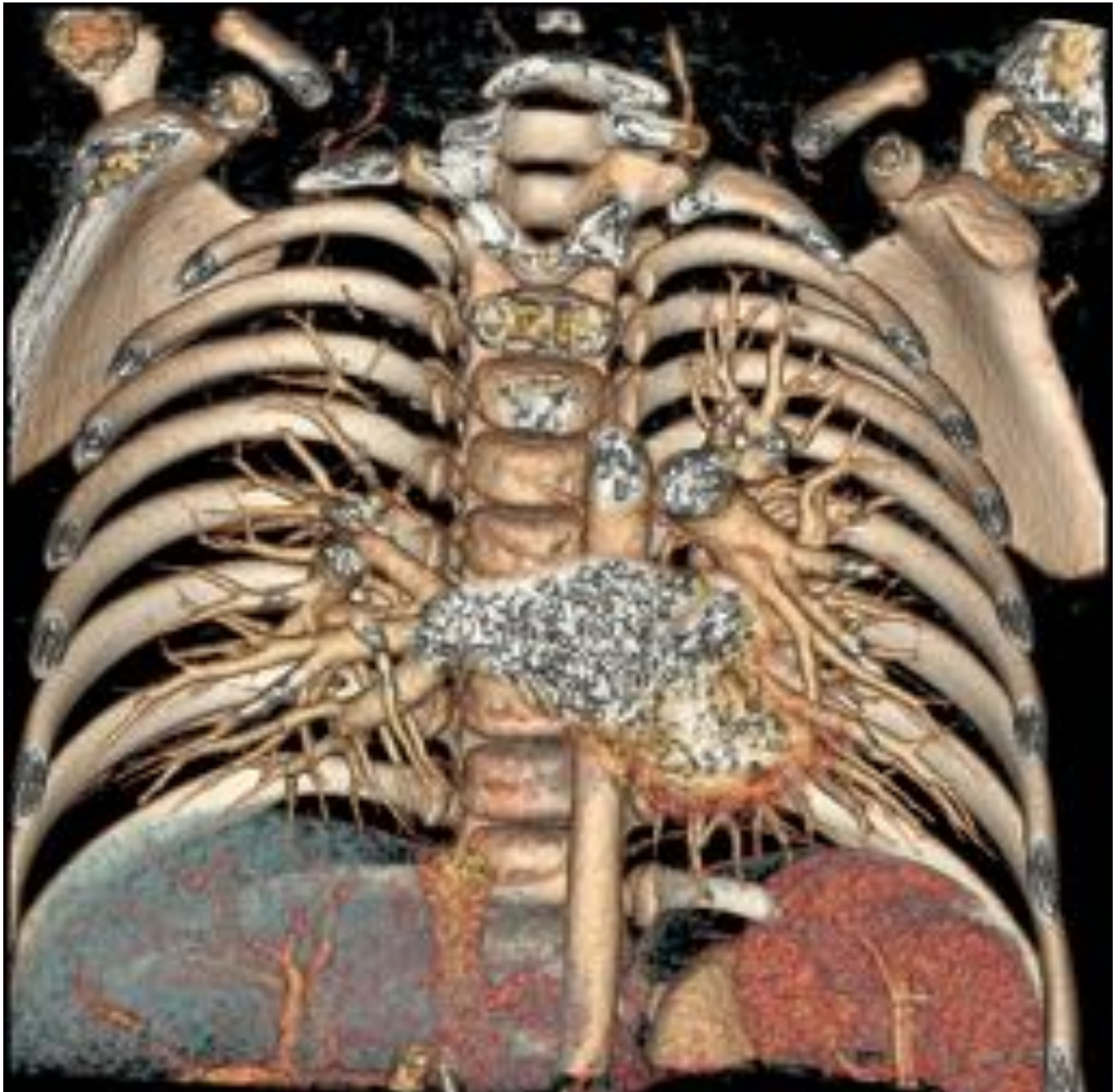
Anatomie intracardiaque

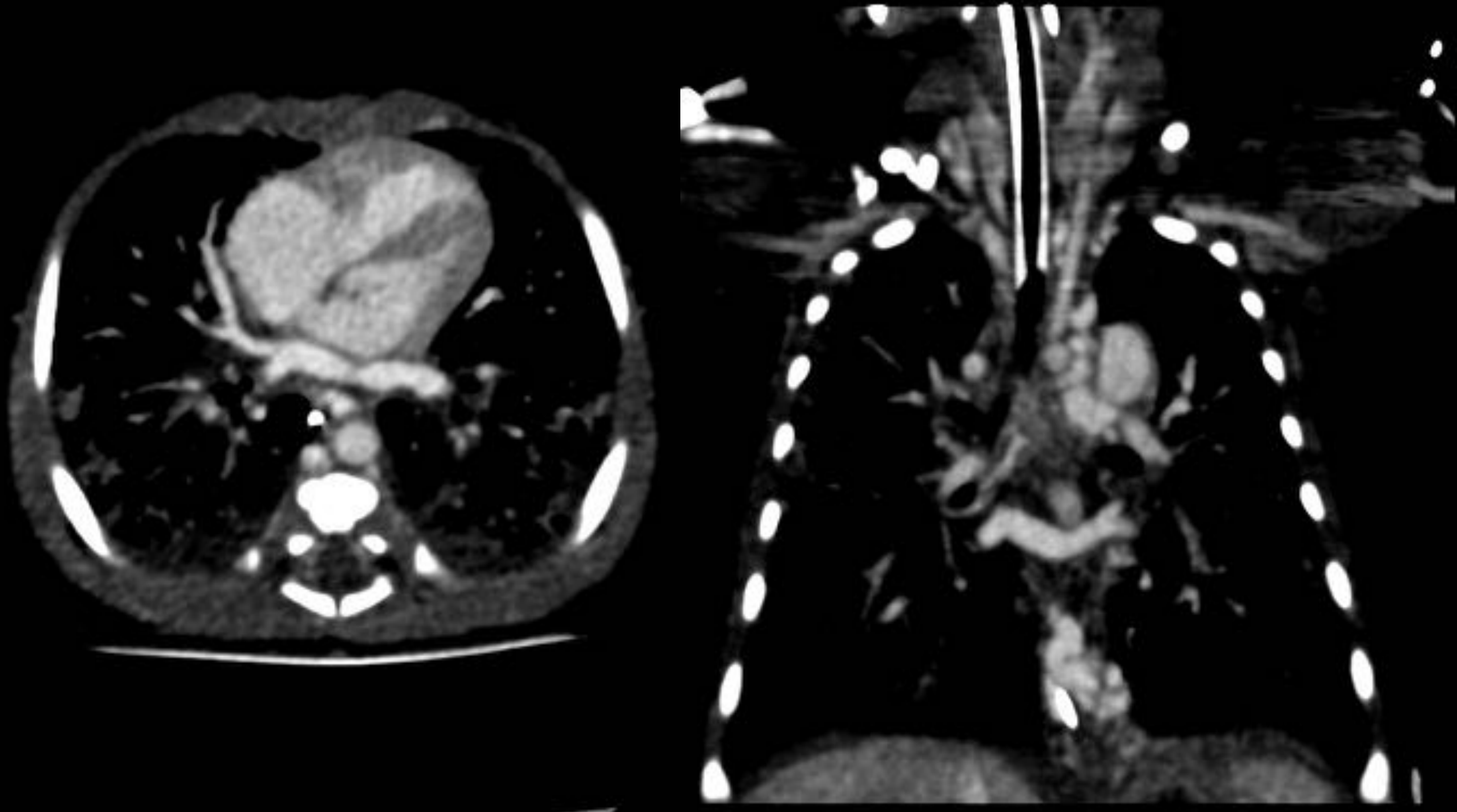
Anatomie complexe



RVPA


olume Rendering   Front cut
Ex:Dec 03 201
FOV 17.0cm
o VOI
v 80
A 229
ot 0.40s /HE+ 39.4mm/rot
6mm 0.984:1 /0.6sp





[redacted]

Indications Scanner

Anatomie

- Etude du parenchyme pulmonaire

20677 - 1 >

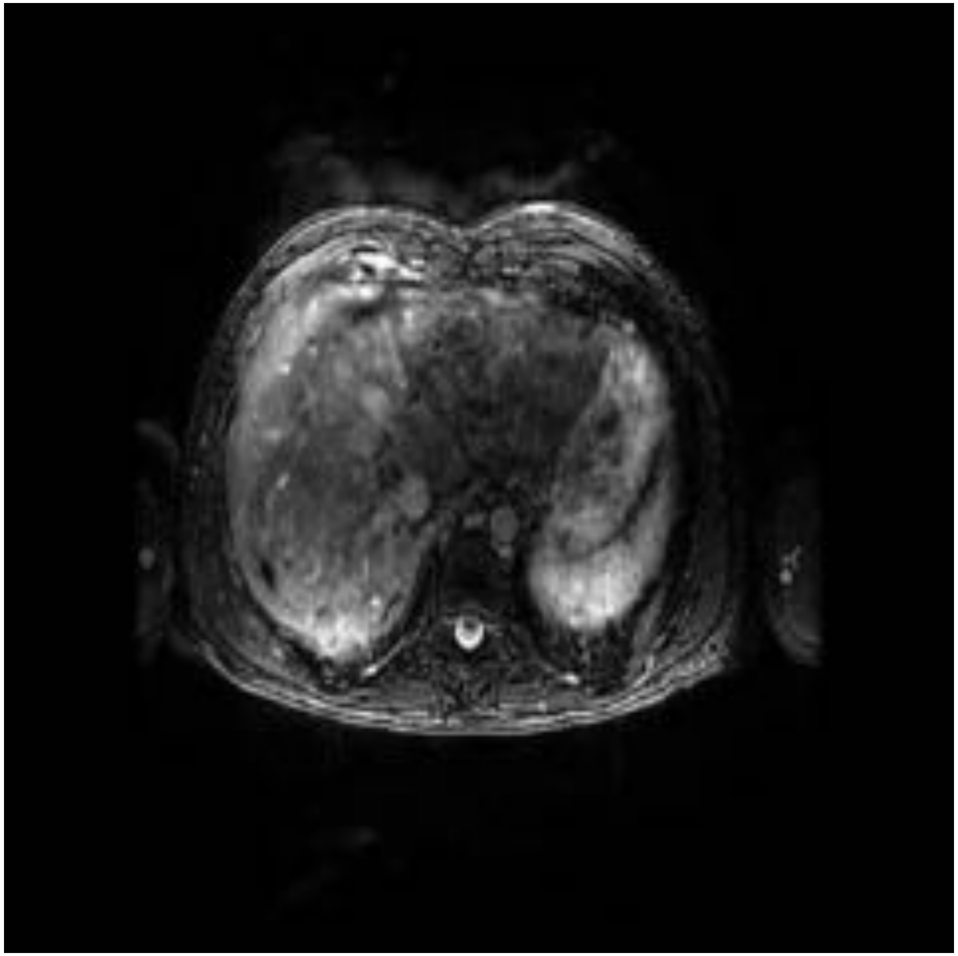
< 20677 - 2 >

Indications IRM

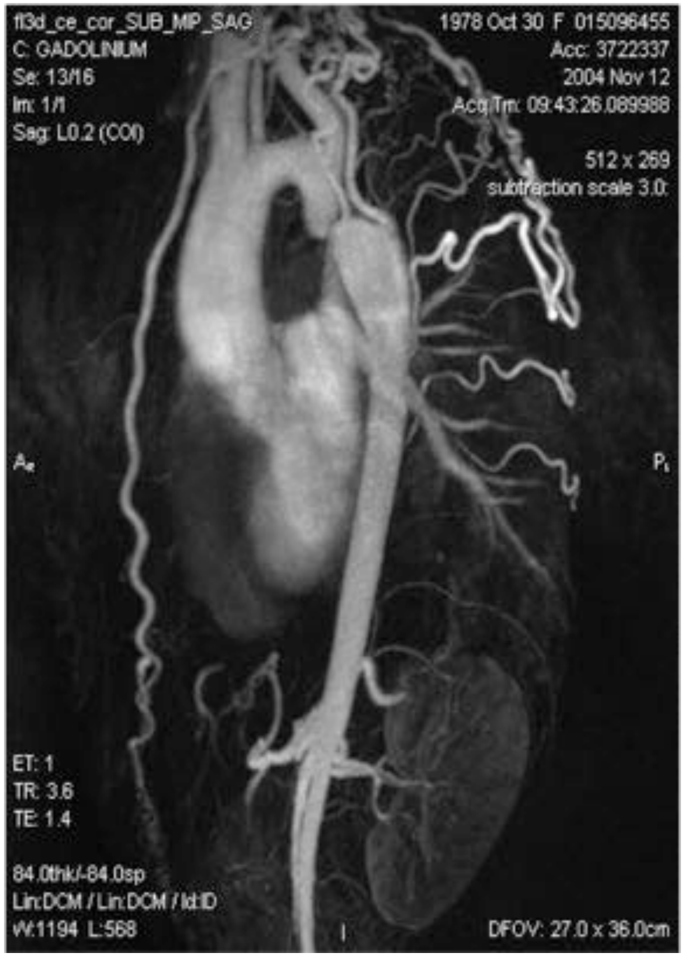
- Morphologie, fonction et analyse tissulaire
  - Morphologie, Volumes, Masses, Fonction des ventricules
  - Fonction des Valves cardiaques
  - Perfusion myocardique/réserve coronaire/réserve contractile
  - Perfusion pulmonaire
  - Etude du myocarde: inflammation/fibrose

Morphologie et fonction

Anatomie

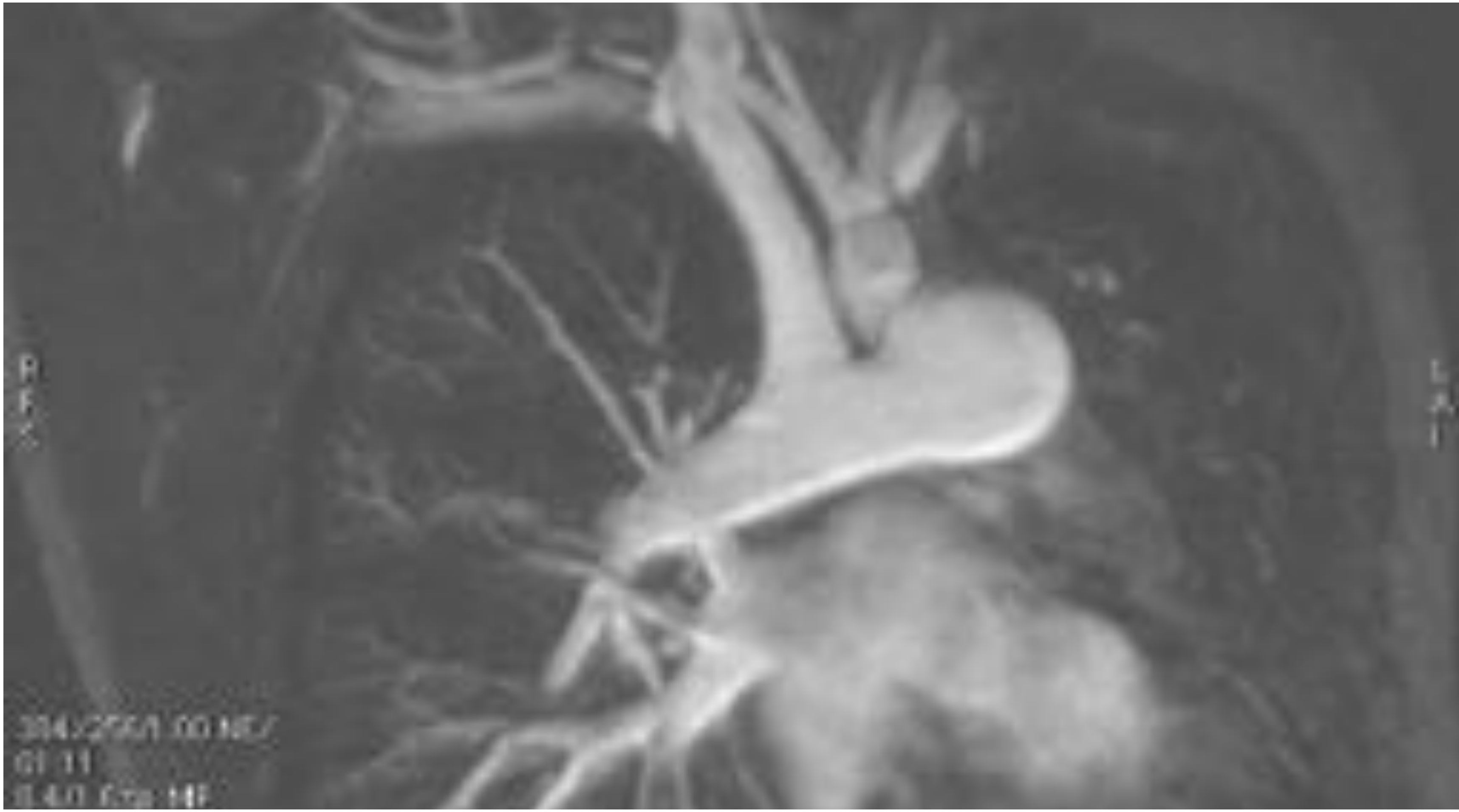


Anatomie

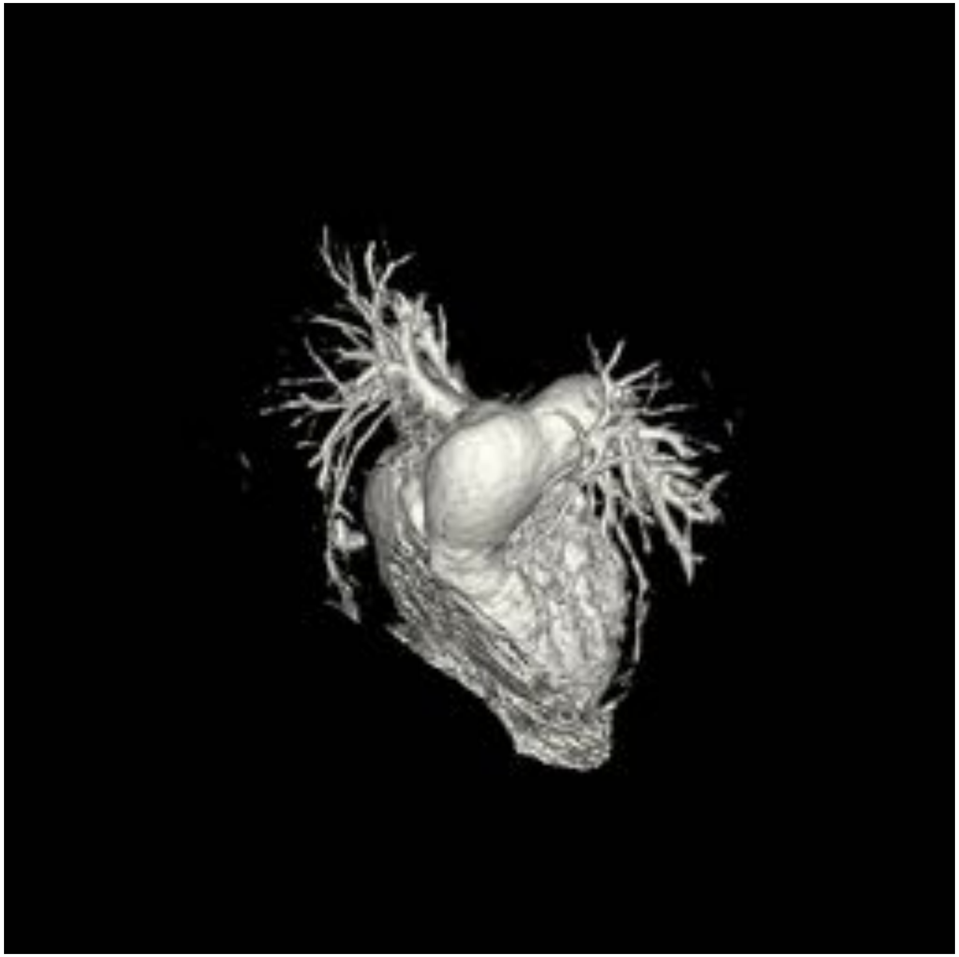

fl3d_ce_cor_SUB_MIP_SAG
C: GADOLINIUM
Se: 13/16
Im: 1/1
Sag: L0.2 (COI)
1978 Oct 30 F 015096455
Acc: 3722337
2004 Nov 12
Acq Tm: 09:43:26.089988
512 x 269
subtraction scale 3.0:
ET: 1
TR: 3.6
TE: 1.4
84.0thk/-84.0sp
Lin:DCM / Lin:DCM / Id:ID
W:1194 L:568
DFOV: 27.0 x 36.0cm


Volume Rendering
DFOV 25.5 cm
ET:1
No VOI
32Ch Cardiac/

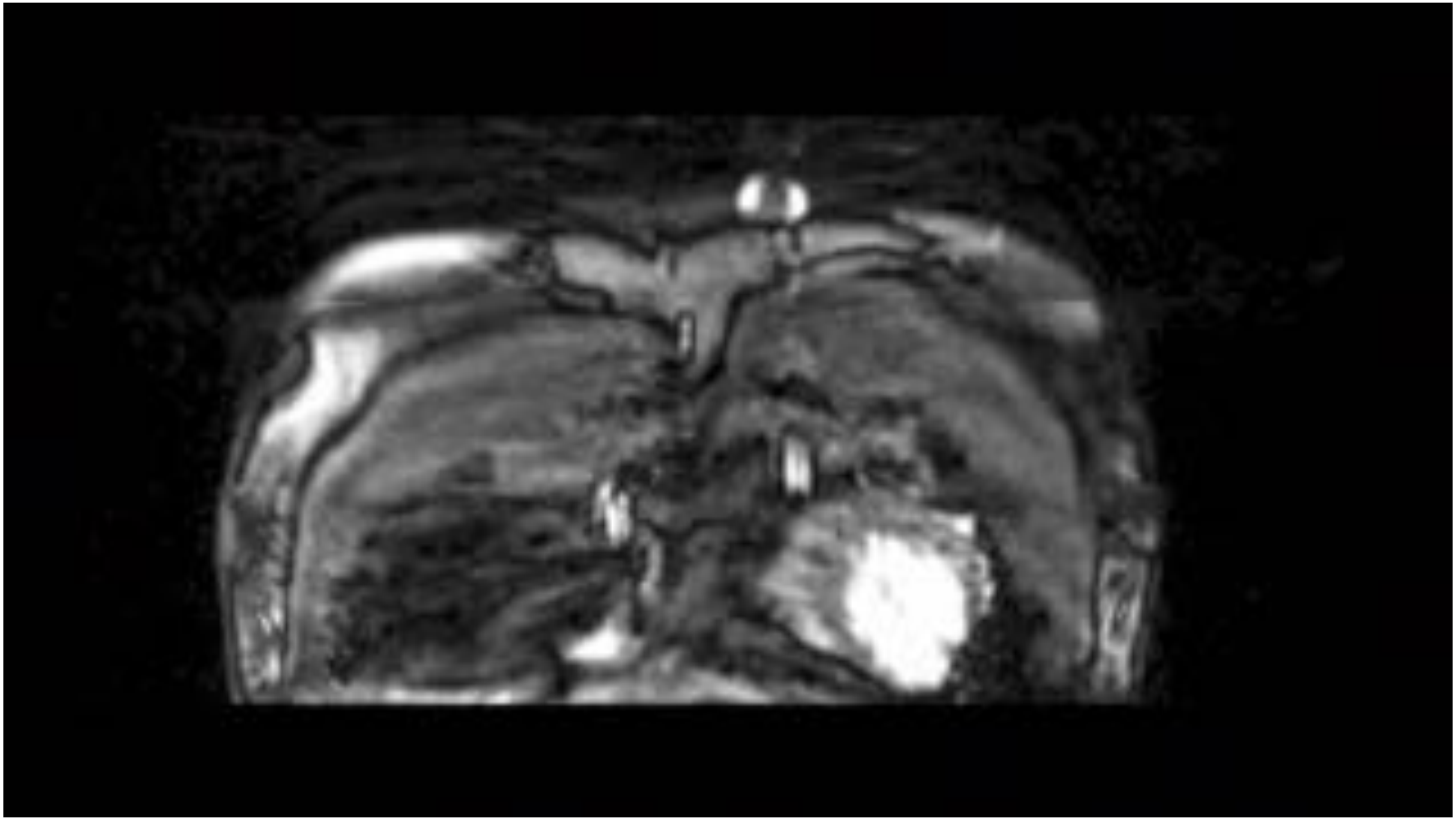
Anatomie



Anatomie



Anatomie



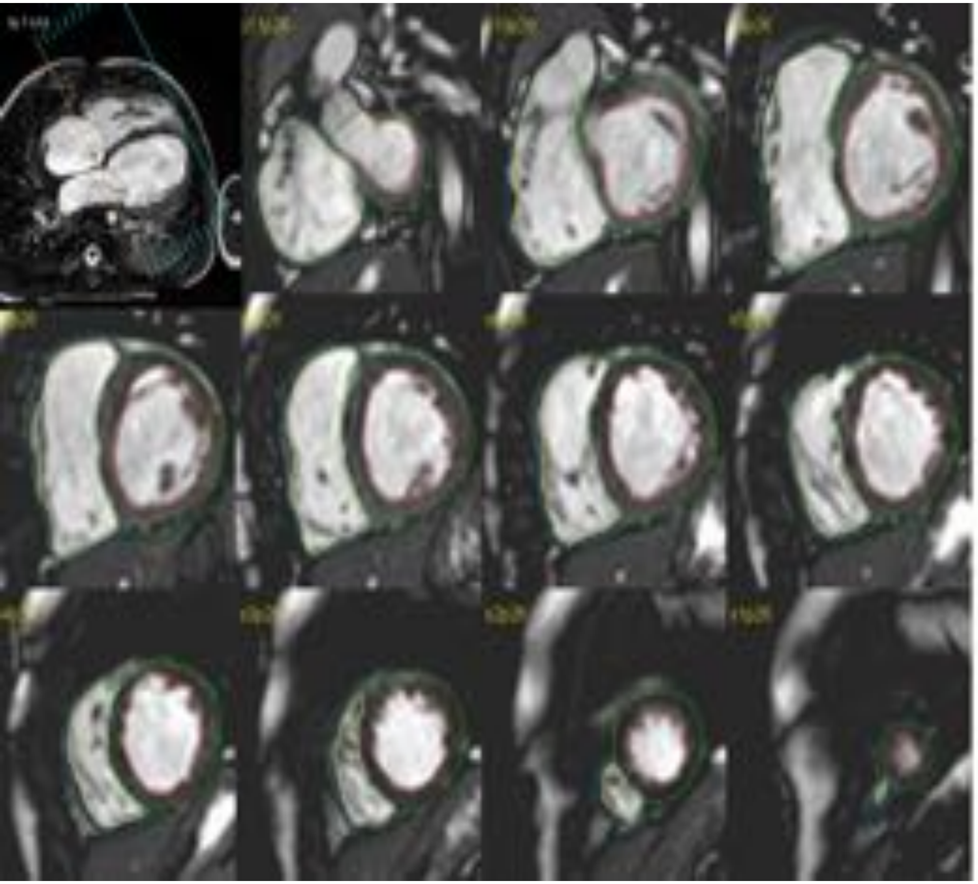
Anatomie

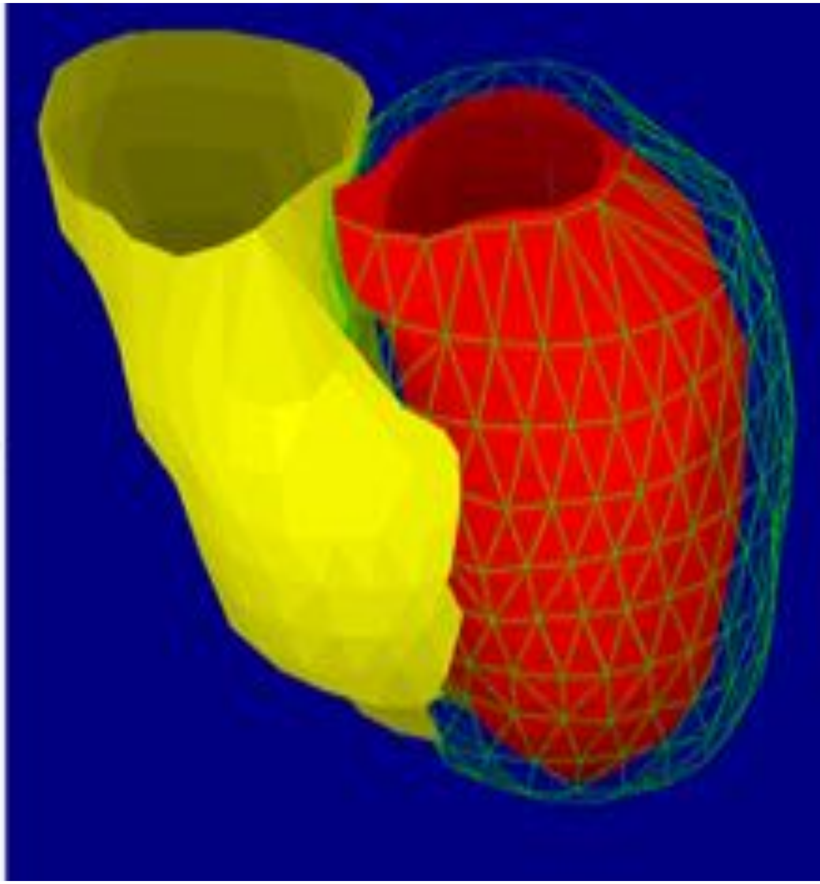

3D
SRP
Volume Rendering No cut
R
P
I
L
A
S
No VOI
4.4mm /1.1sp
DFOV 30.0cm
W = 4095 L = 2048
ILA

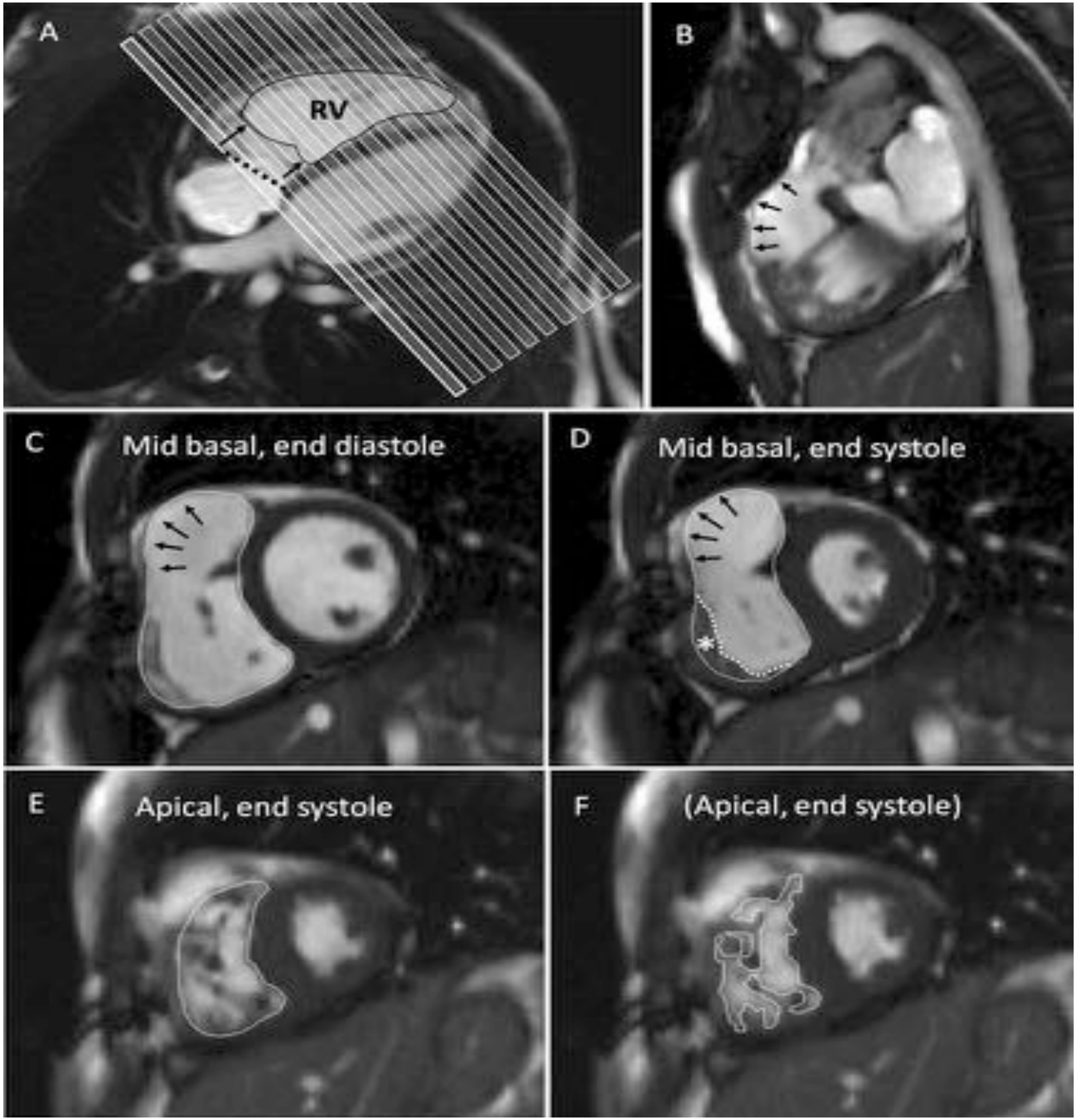
Anatomie

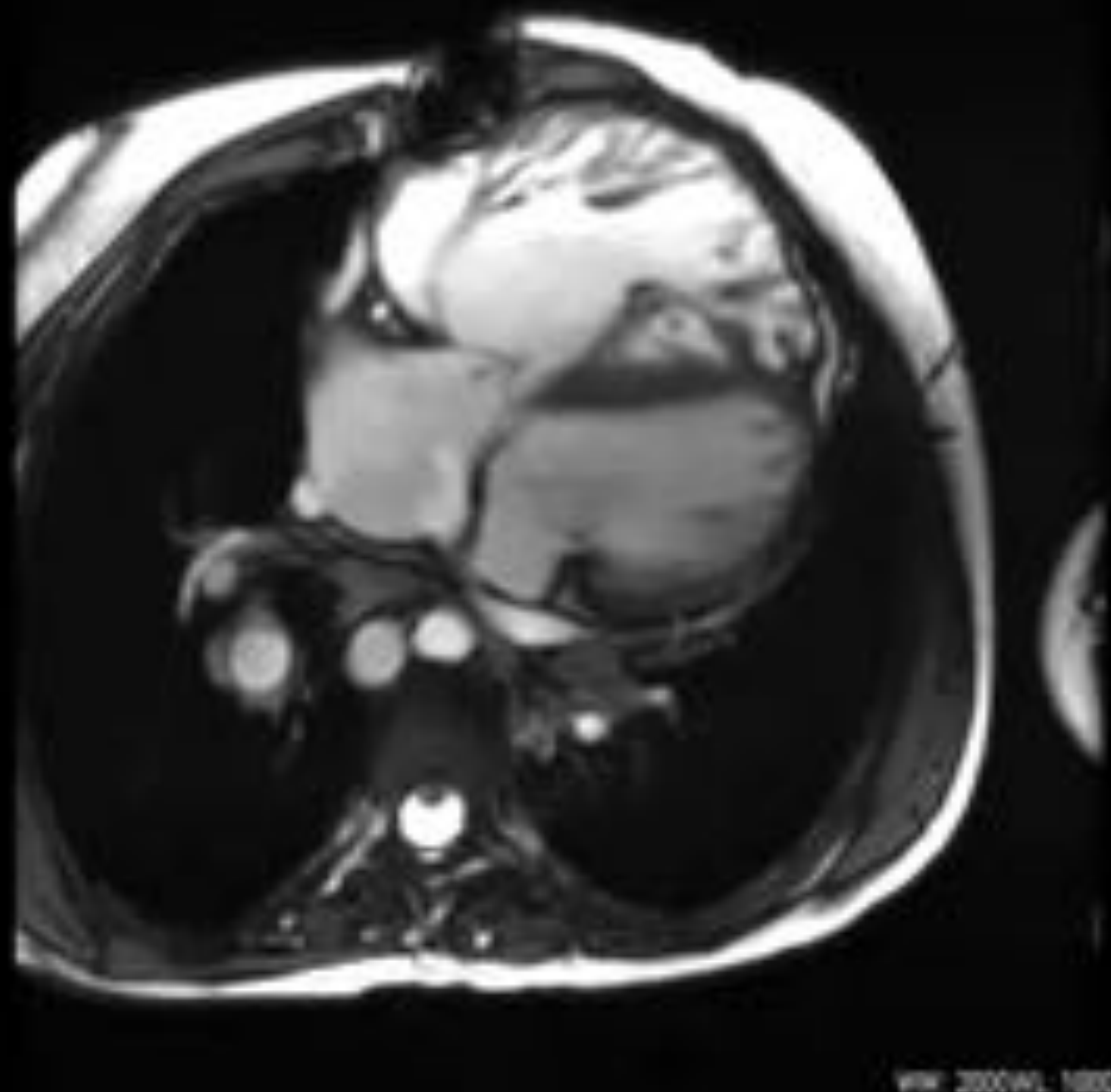

Surface
SAL
Volume Rendering No cut
L
I
A
R
S
P
No VOI
3.0mm /1.9sp
DFOV 22.3 cm
W = 462 L = 209
IPR

Volumes-Fonction

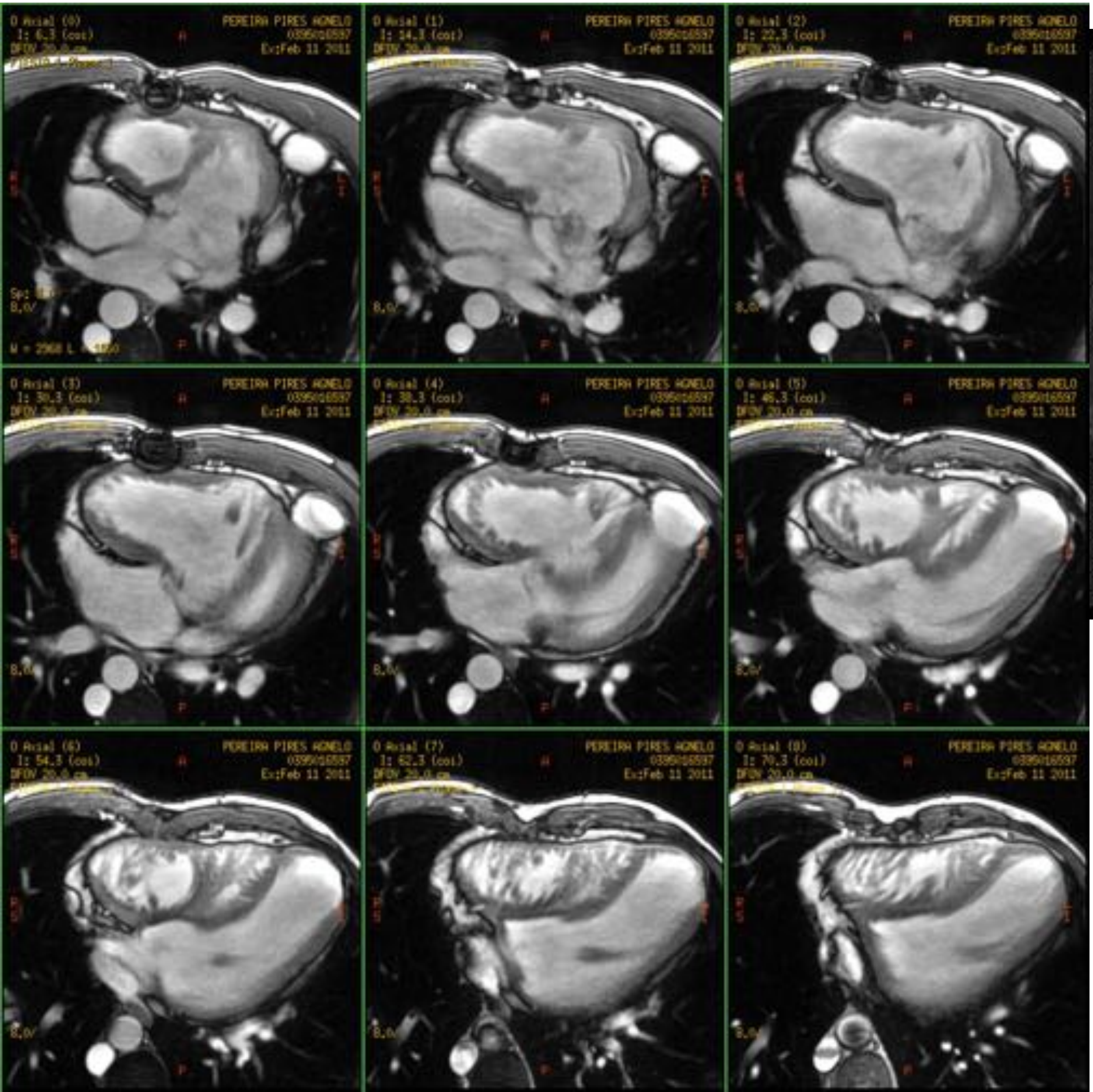


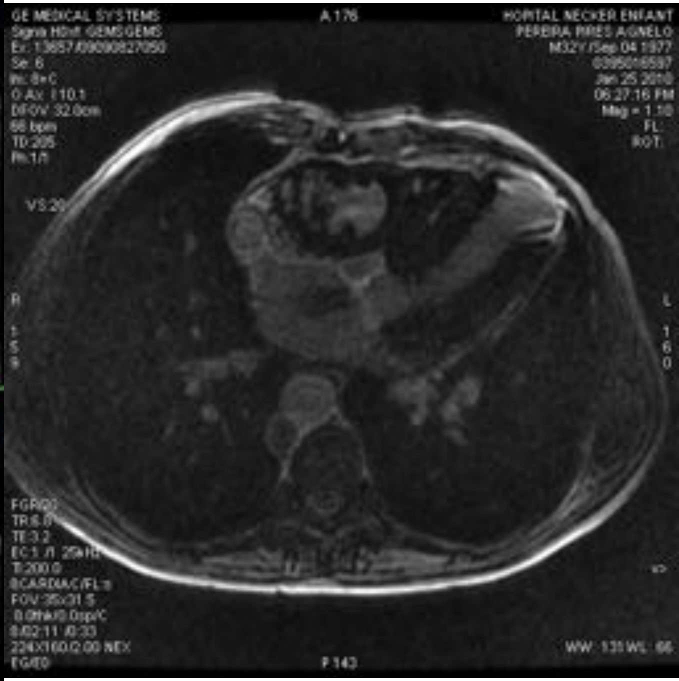



A
RV
B
C
Mid basal, end diastole
D
Mid basal, end systole
E
Apical, end systole
F
(Apical, end systole)

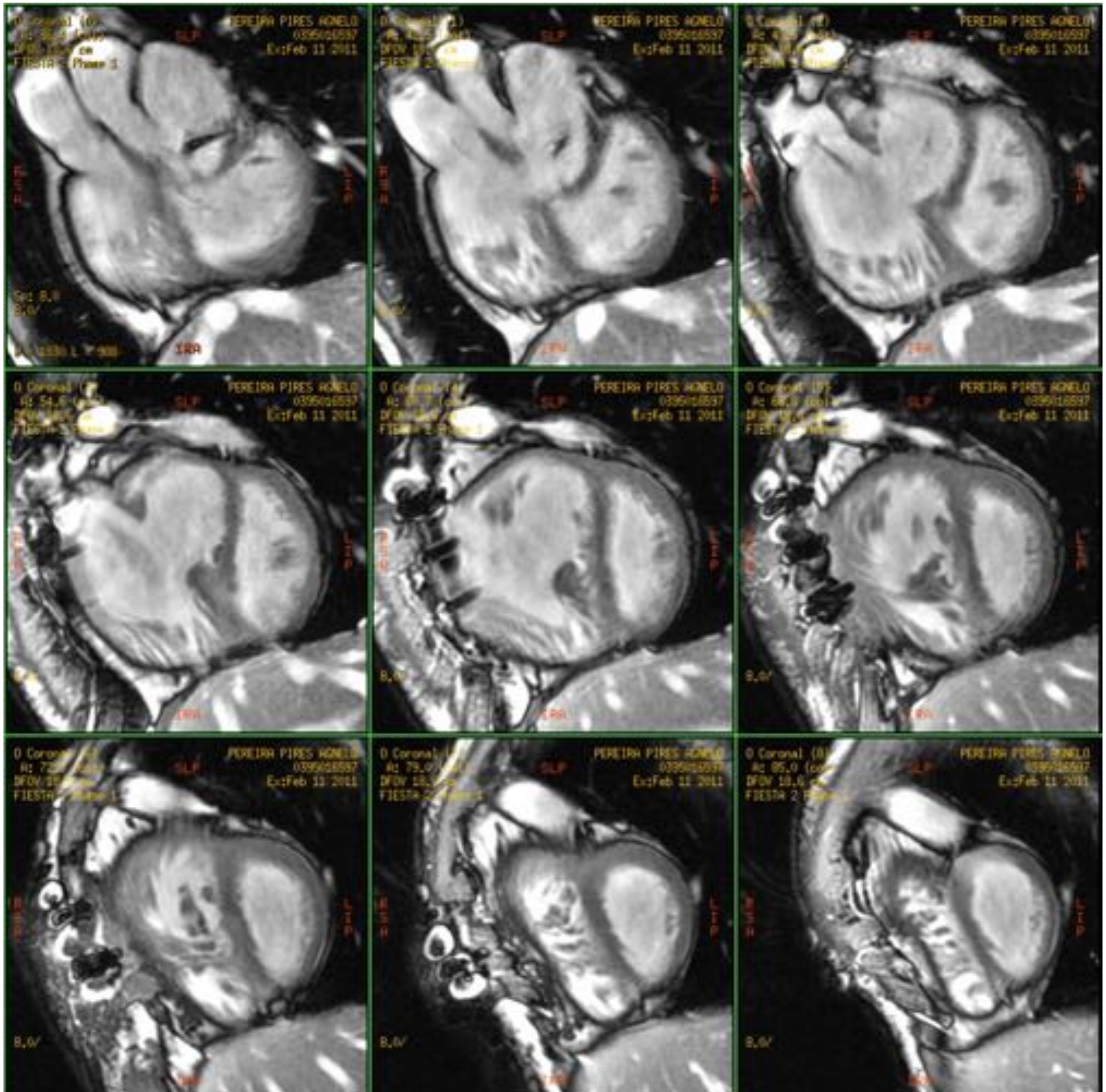


Criss cross

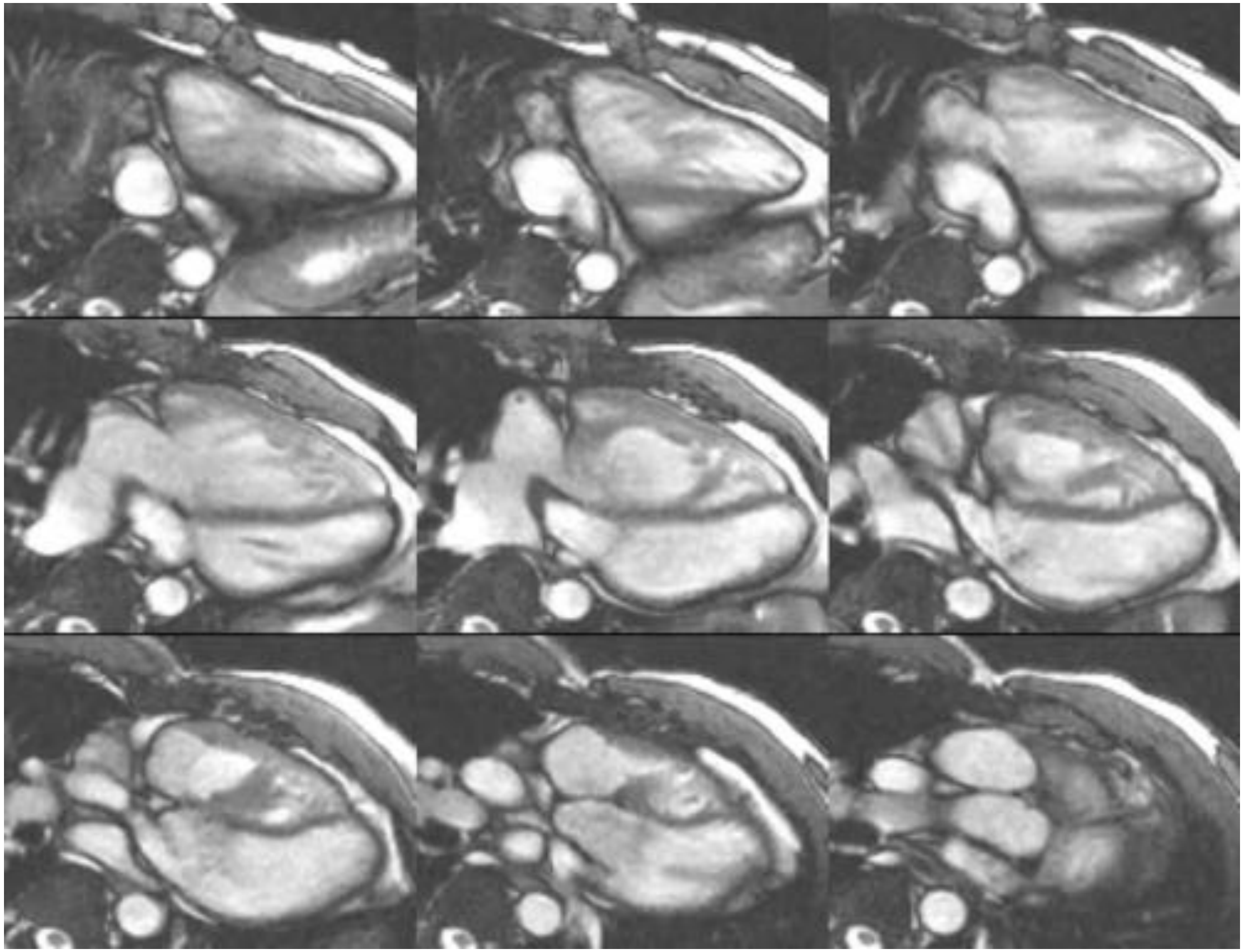




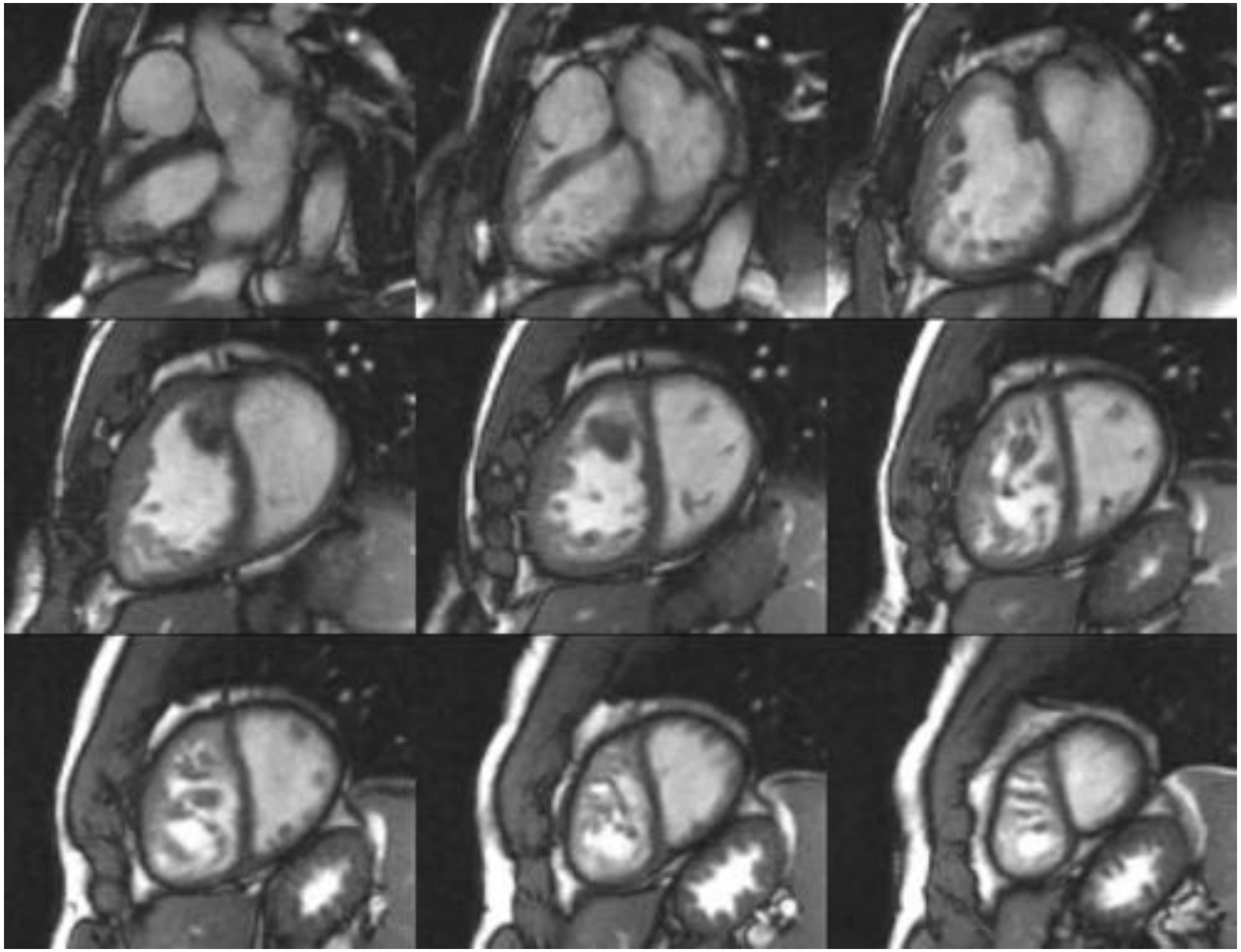
Criss cross



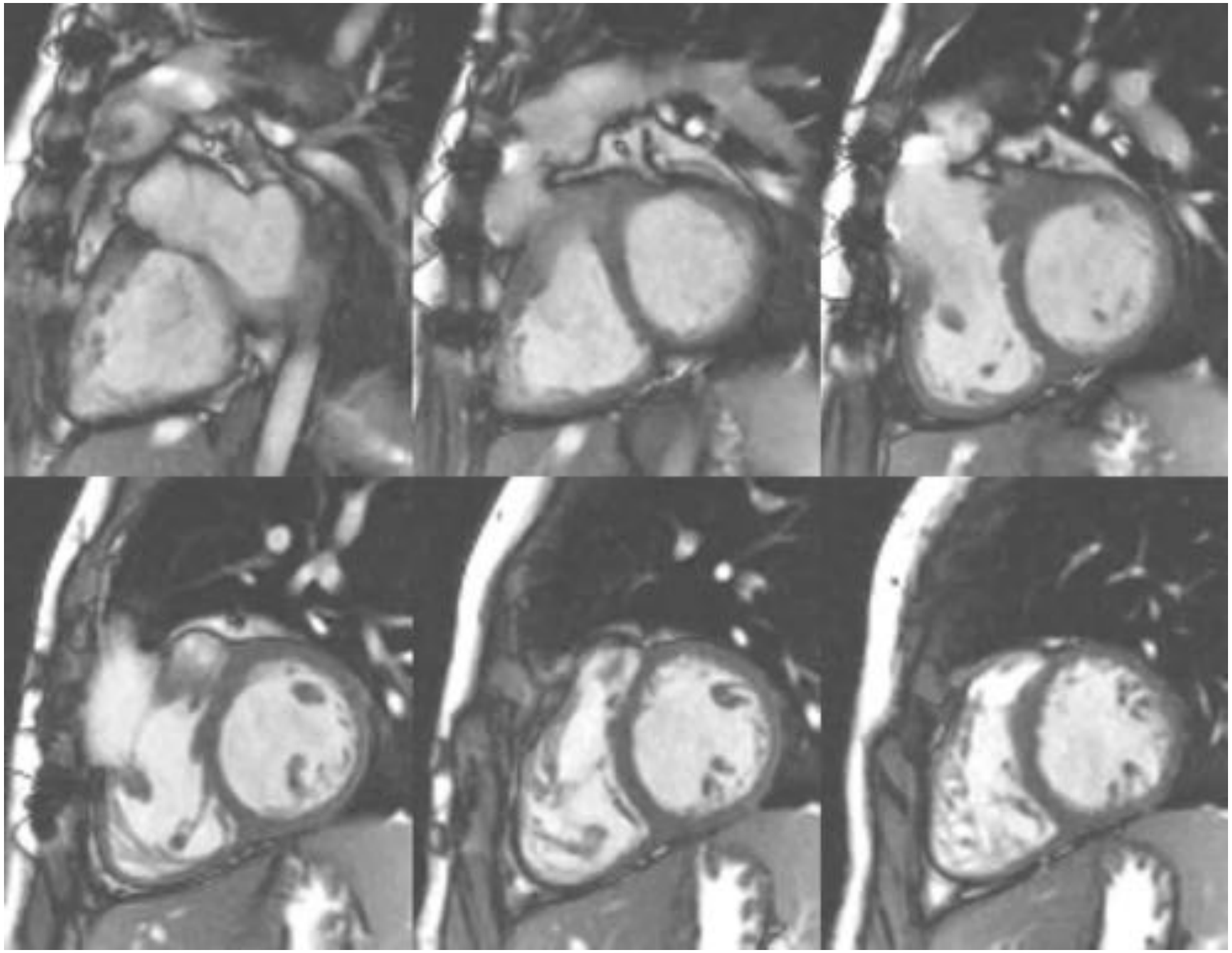
VD systémique / Mustard



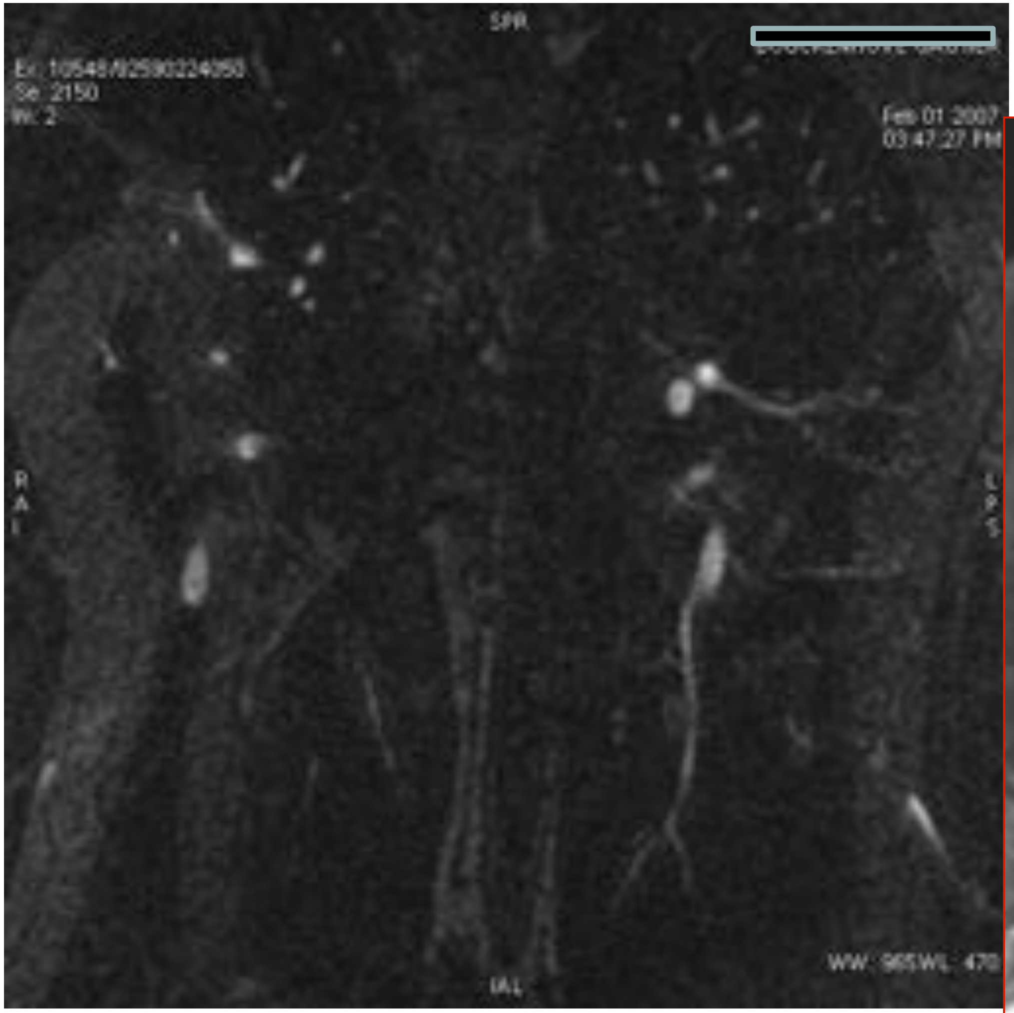
VD systémique / Mustard



Rastelli

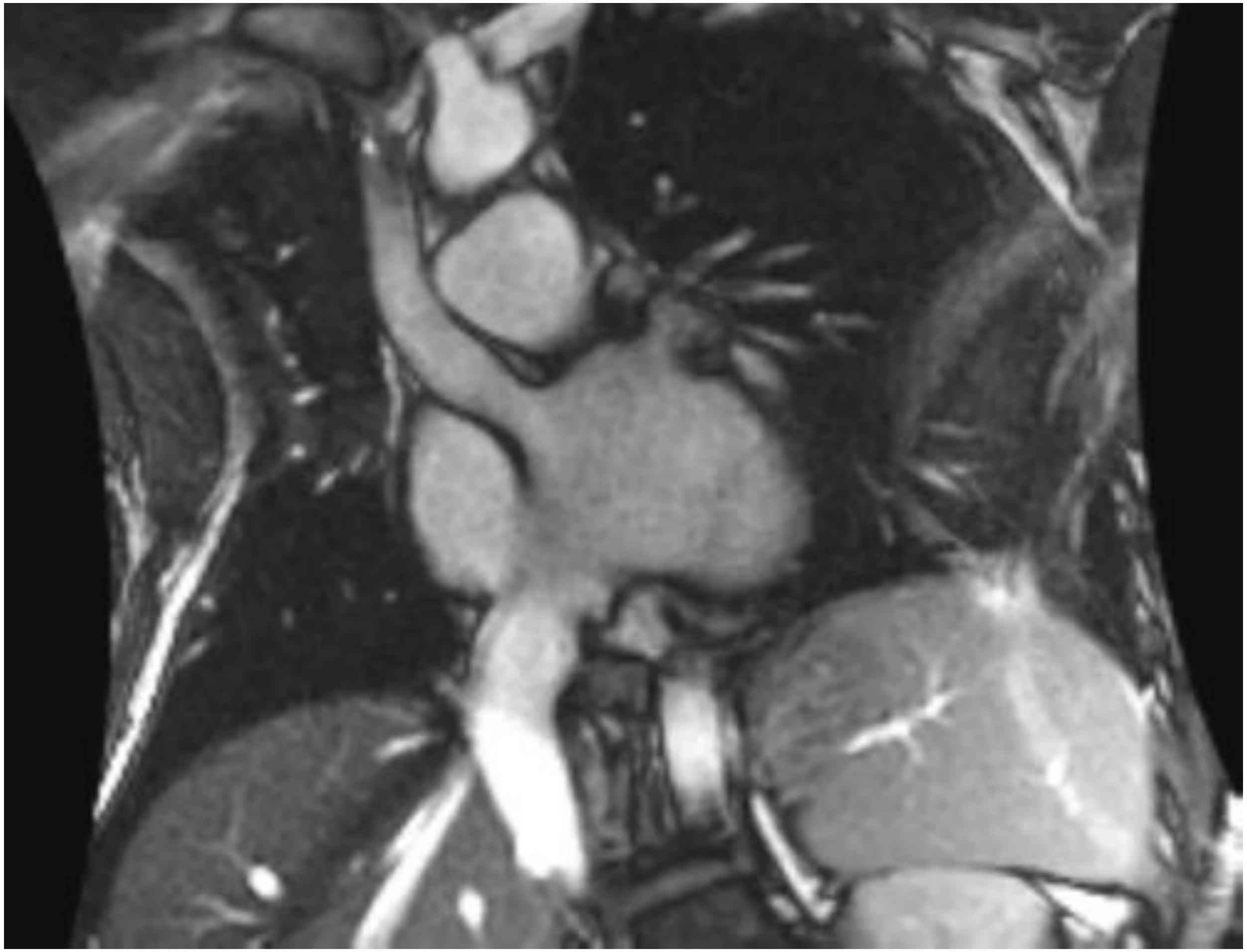


Chenaux atriaux / Mustard

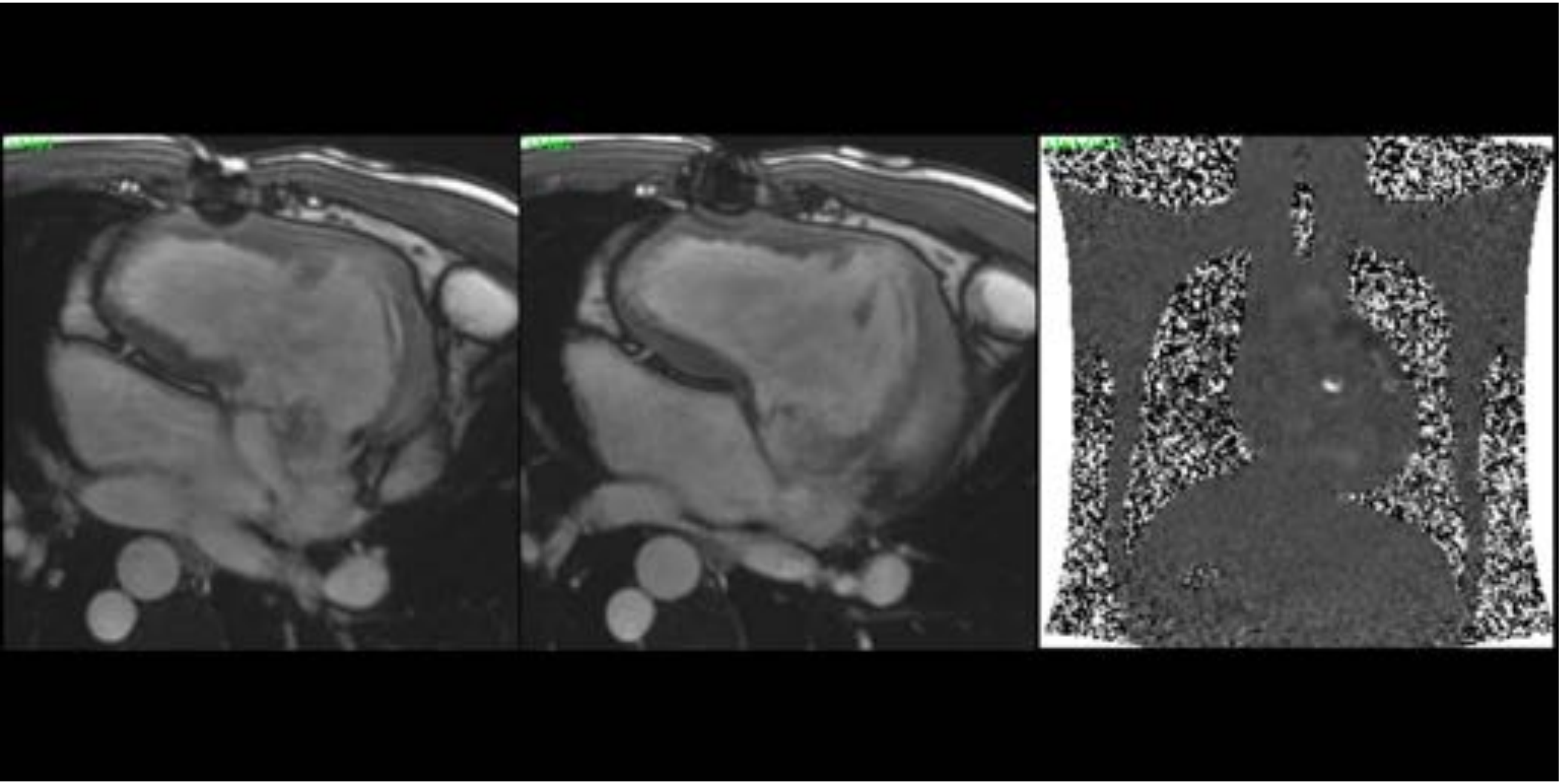


Chenaux atriaux / Mustard

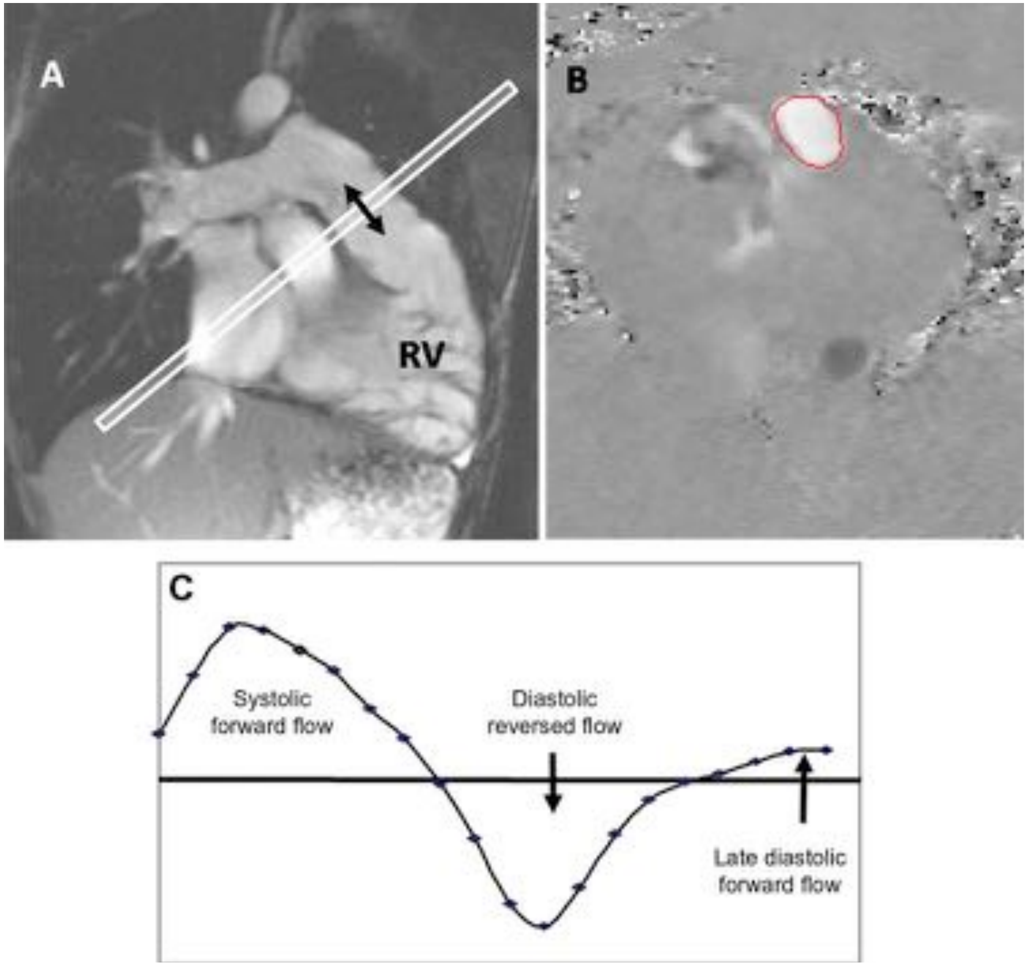
Chenaux atriaux / Senning

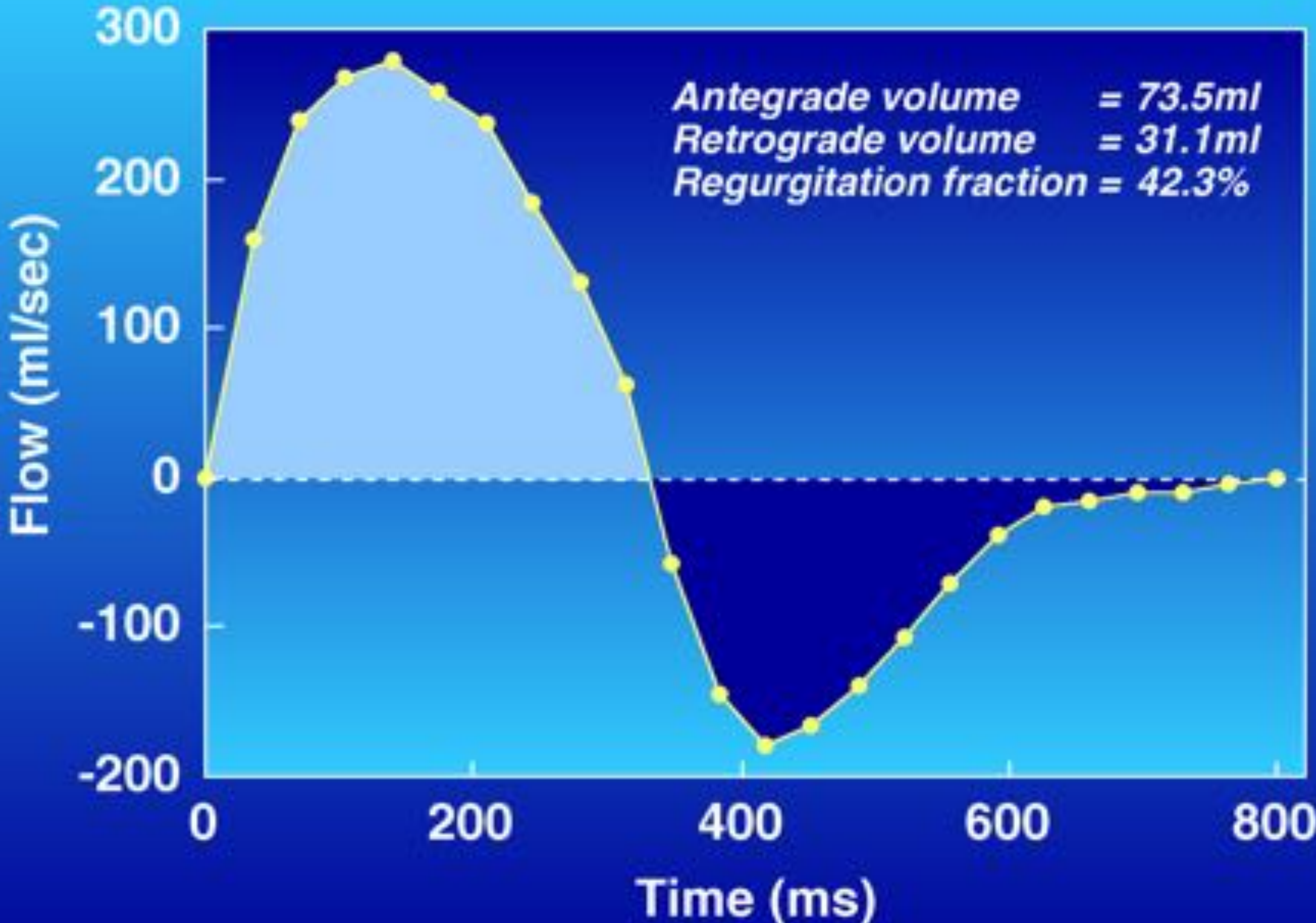


Valves



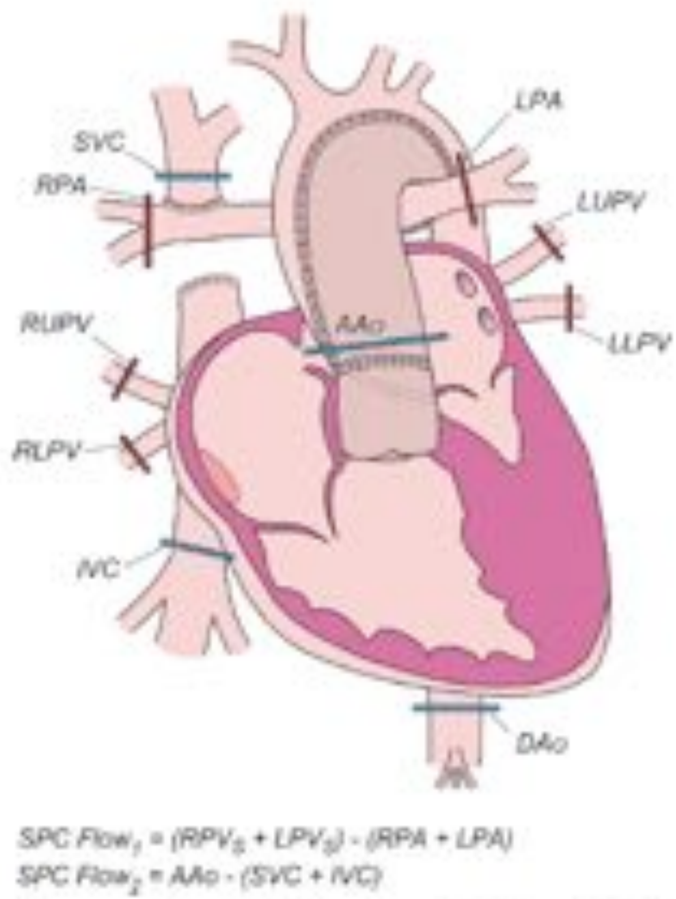
Valves: Velocimetrie

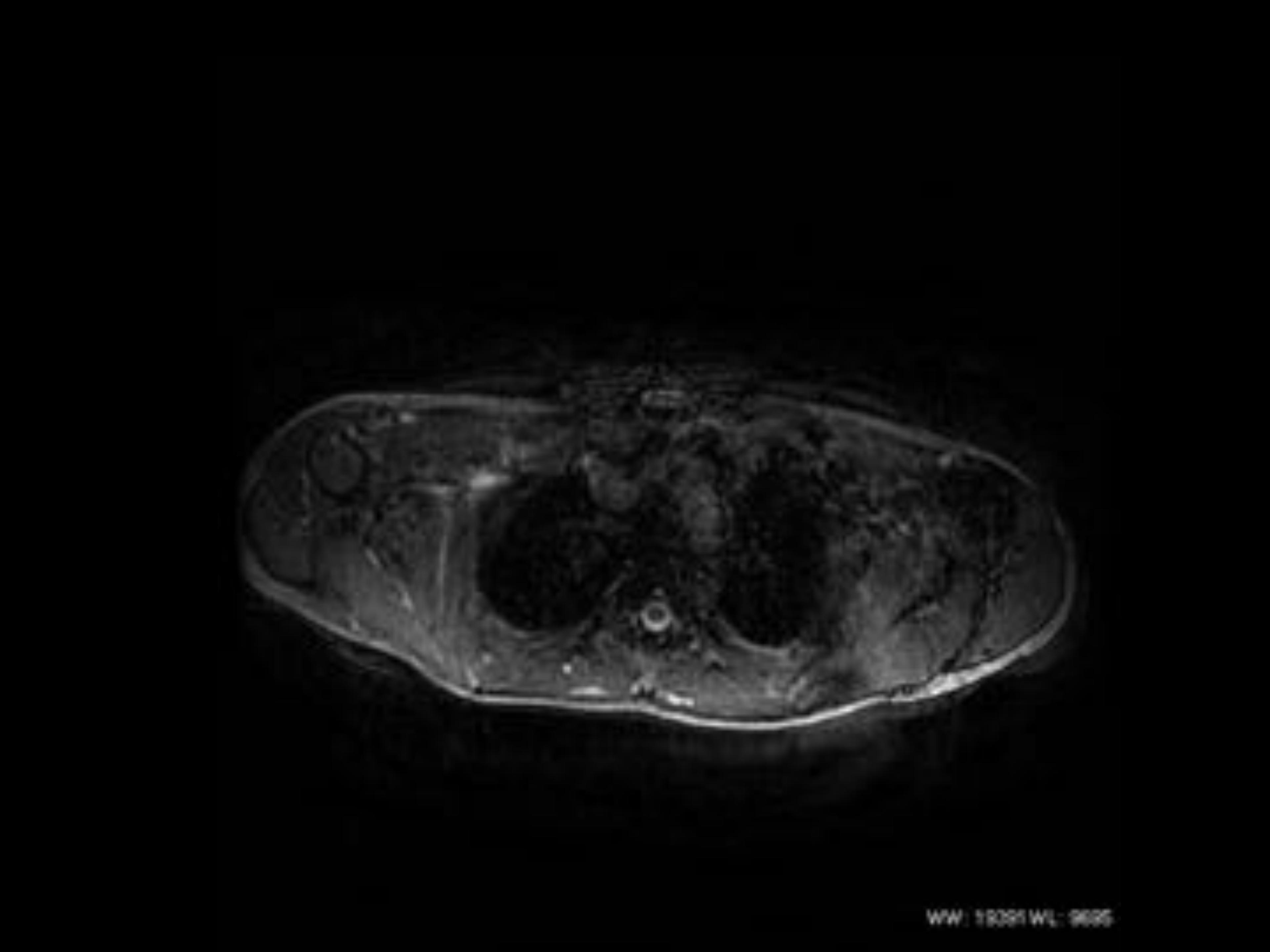


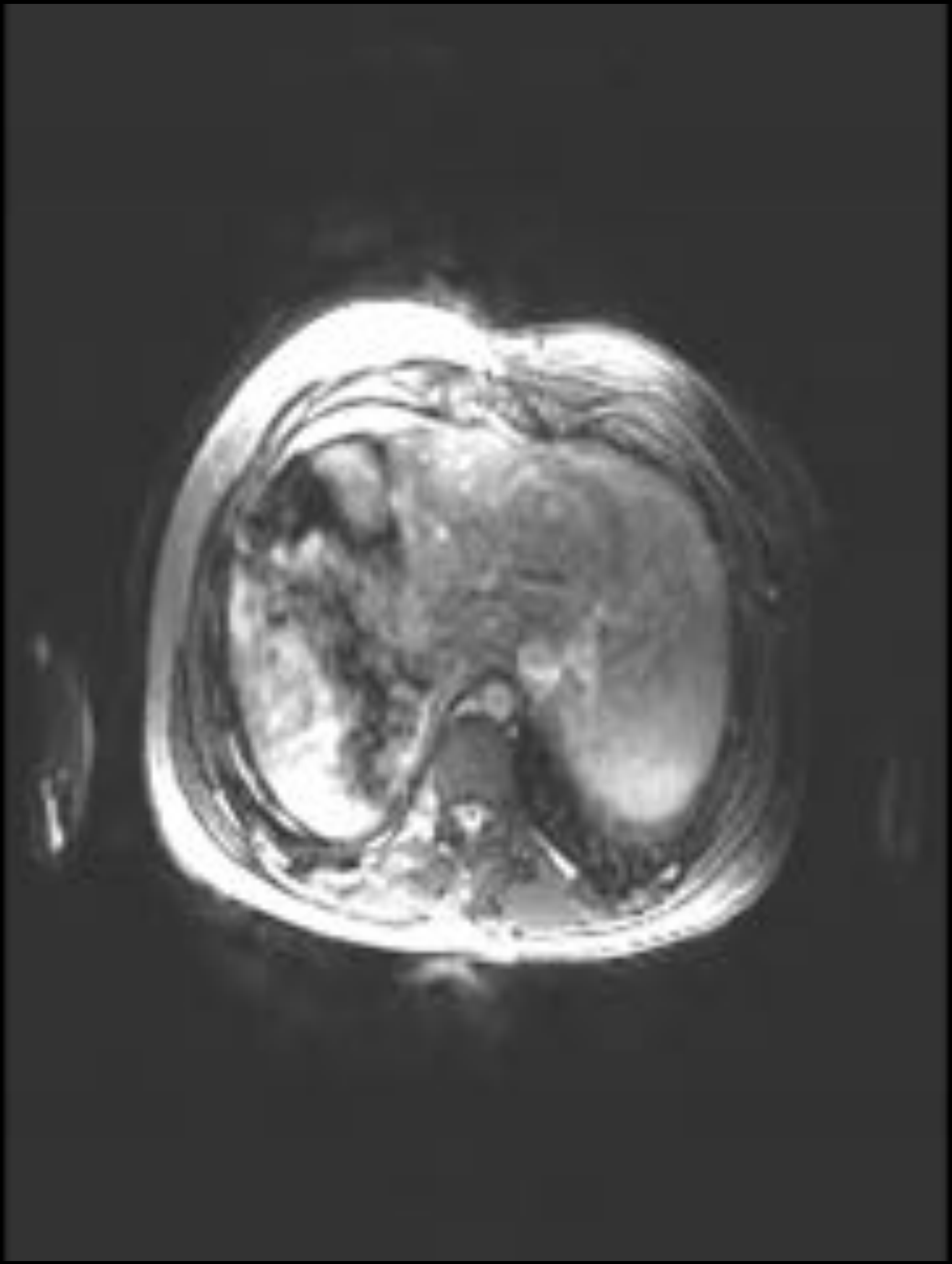

Antegrade volume = 73.5ml
Retrograde volume = 31.1ml
Regurgitation fraction = 42.3%
Flow (ml/sec)
300
200
100
0
-100
-200
0
200
400
600
800
Time (ms)

Fontan

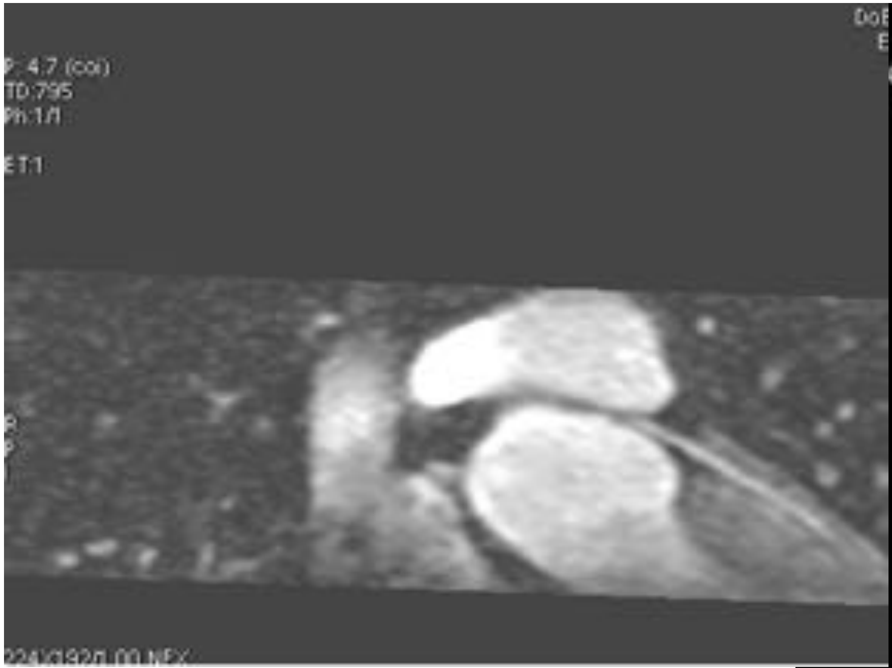
Velocimetrie

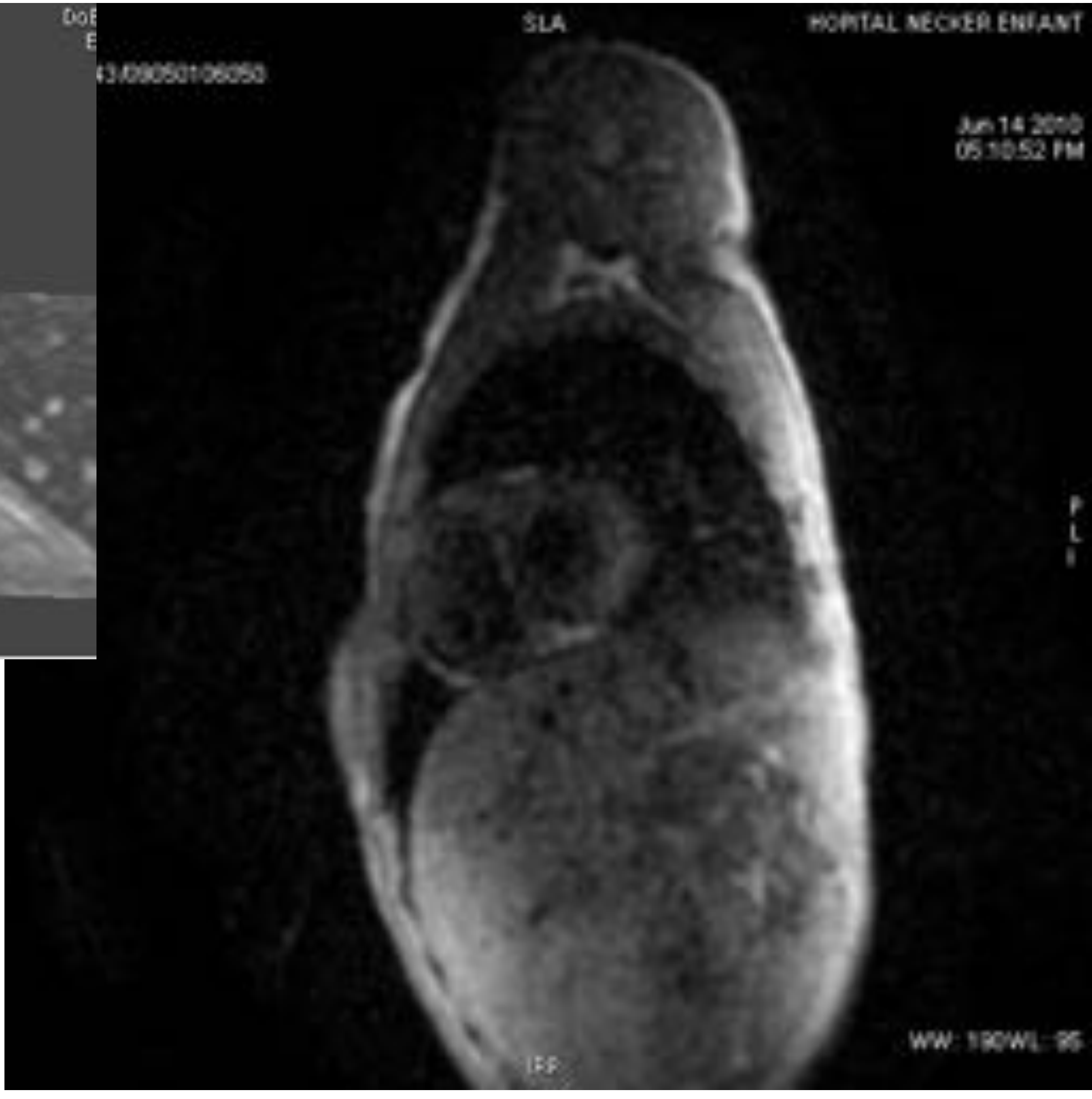






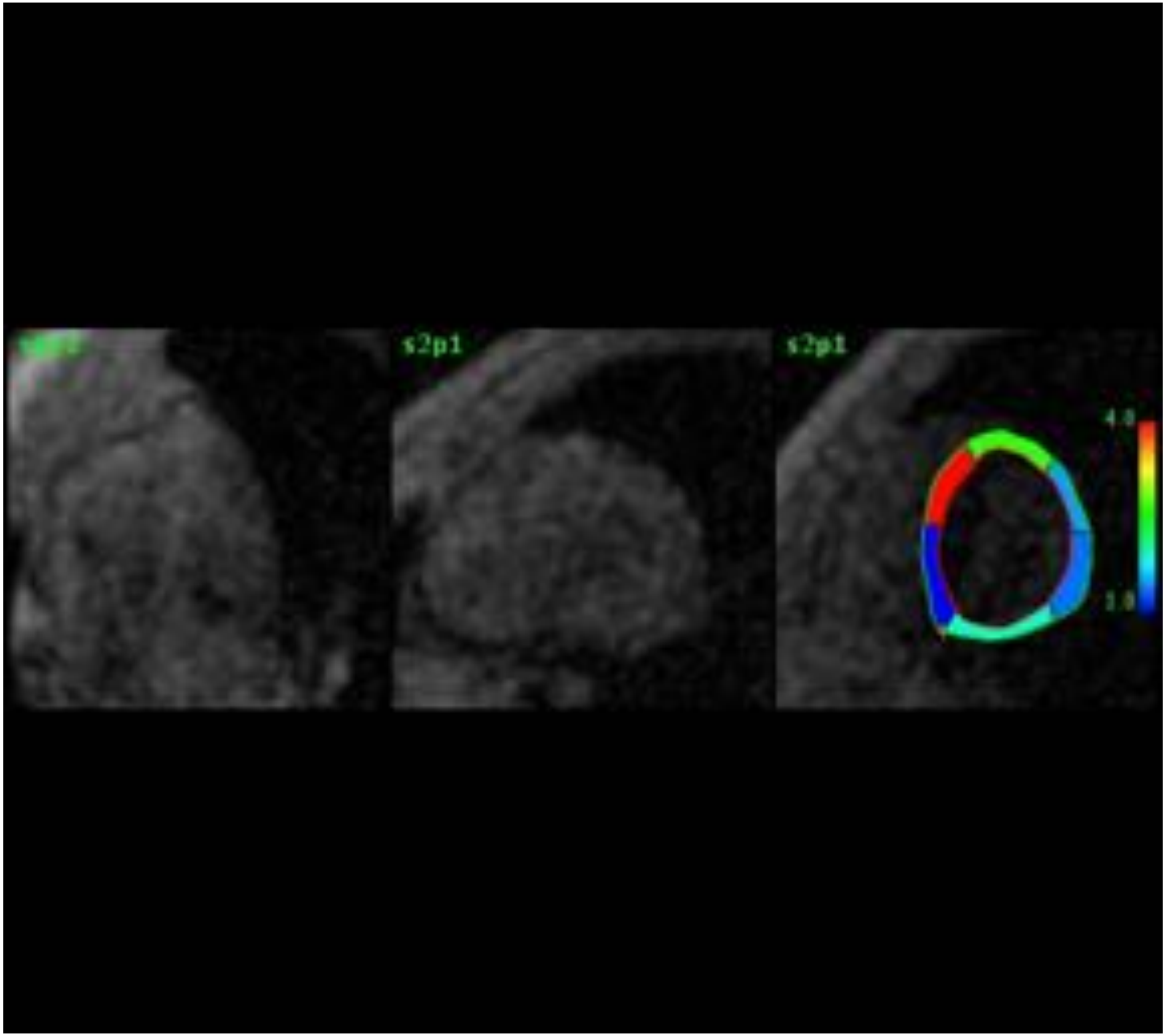
Perfusion myocardique





Réserve coronaire

Réserve coronaire



Réserve coronaire

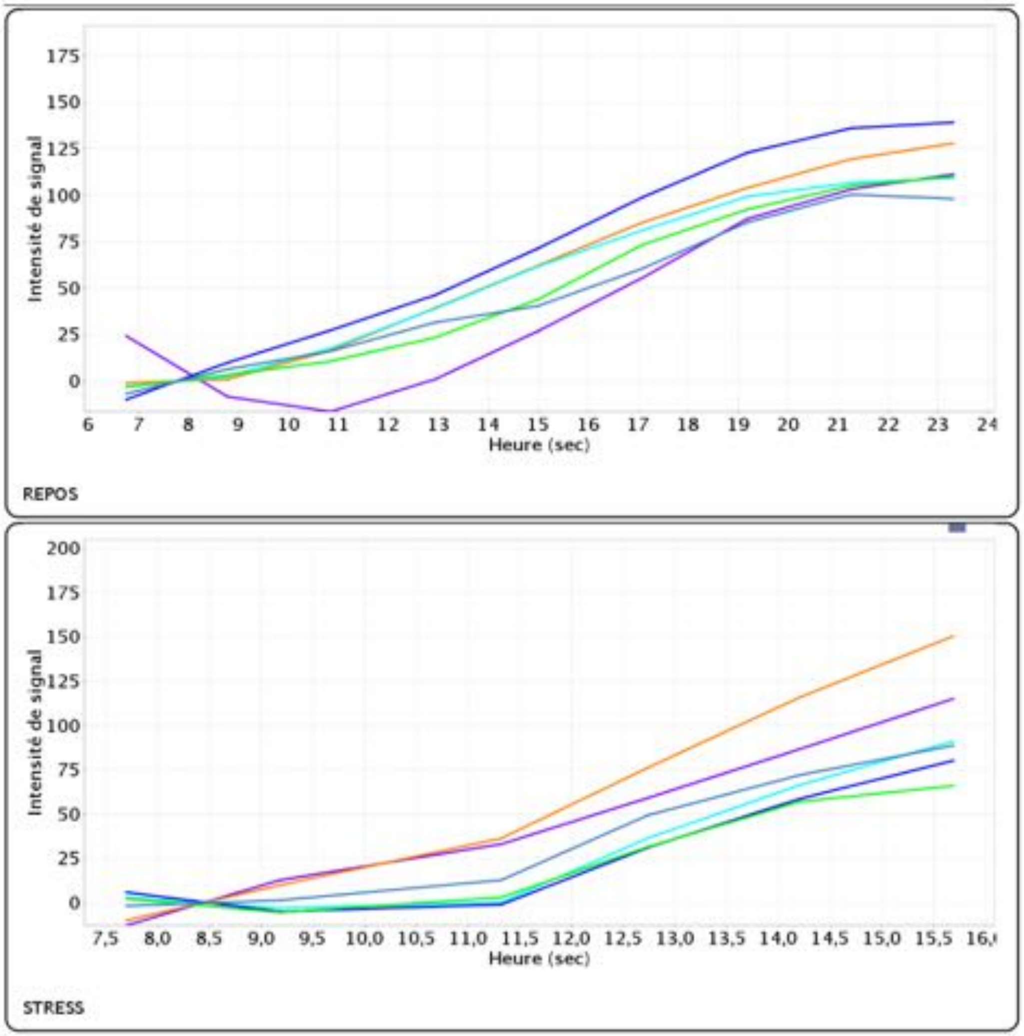
Left Ventricle

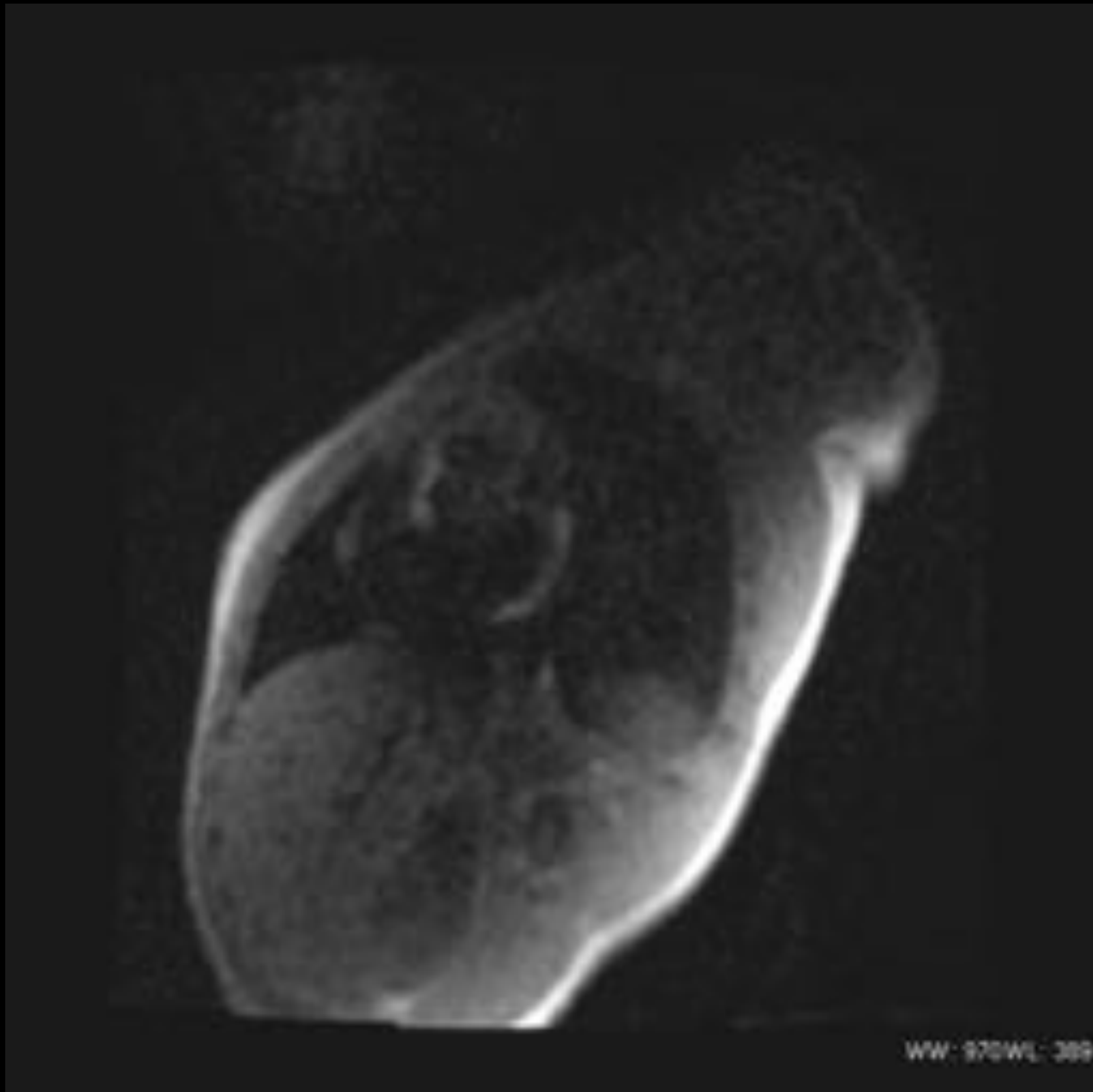
Sector Label	Arrival Time (sec)	Peak Time (sec)	Slope (/sec)	Max Slope (/sec)	Signal Intensity Ratio
1	8,8	21,3	16,7	22,4	1,4
2	8,8	21,3	17,5	24,9	1,1
3	8,8	21,3	22,7	26,2	1,5
4	8,8	21,3	17,8	22	0,9
5	8,8	21,3	19,9	23	0,9
6	10,8	21,3	20,6	30,2	0,7

Left Ventricle

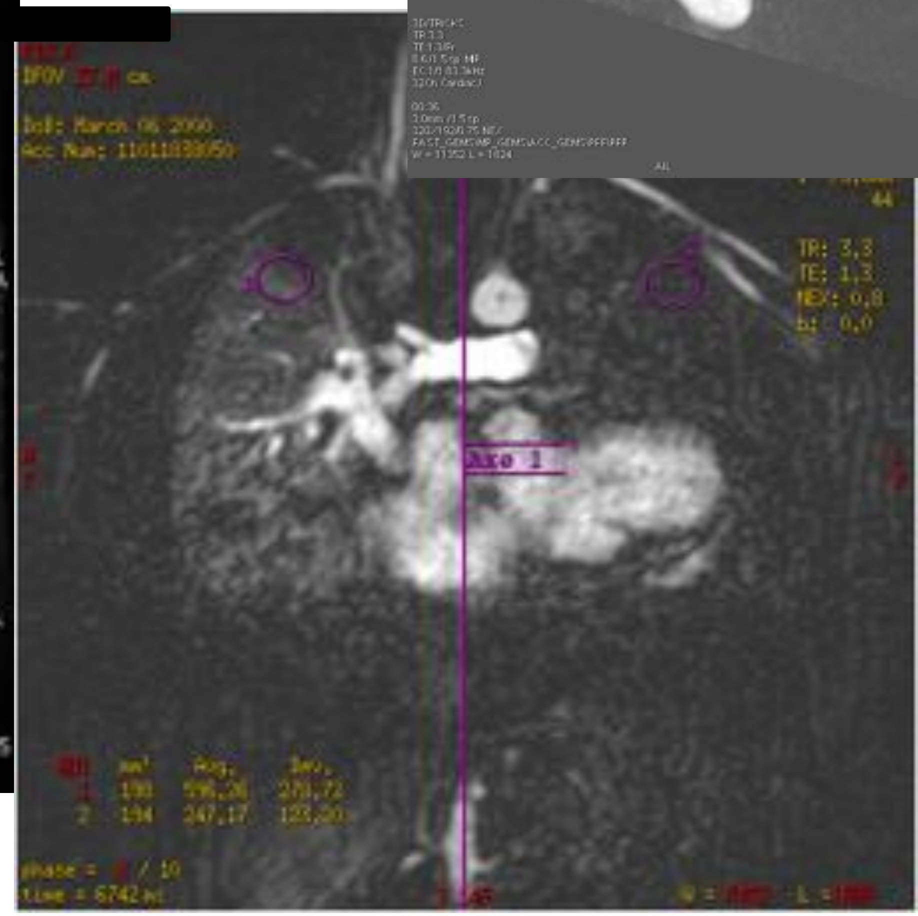
Sector Label	Arrival Time (sec)	Peak Time (sec)	Slope (/sec)	Max Slope (/sec)	Signal Intensity Ratio
1	9,2	14,2	24	29,6	0,7
2	11,3	14,2	28,6	27,1	0,7
3	11,3	14,2	29,2	29,8	0,5
4	11,3	14,2	33,1	33	0,5
5	9,2	14,2	38,7	39,8	0,8
6	9,2	14,2	28,9	26,8	0,6

Réserve coronaire

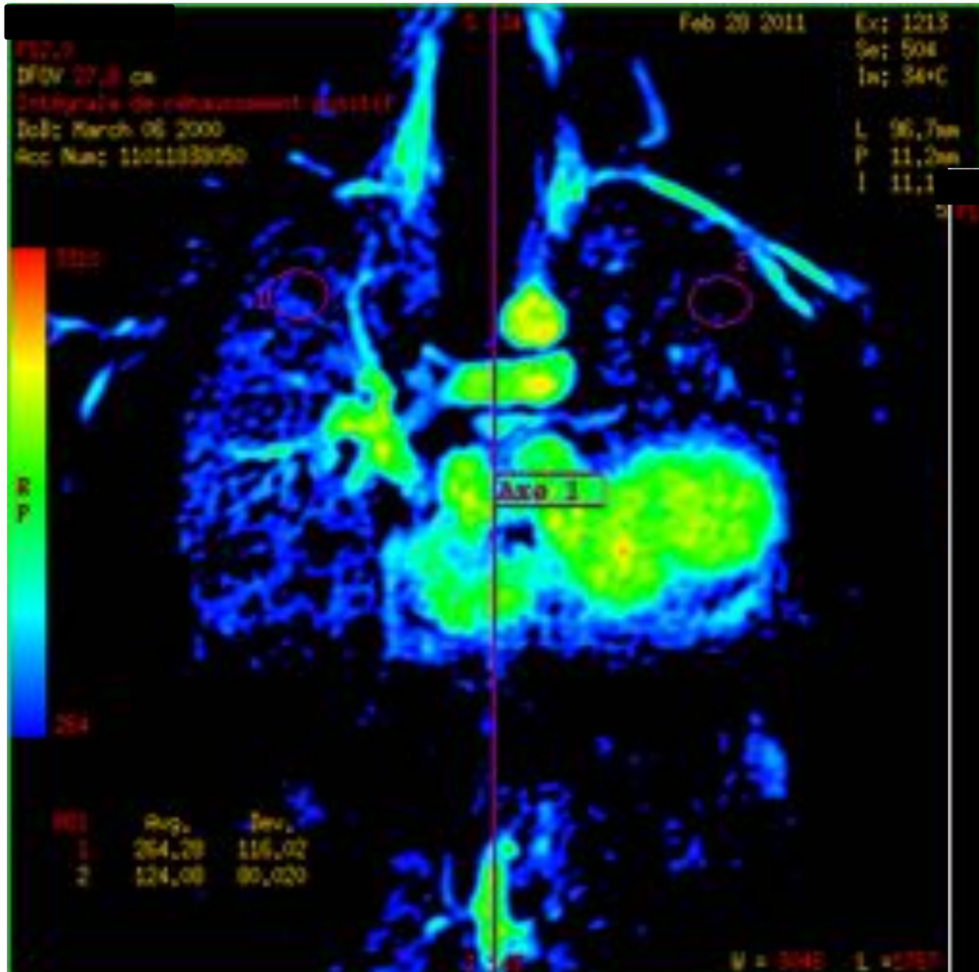


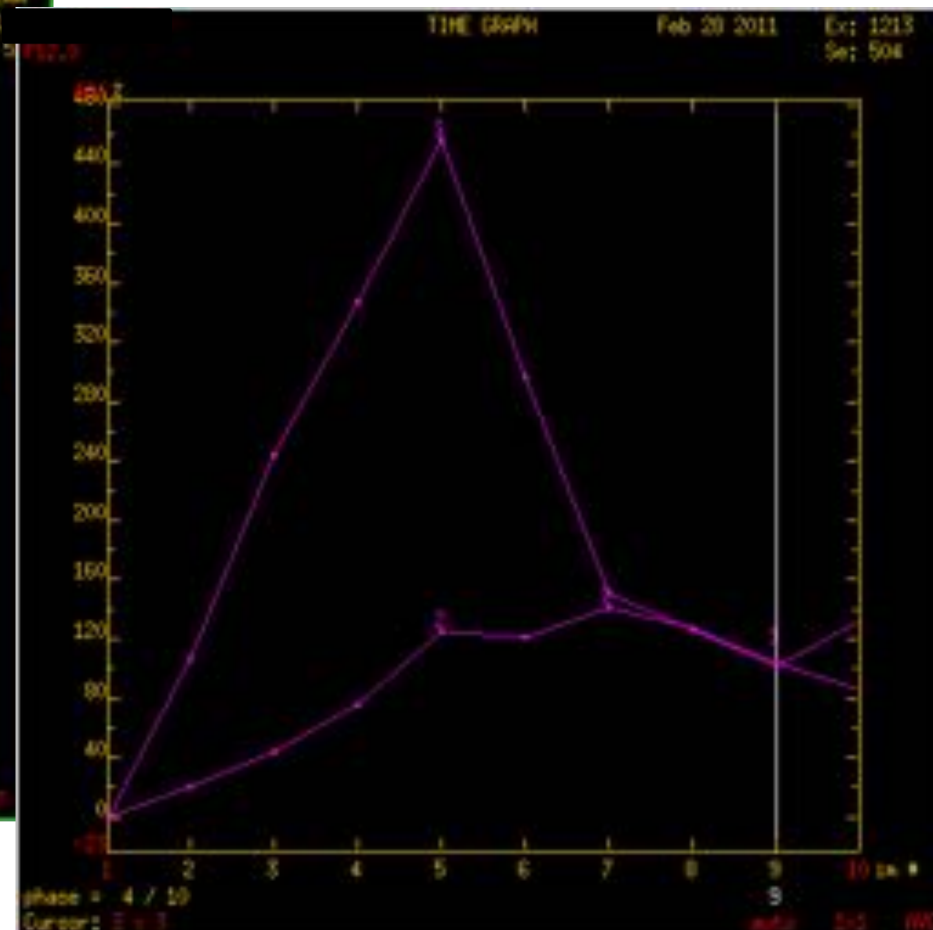


Perfusion pulmonaire



Perfusion pulmonaire





Analyse tissulaire

- *Oedeme*
- *Graisse*
- *Fibrose*
- *Composition tissulaire (spetroscopie)*

Analyse tissulaire

- Pathologies inflammatoire: myocardite aigue, péricardite
- Myocardiopathies: hypertrophique, dilatative, dysplasie arytmogène du ventricule droit
- Recherche de fibrose ventriculaire dans les cardiopathies congenitales (VD systemique, Tetralogie de Fallot, ALCAPA etc)
- Pathologies avec altération de la composition tissulaire (pathologies métaboliques, glycogénose, amyloïdes, Fabry disease)

Analyse tissulaire

- ***Edema***
- T2-weighted image sensitivity detects tissue edema with the long
- T2 of water bound protons as the contrast-generating mechanism, resulting in a high signal intensity of edematous tissue.

- ***Hyperemia and capillary leak (myocardial early gadolinium enhancement)***
- Contrast-enhanced fast spin-echo T1-weighted MR is used to assess myocardial hyperemia and inflammation.

- ***Necrosis and fibrosis (late gadolinium enhancement [LGE])***
- Myocardial LGE reflects irreversible myocardial injury (i.e., necrosis and fibrosis

- *Schultz JS, et al. Mayo Clin Proc. 2009*

Acute myocarditis

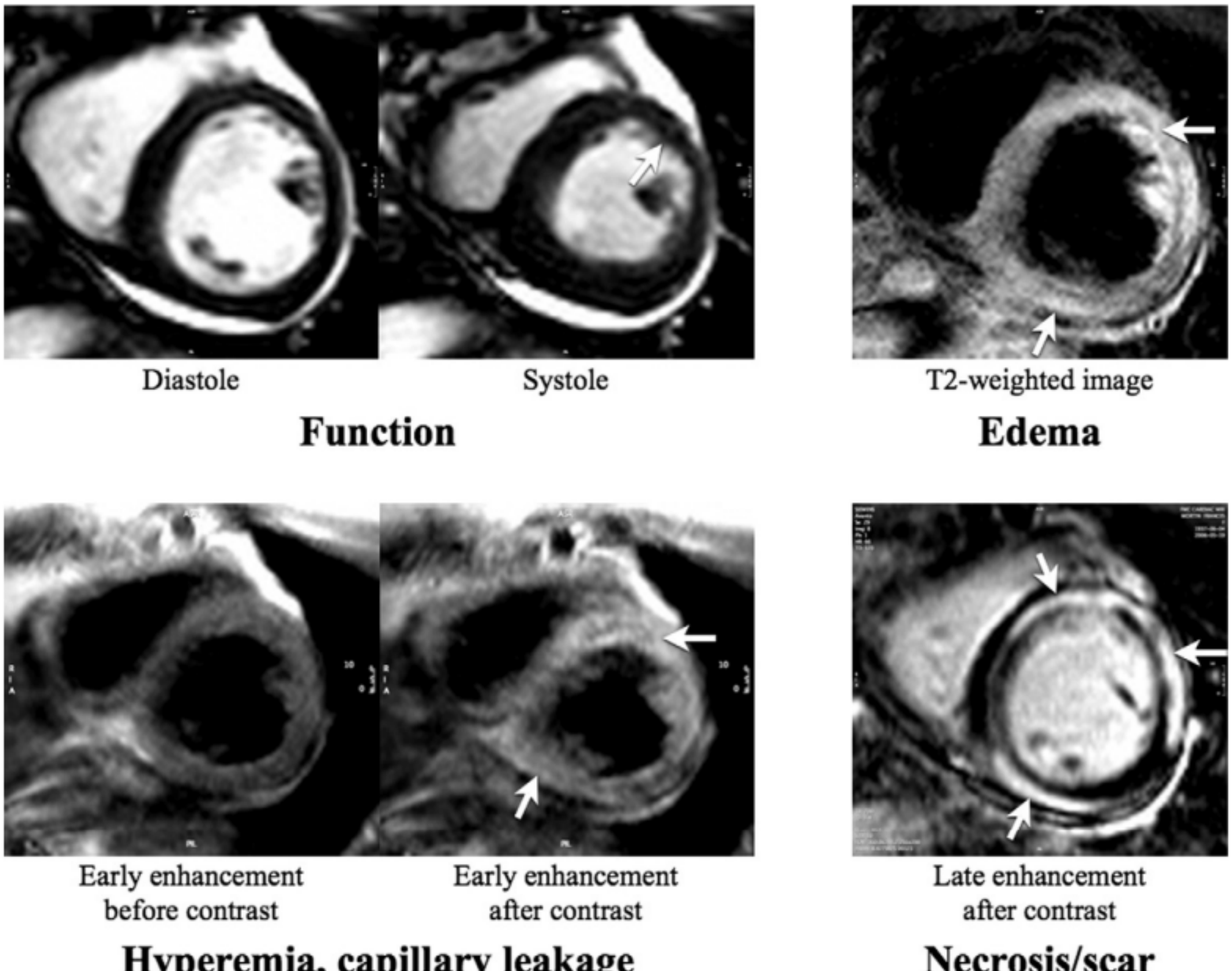
<u>*Cardiovascular Magnetic Resonance*</u>

- Primary tool for non invasive assessment of myocardial inflammation

- *Diagnostic CMR targets*:

1. Functional abnormalities
2. Pericardial effusion
3. Morphological abnormalities
4. Tissue characterization

Myocardite aigue



CMR in Acute myocarditis

Table 1
Published controlled studies on CMR in myocarditis

	Validation	n *patients*	n *controls*
Friedrich et al., Circulation 1998 (9)	Clinical	19	18
Laissy et al., Chest 2002 (11)	Clinical	20	7
Rieker et al., RoFo 2002 (36)	Clinical	11	10
Laissy et al., Radiology 2005 (37)*	Clinical	24	31
Abdel-Aty et al., J Am Coll Cardiol 2005 (13)	Clinical	25	22
Mahrholdt et al., Circulation 2006 (40)	Histology	87	26
Gutberlet et al., Radiology 2008 (34)**	Histology	48	35
Yilmaz et al., Heart 2008 (43) **	Histology	55	30
		289	**179**

* Comparison to patients with acute myocardial infarction.
** Comparison to patients with clinical evidence, but lack of immunohistologic evidence for chronic myocarditi:

Myocardite aigue

Table 9

Overview of the Diagnostic Accuracy of Individual Tissue Criteria as Assessed in Controlled Trials

	Validation	Sensitivity (%)	Specificity (%)	Accuracy (%)	PPV (%)	NPV (%)
Early myocardial gadolinium enhancement						
Friedrich et al., *Circulation* 1998 (9)	Clinical	84	89	86	89	84
Laissy et al., *Chest* 2002 (11)	Clinical	85	100	89	100	70
Abdel-Aty et al., *J Am Coll Cardiol* 2005 (13)	Clinical	80	68	74	74	75
Gutberlet et al., *Radiology* 2008 (34)	Histology	63	86	72	86	63
Pooled data (n = 184)		74	83	78	88	70
T2						
Rieker et al., *Rofo* 2002 (36)	Clinical	100	50	76	69	100
Laissy et al., *Chest* 2002 (11)	Clinical	45	100	59	100	39
Abdel-Aty et al., *J Am Coll Cardiol* 2005 (13)	Clinical	84	74	79	78	81
Gutberlet et al., *Radiology* 2008 (34)	Histology	67	69	67	74	60
Pooled data (n = 179)		70	71	70	77	63
Late enhancement						
Rieker et al., *Rofo* 2002 (36)	Clinical	45	60	52	56	50
Abdel-Aty et al., *J Am Coll Cardiol* 2005 (18)	Clinical	44	100	71	78	62
Mahrholdt et al., *Circulation* 2006 (40)	Histology	95	96	96	90	91
Gutberlet et al., *Radiology* 2008 (34)	Histology	27	80	49	65	44
Yilmaz et al., *Heart* 2008 (43)	Histology	35	83	51	81	38
Pooled data (n = 336)		59	86	68	89	53

Abbreviations as in Table 2.

CMR in Acute myocarditis

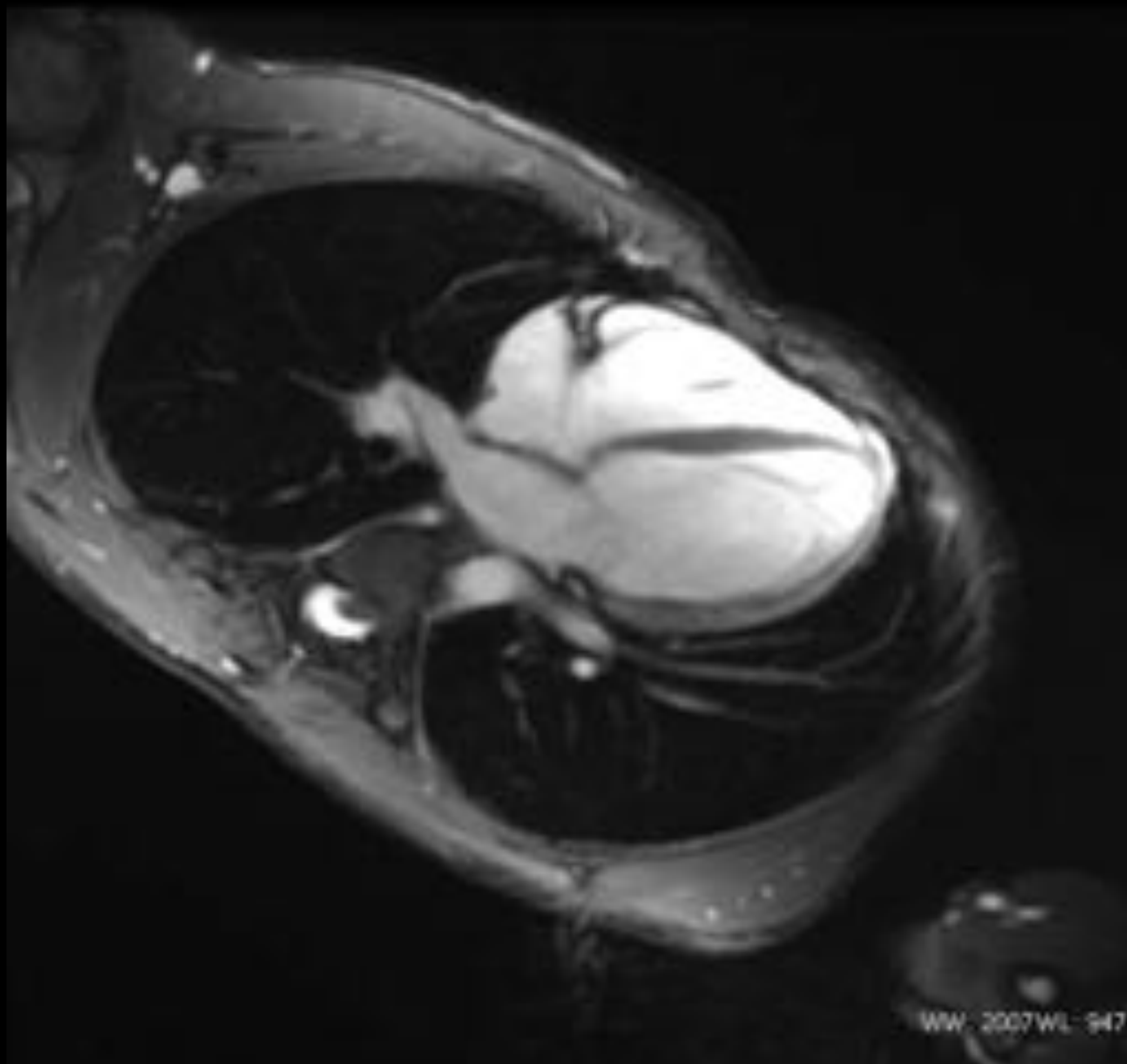
Table 4

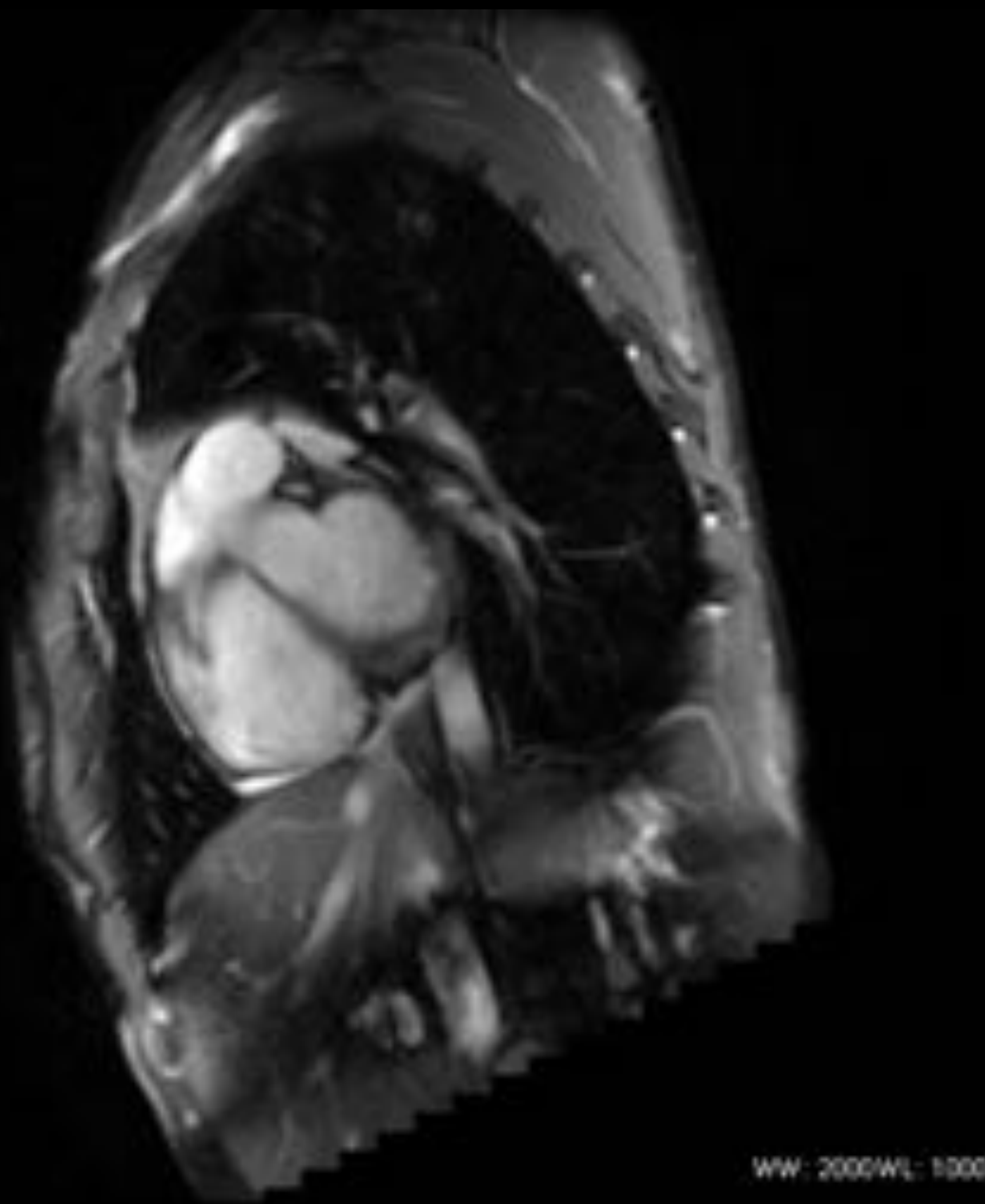
Overview of the Diagnostic Accuracy of Several Combinations of Tissue Criteria

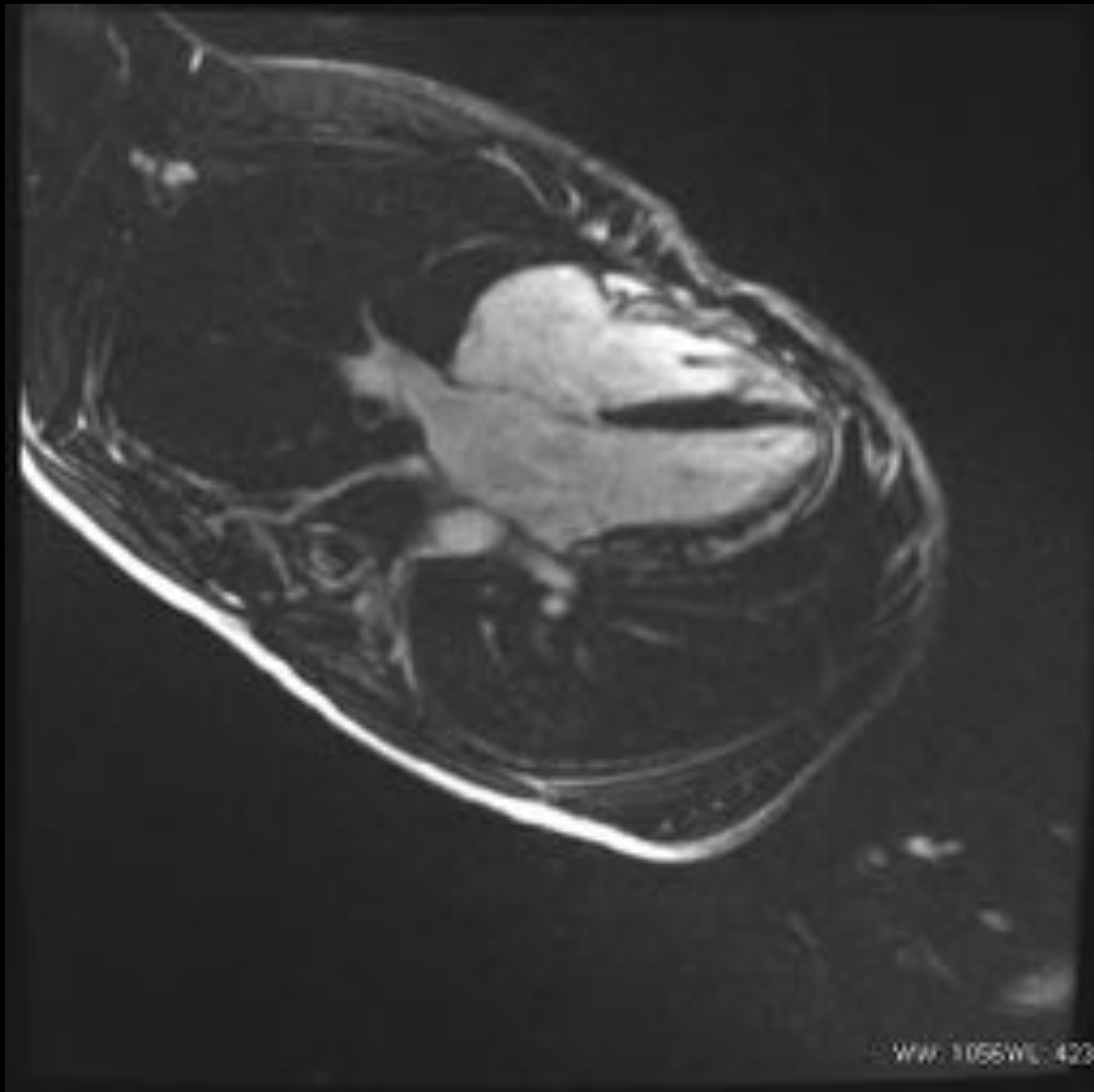
	Validation	Sensitivity (%)	Specificity (%)	Accuracy (%)	PPV (%)	NPV (%)
T2 + LGE						
Abdel-Aty et al., *J Am Coll Cardiol* 2005 (13)	Clinical	40	100	69	100	61
Gutberlet et al., *Radiology* 2008 (34)	Histology	17	91	48	73	44
Pooled data (n = 130)		25	95	56	86	50
T2 and/or LGE						
Abdel-Aty et al., *J Am Coll Cardiol* 2005 (13)	Clinical	88	74	81	100	85
Gutberlet et al., *Radiology* 2008 (34)	Histology	50	57	52	80	25
Pooled data (n = 130)		80	66	62	79	43
Any 1 of 3						
Abdel-Aty et al., *J Am Coll Cardiol* 2005 (13)	Clinical	100	48	75	58	100
Gutberlet et al., *Radiology* 2008 (42)	Histology	81	49	67	68	65
Pooled data (n = 130)		88	48	73	68	76
Any 2 of 3						
Abdel-Aty et al., *J Am Coll Cardiol* 2005 (13)	Clinical	76	96	85	95	79
Gutberlet et al., *Radiology* 2008 (34)	Histology	63	89	73	88	63
Pooled data (n = 130)		67	91	78	91	69

LGE = late gadolinium enhancement; other abbreviations as in Table 2.


T2
WW: 2000/WL: 1000


WW: 2007WL: 947


WW : 2000/WL : 1000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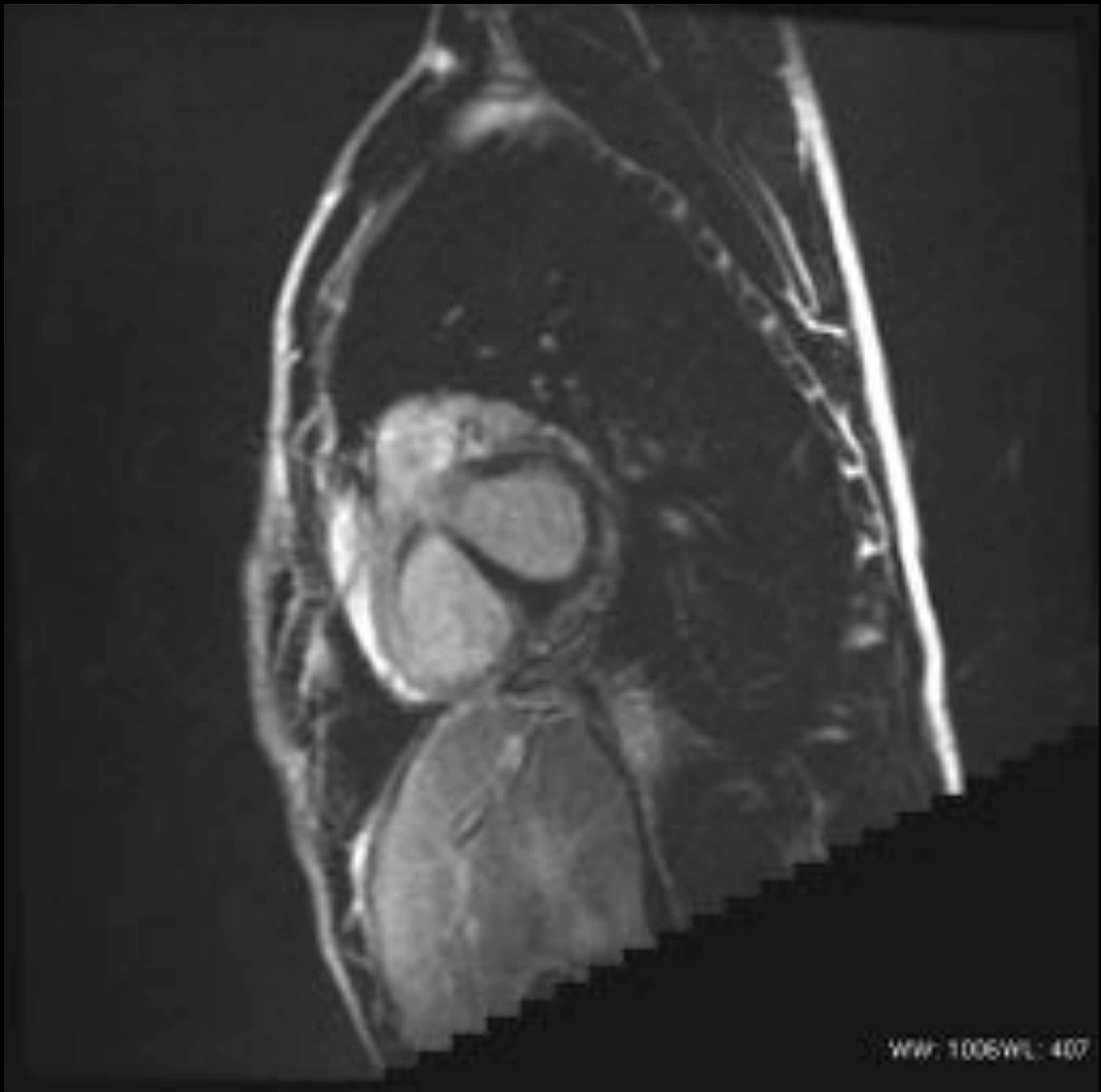
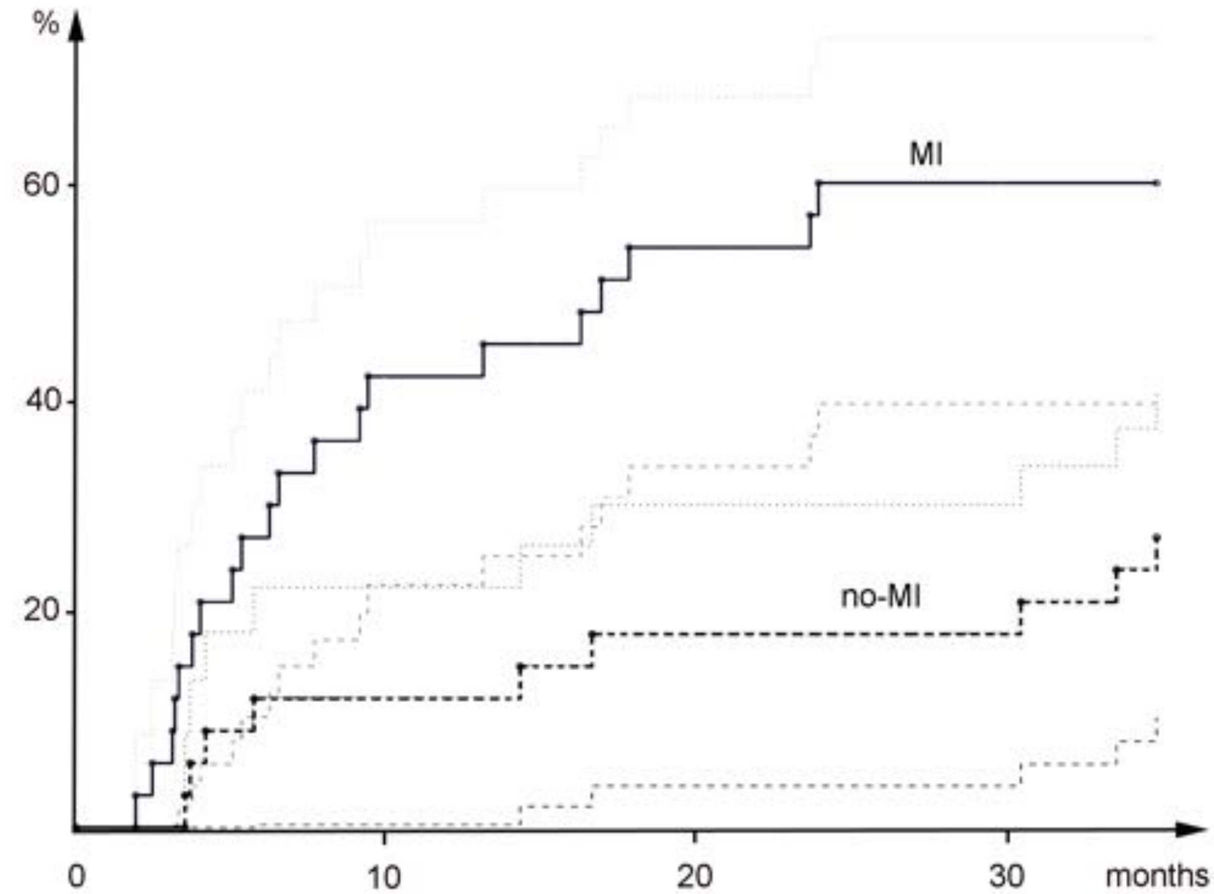
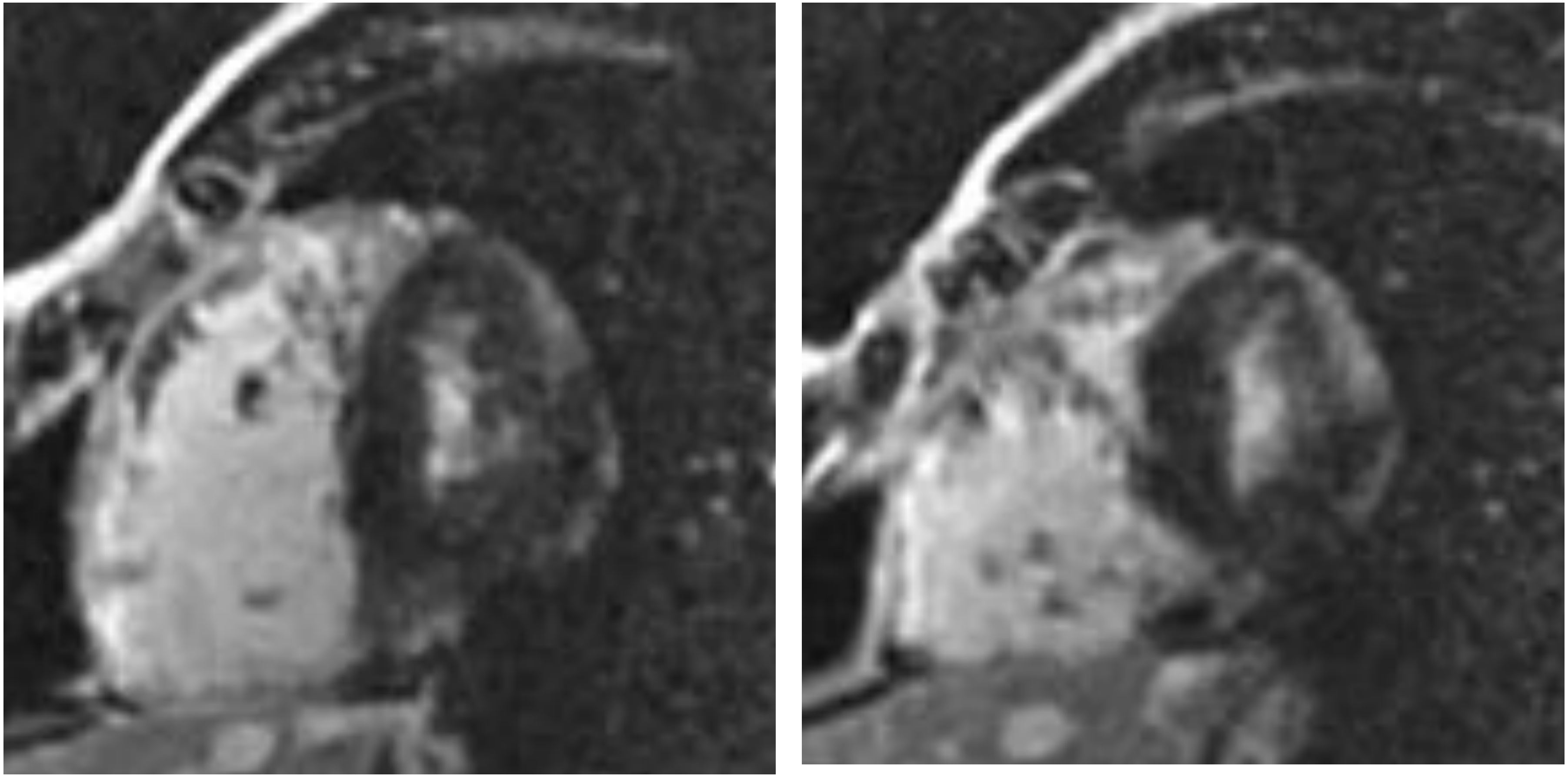

WW: 1006WL: 407

Myocardite aigue



Fibrose VD systémique



Cardiomyopathie hypertrophique

Morphologie

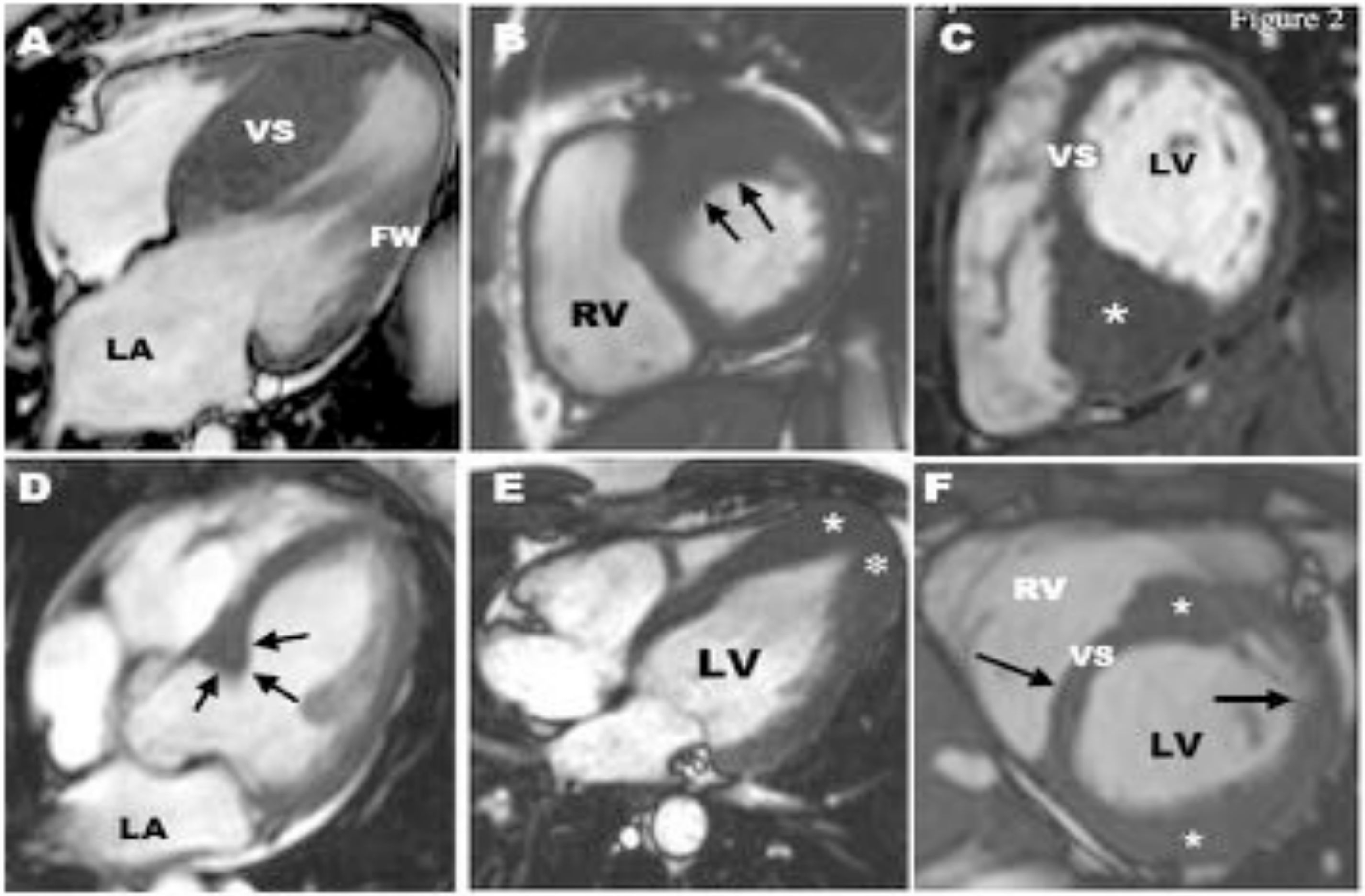
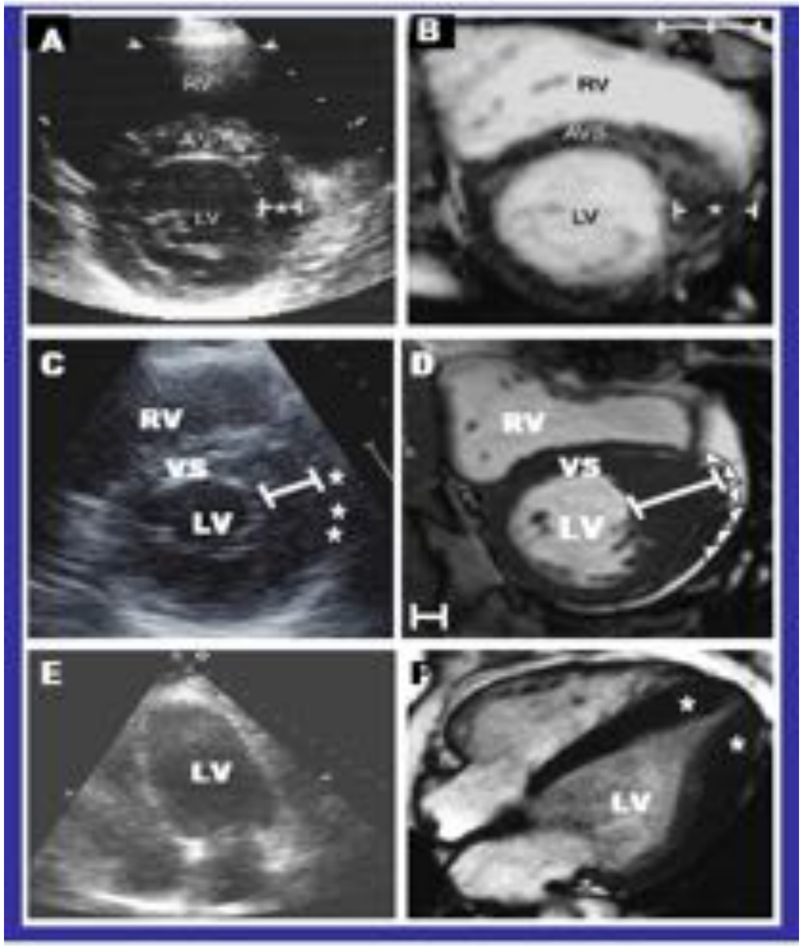
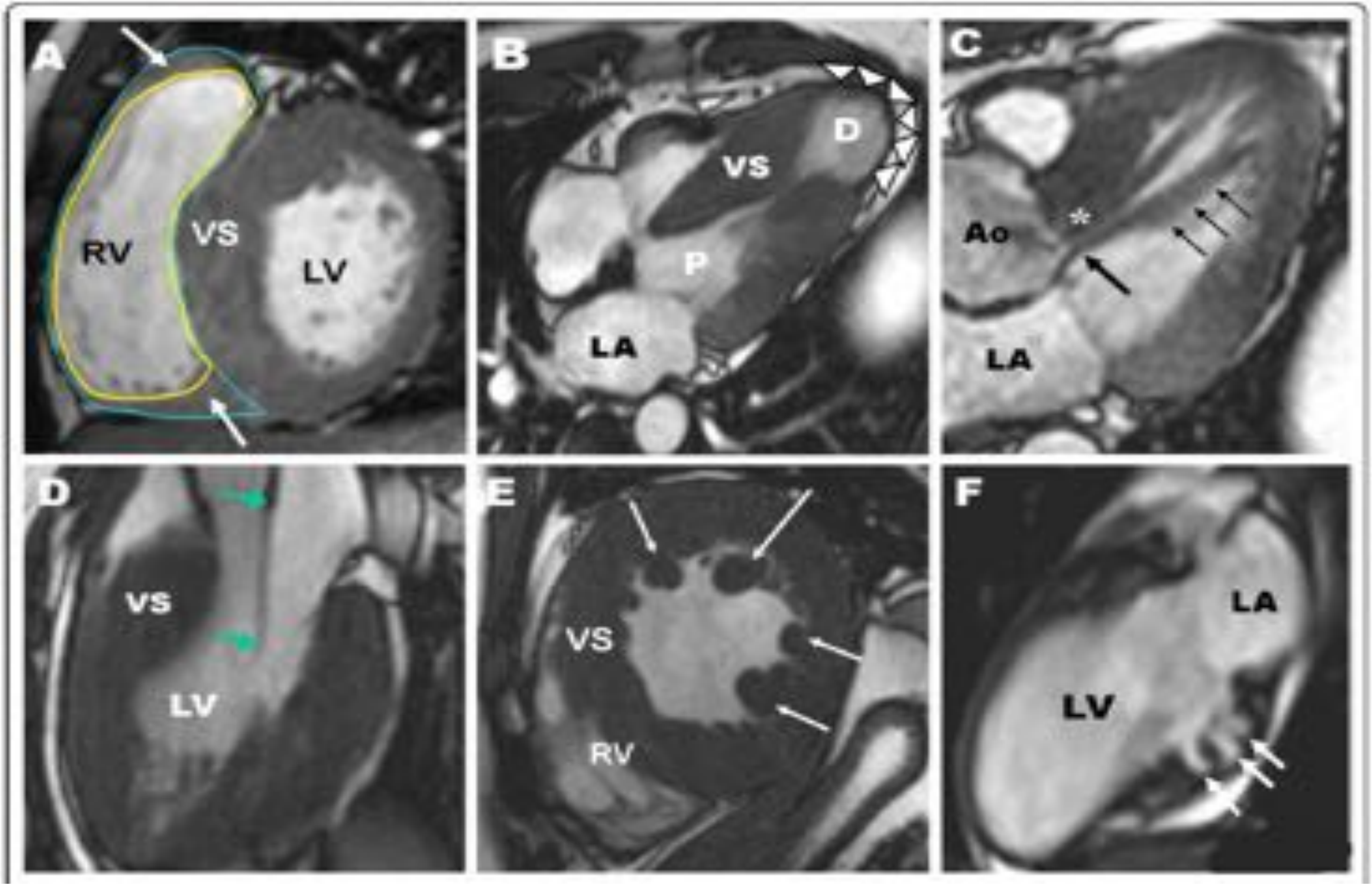


Figure 2 CMR end-diastolic images demonstrating diverse patterns of LVH in HCM. (A) involving ventricular septum (VS), but sparing the LV free wall (FW); **(B)** hypertrophy of the basal anterior free wall and a portion of the contiguous anterior septum, representing the most common area of LV wall thickening in HCM; **(C)** massive hypertrophy (wall thickness, 33 mm) limited to basal posterior ventricular septum (asterisk); **(D)** focal area sharply confined to basal anterior septum (arrows); **(E)** localized to LV apex (asterisks); **(F)** segmental LV hypertrophy of the basal anterior septum and anterolateral wall (asterisks), separated by regions of normal LV thickness (arrows). Adapted with permission, from Maron MS et al.[29] FW = free wall; LA = left atrium; LV = left ventricle; RA = right atrium; RV = right ventricle; VS = ventricular septum.

Echo-IRM



Phenotype



Fibrose

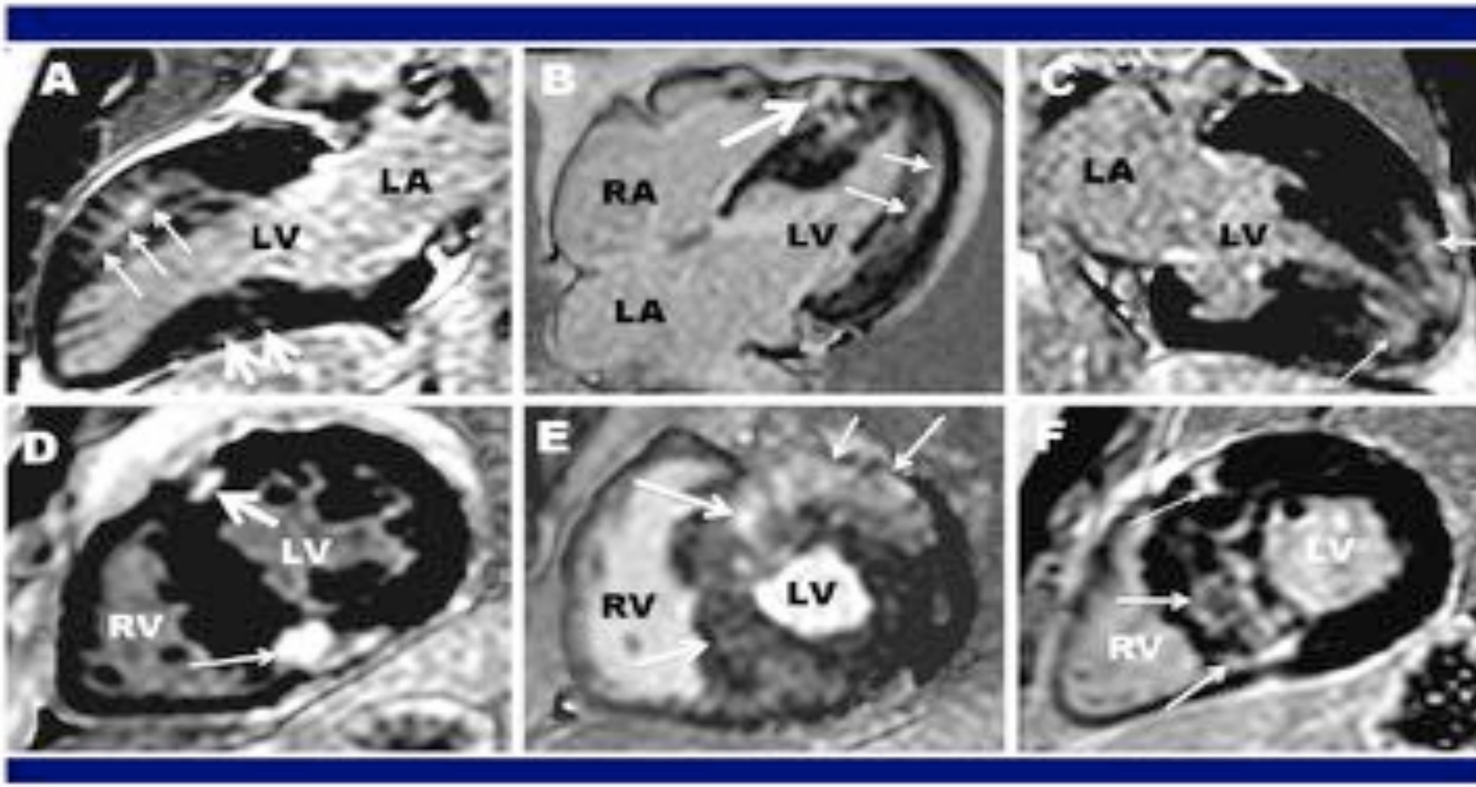


Figure 6 Contrast-enhanced CMR images in 6 different HCM patients demonstrating the diverse pattern and extent of late gadolinium enhancement in this disease. **(A)** extensive transmural LGE in the anterior wall (small arrows) with smaller focal area in the inferior wall (small arrows); **(B)** mid-myocardial LGE in the lateral wall (small arrows) and diffuse LGE in the ventricular septum which extends into the RV wall (large arrow) in a 26 year-old man with "end-stage" phase of HCM with an ejection fraction of 40%; **(C)** LGE confined to the LV apex (arrows); **(D)** LGE localized to the insertion area of the RV wall into the anterior (large arrow) and posterior ventricular septum (small arrow); **(E)** transmural LGE involving the majority of the ventricular septum (large arrow) and lateral wall (small arrow); **(F)** Basal short-axis image with transmural LGE located predominantly in the ventricular septum (arrows). RA = right atrium; RV = right ventricle; LA = left atrium; LV = left ventricle

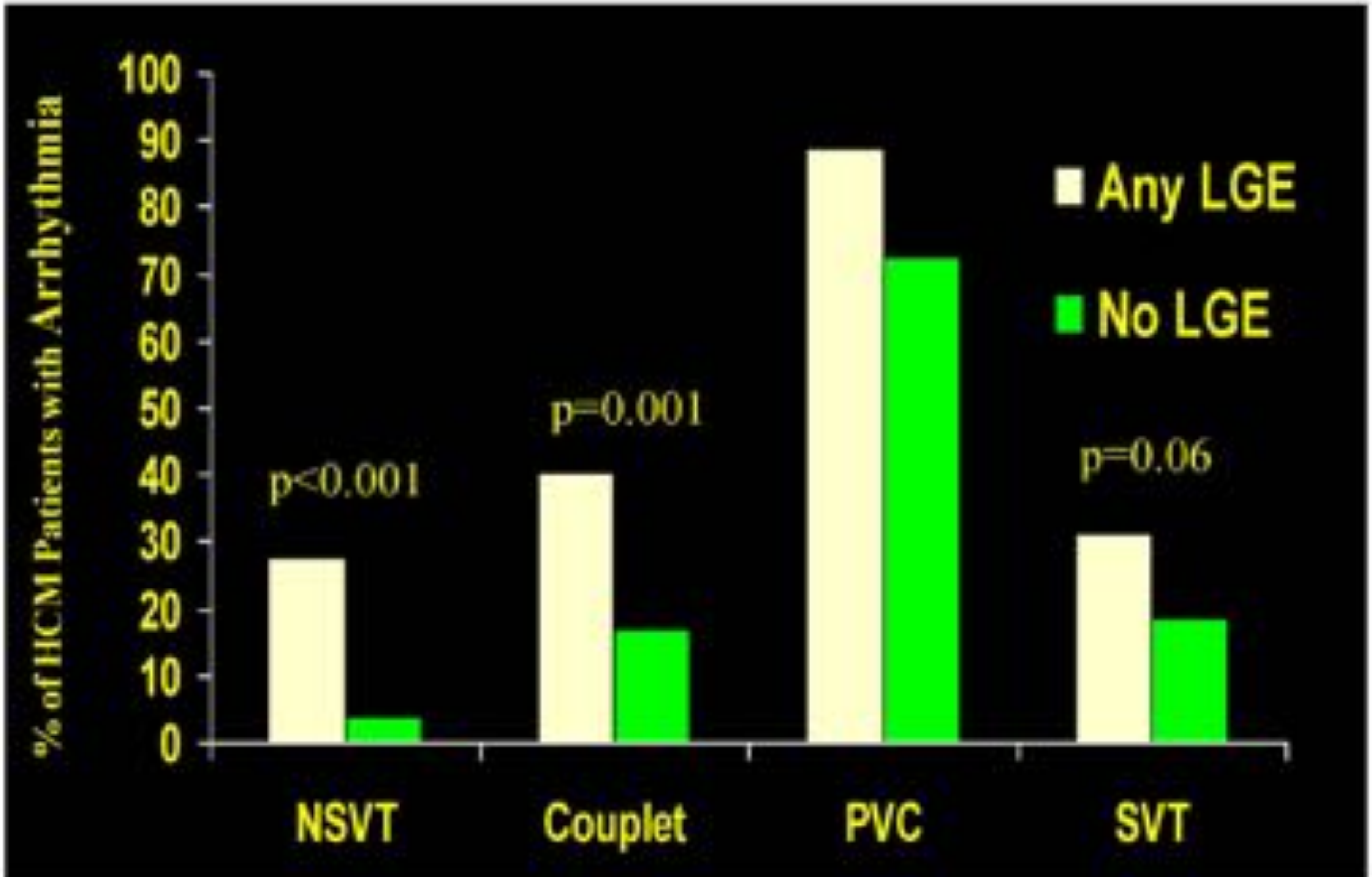
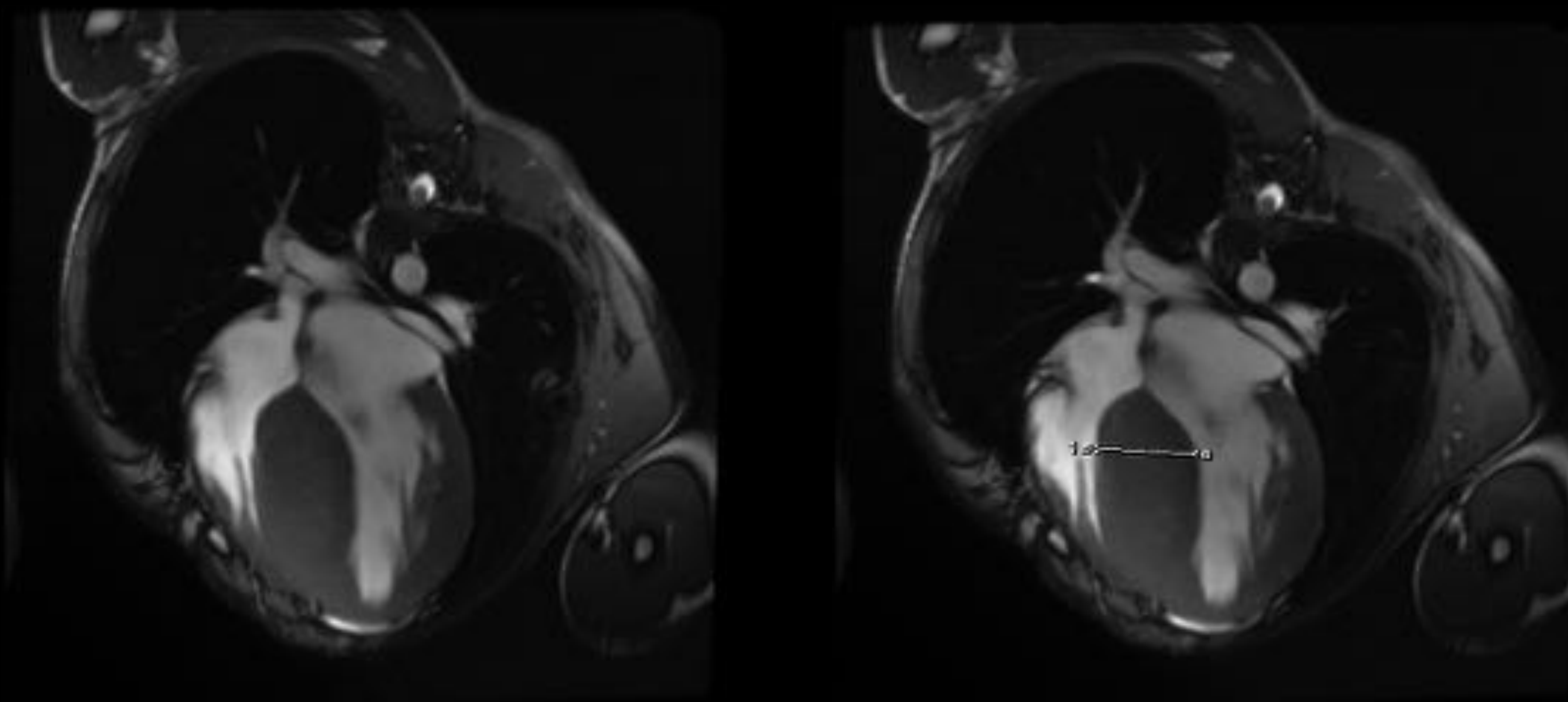
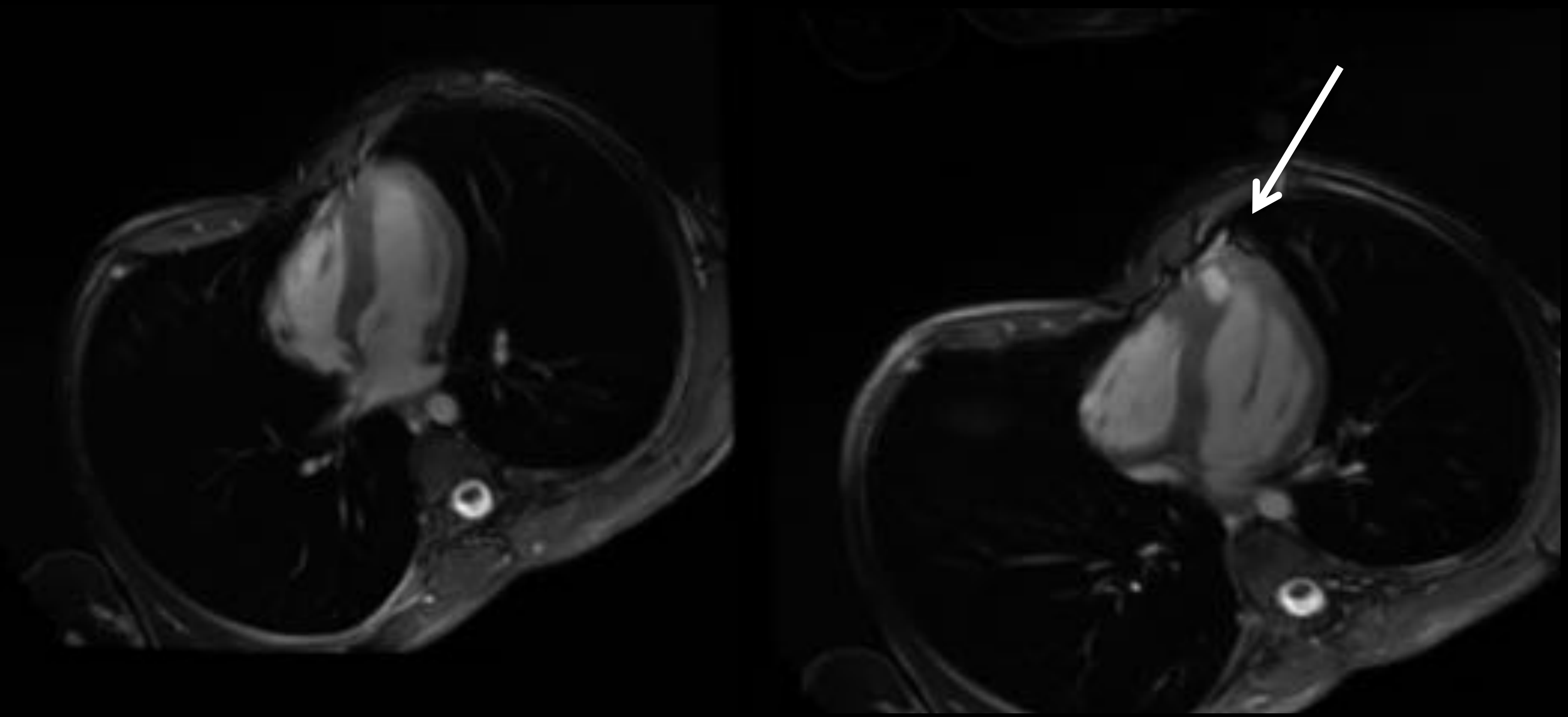
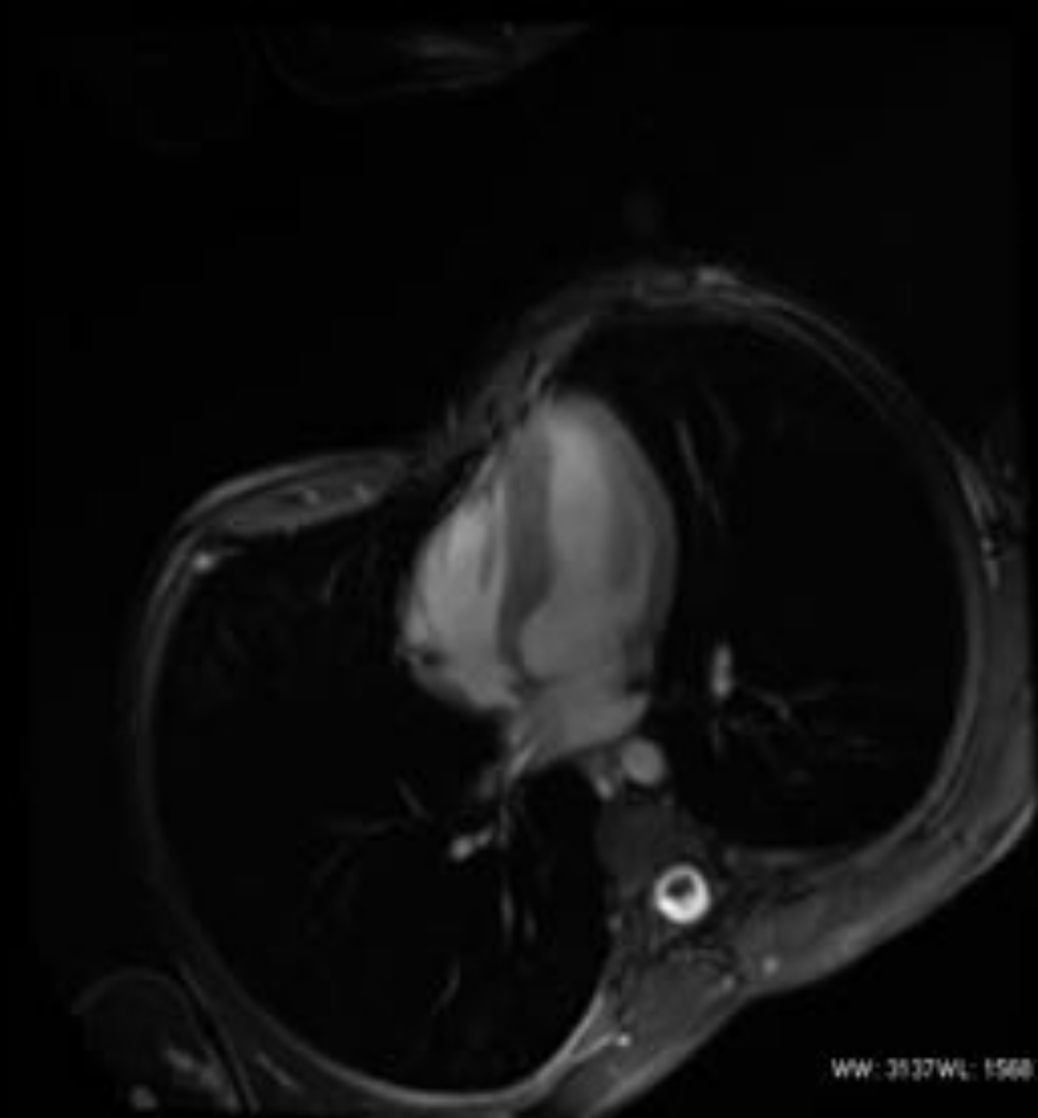


Figure 7 Prevalence of arrhythmia on 24-hour Holter ECG with respect to presence of late gadolinium enhancement in patients with HCM. Adapted with permission, from Adabag et al.[93]. ECG = electrocardiogram; HCM = hypertrophic cardiomyopathy; LGE = late gadolinium enhancement; NSVT = nonsustained ventricular tachycardia; PVC = premature ventricular contraction; SVT = supraventricular tachychardia



IVS 41 mm

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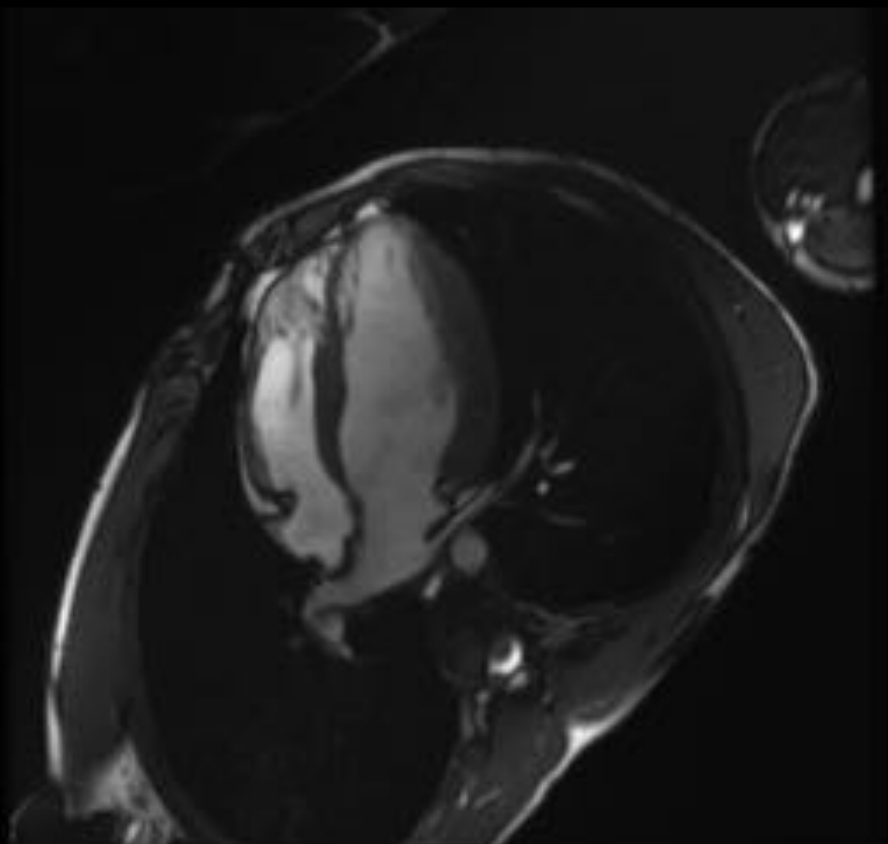
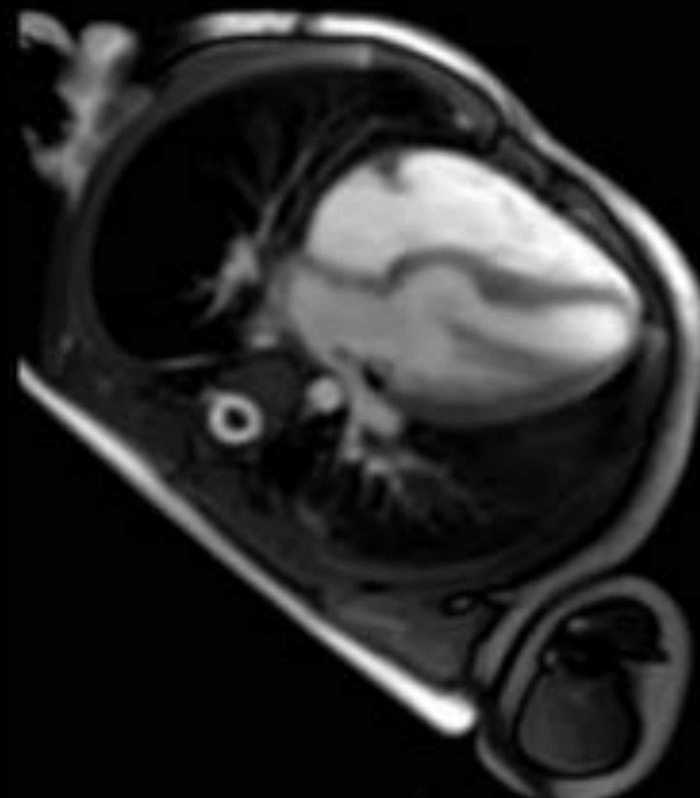
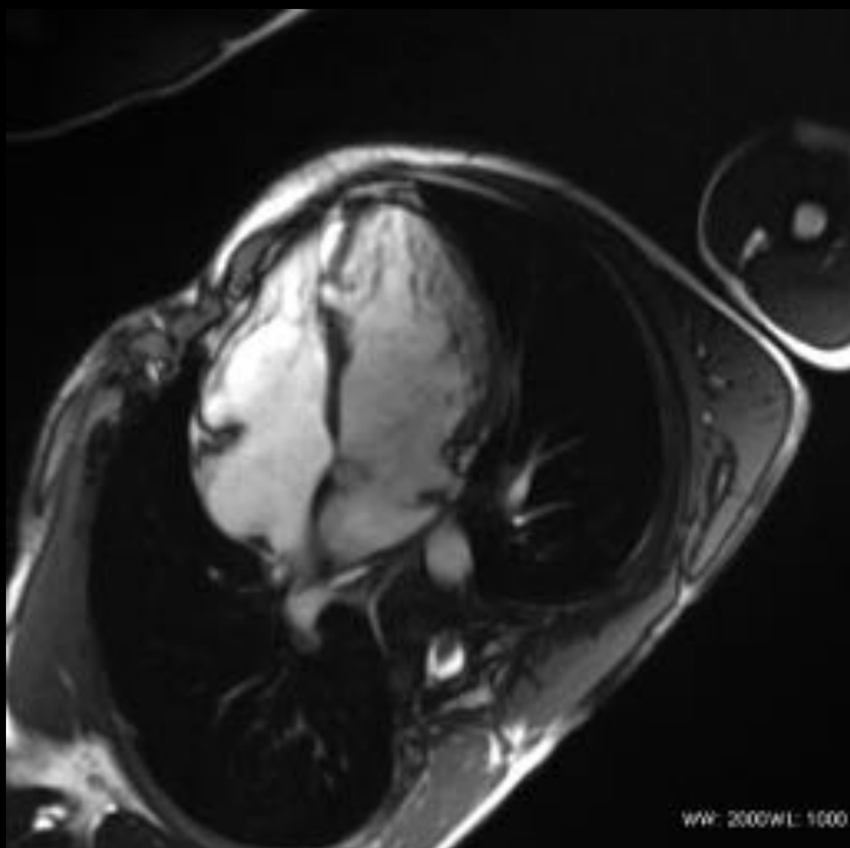
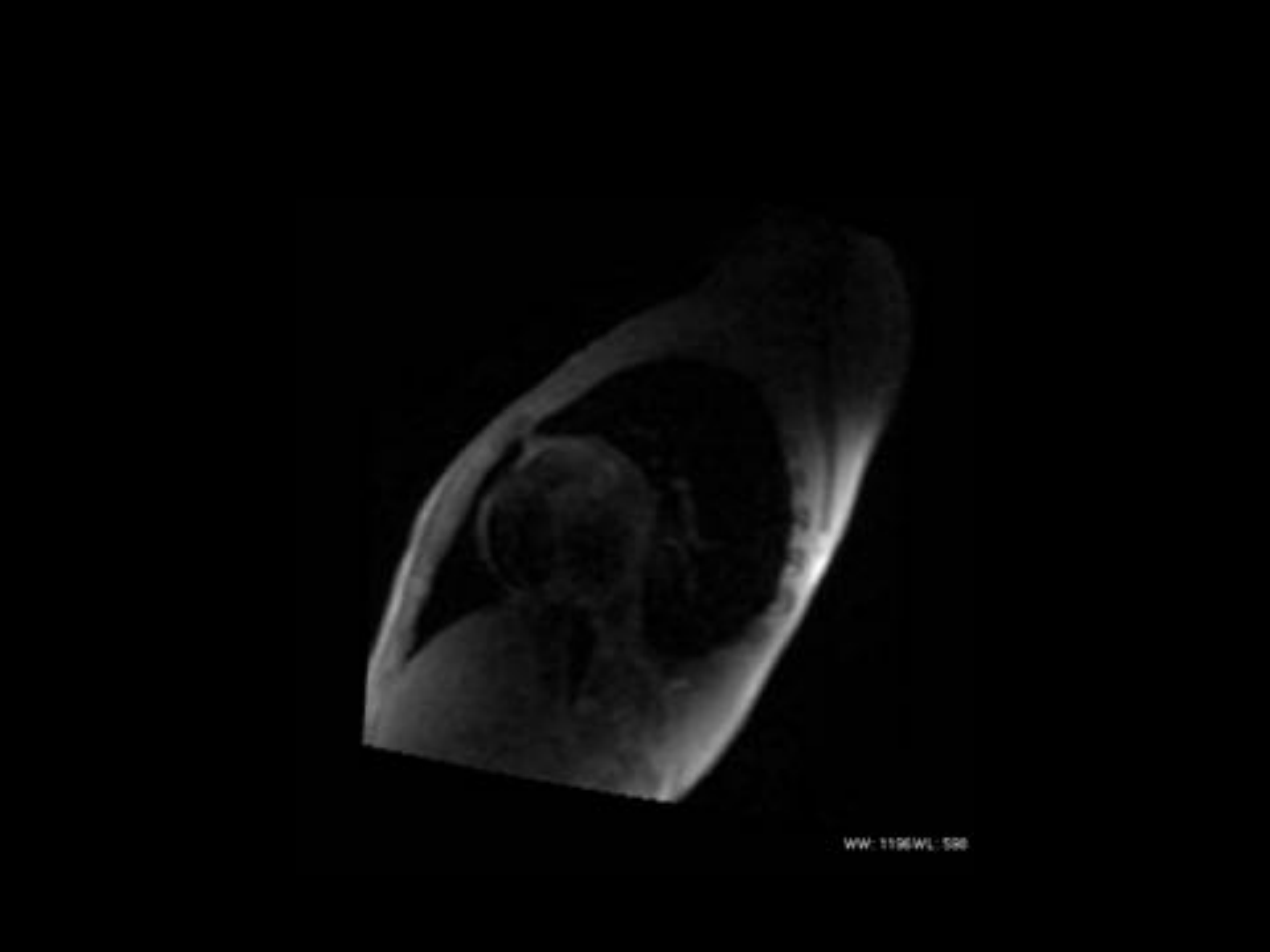


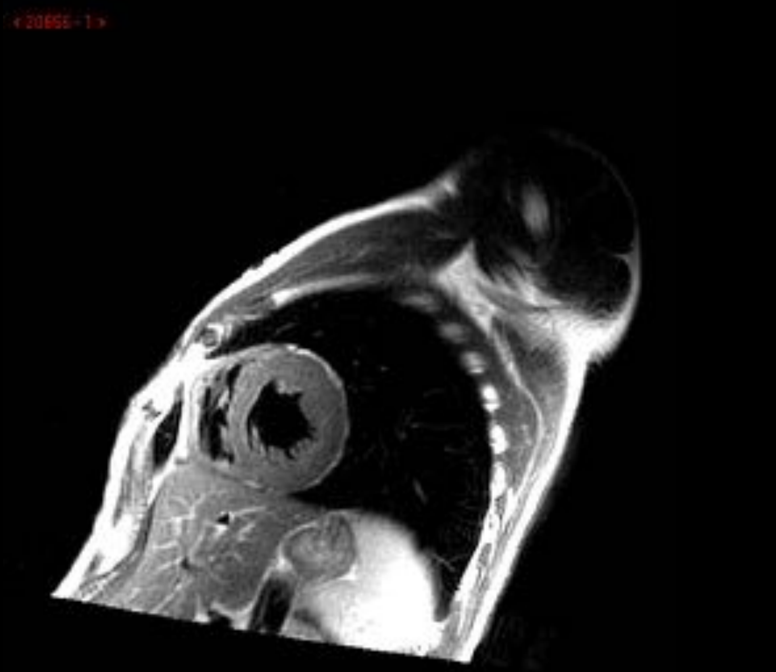



WW: 2000WL: 1000

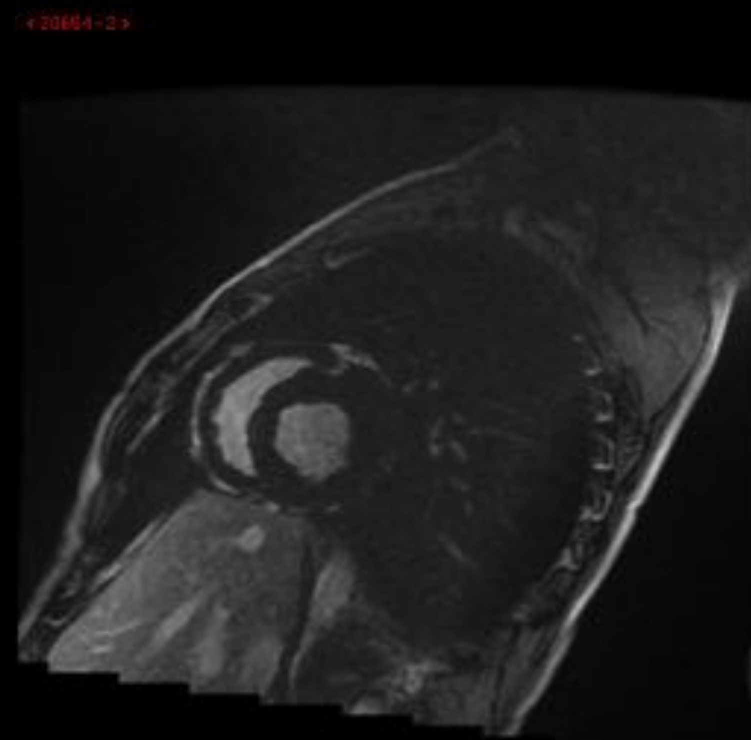

WW: 2000WL: 1000


WW: 1196WL: 598

Tissue analysis

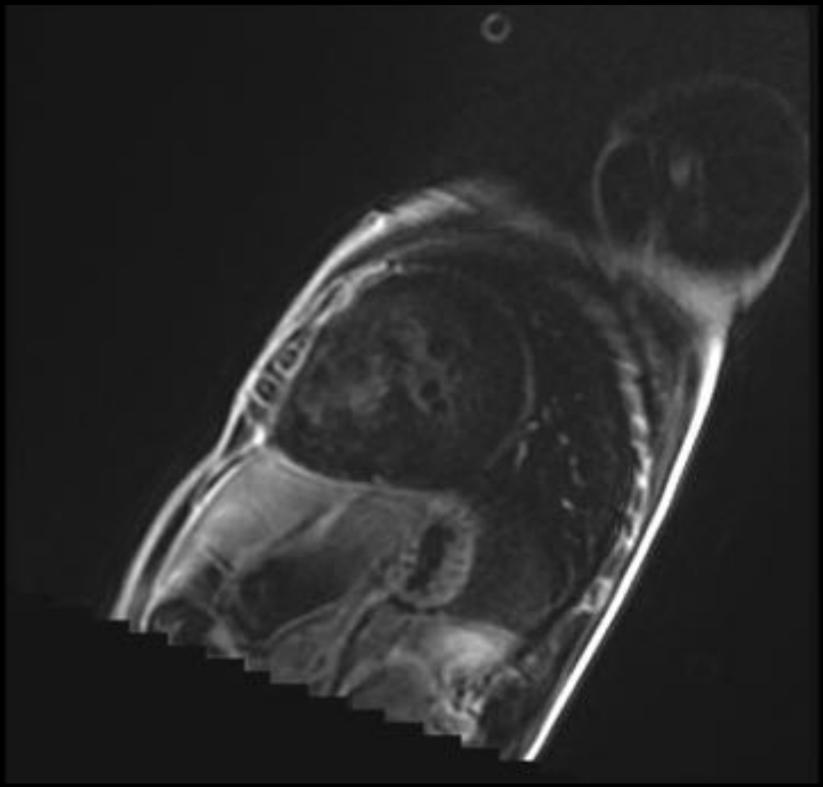


T2 sang noir

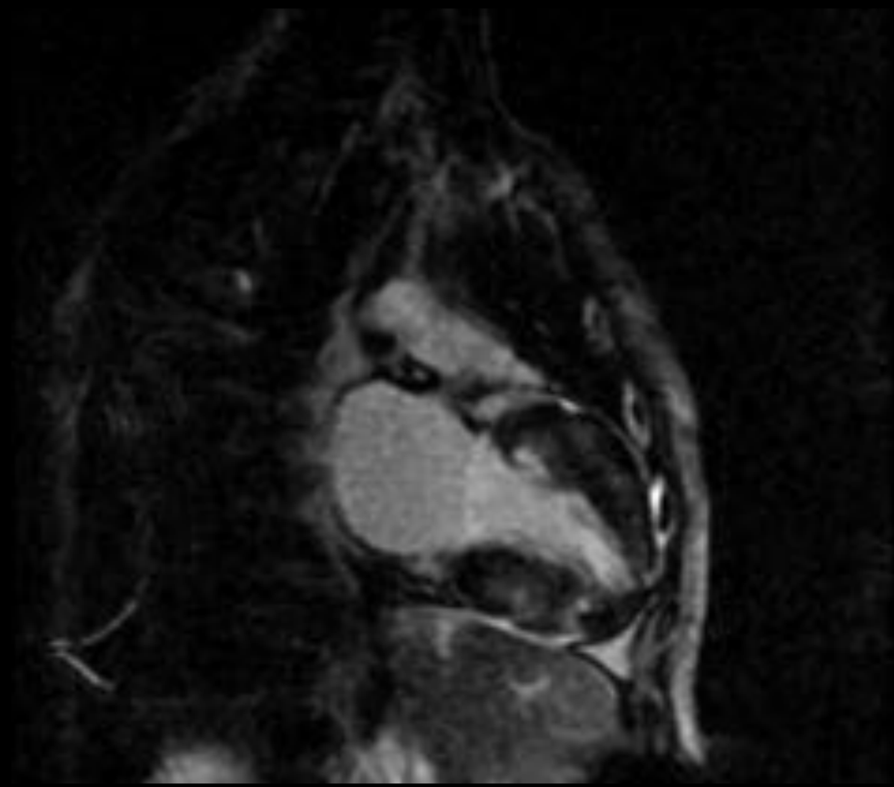


LGE

Fibrose

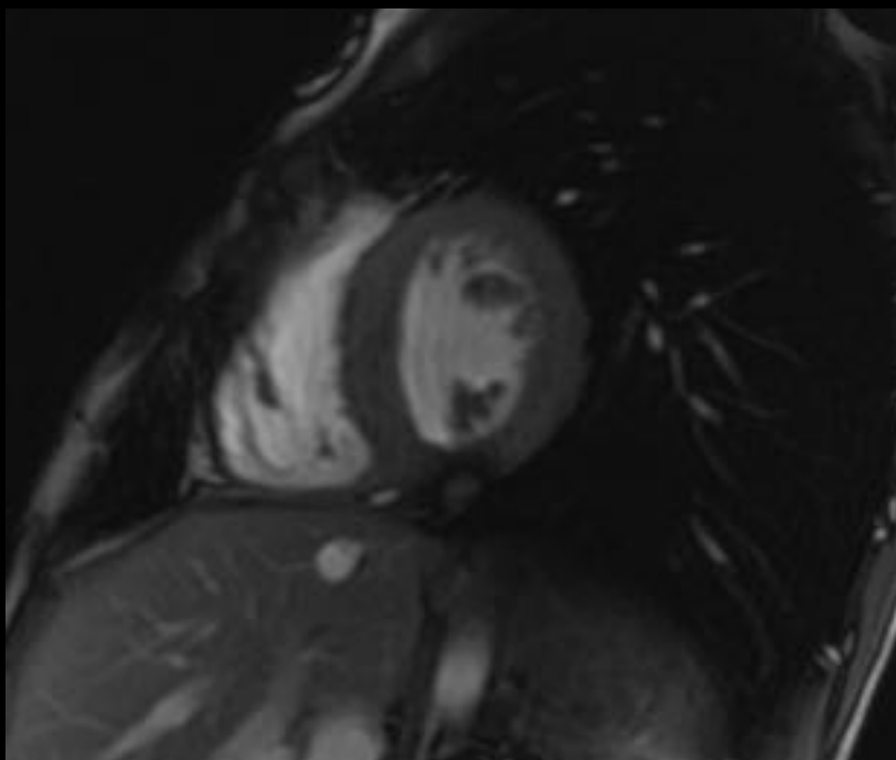


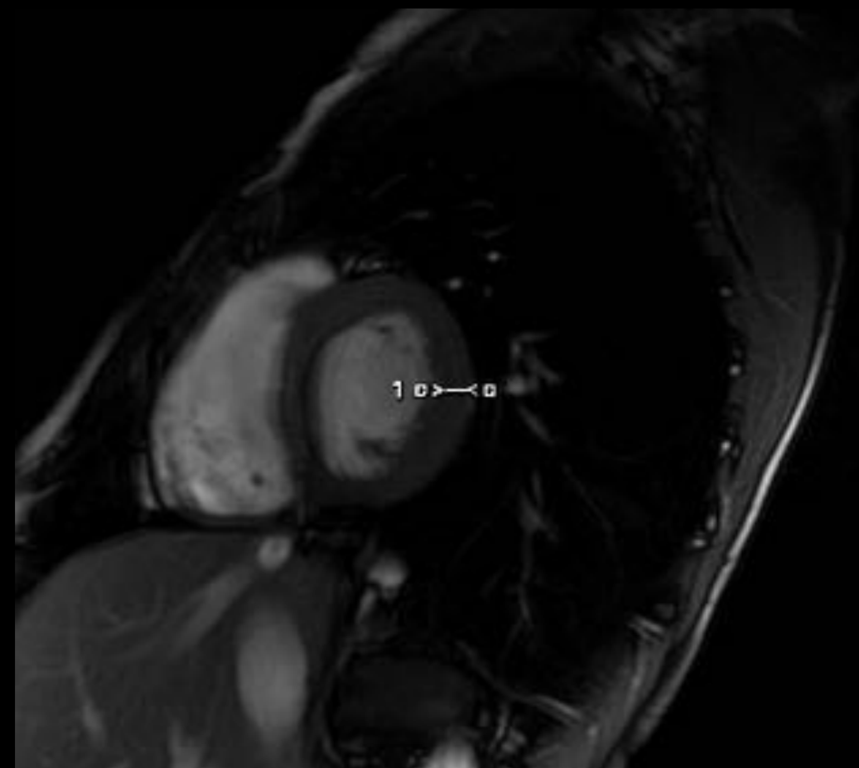
LGE



LGE

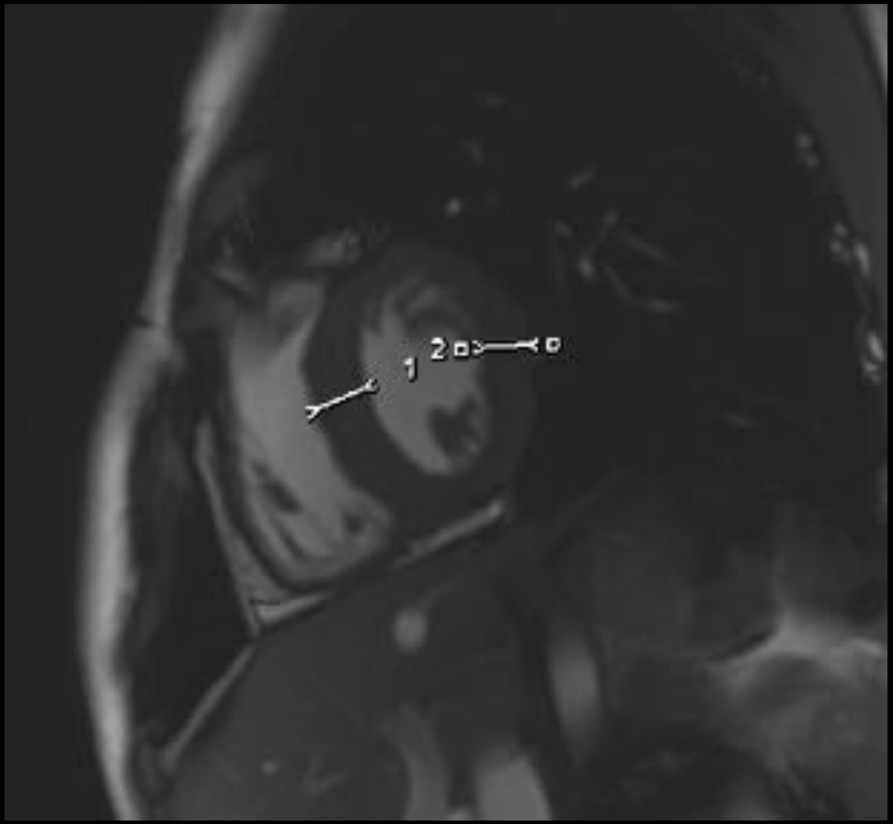
Progression





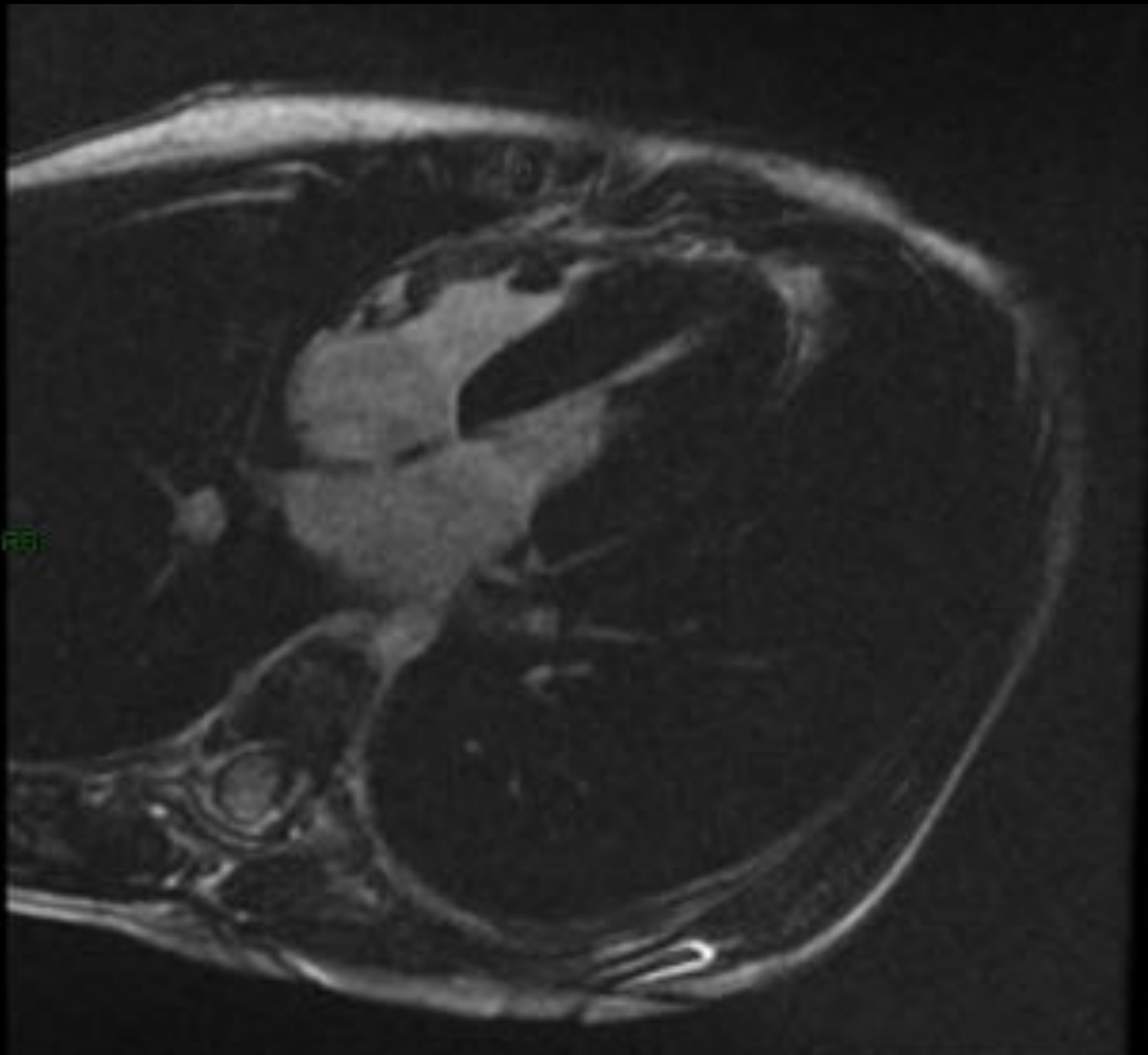
LW 6.7 mm

Progression



IVS 12 mm, LW 10.5 mm

Progression

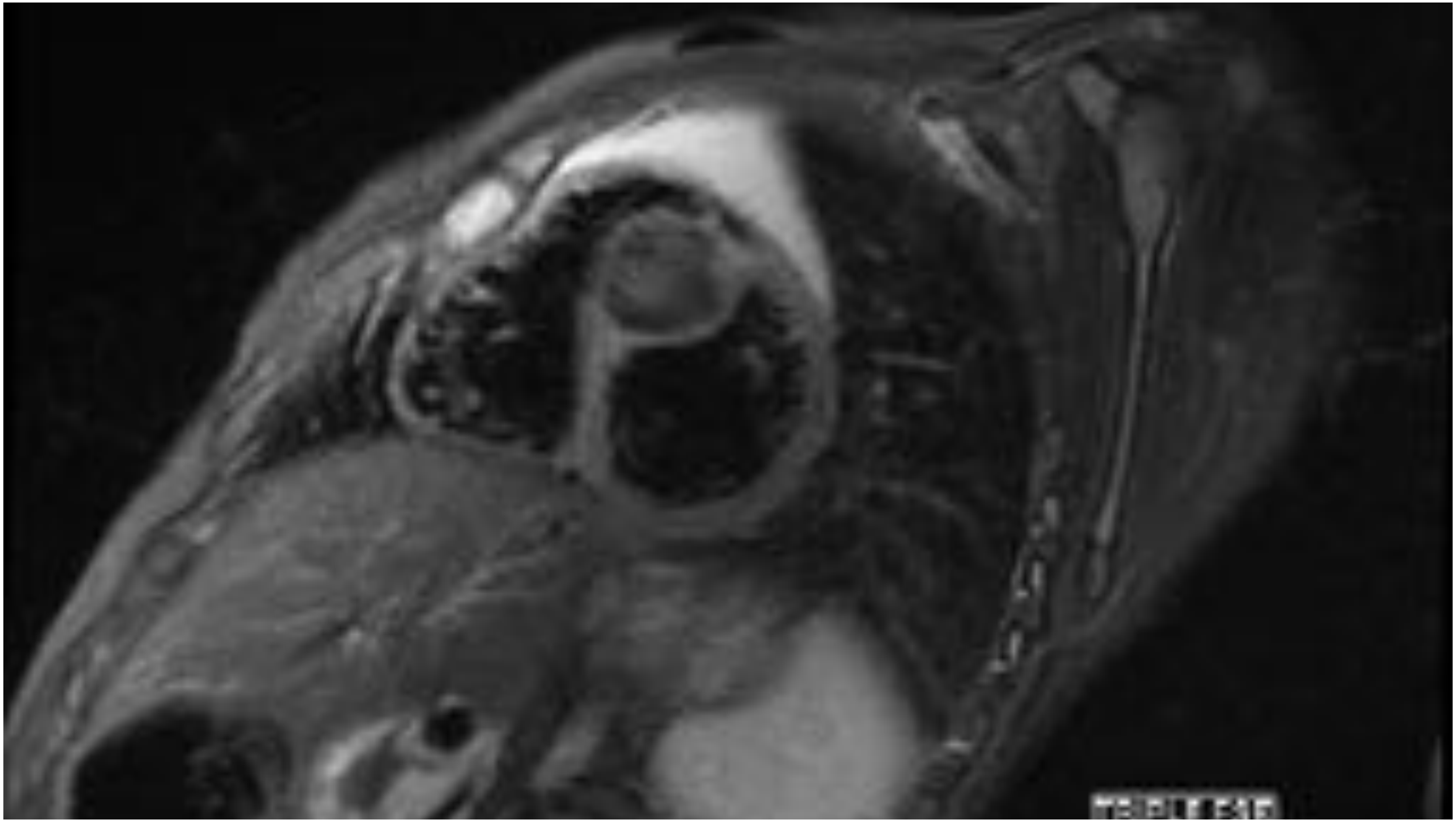


Tumeurs

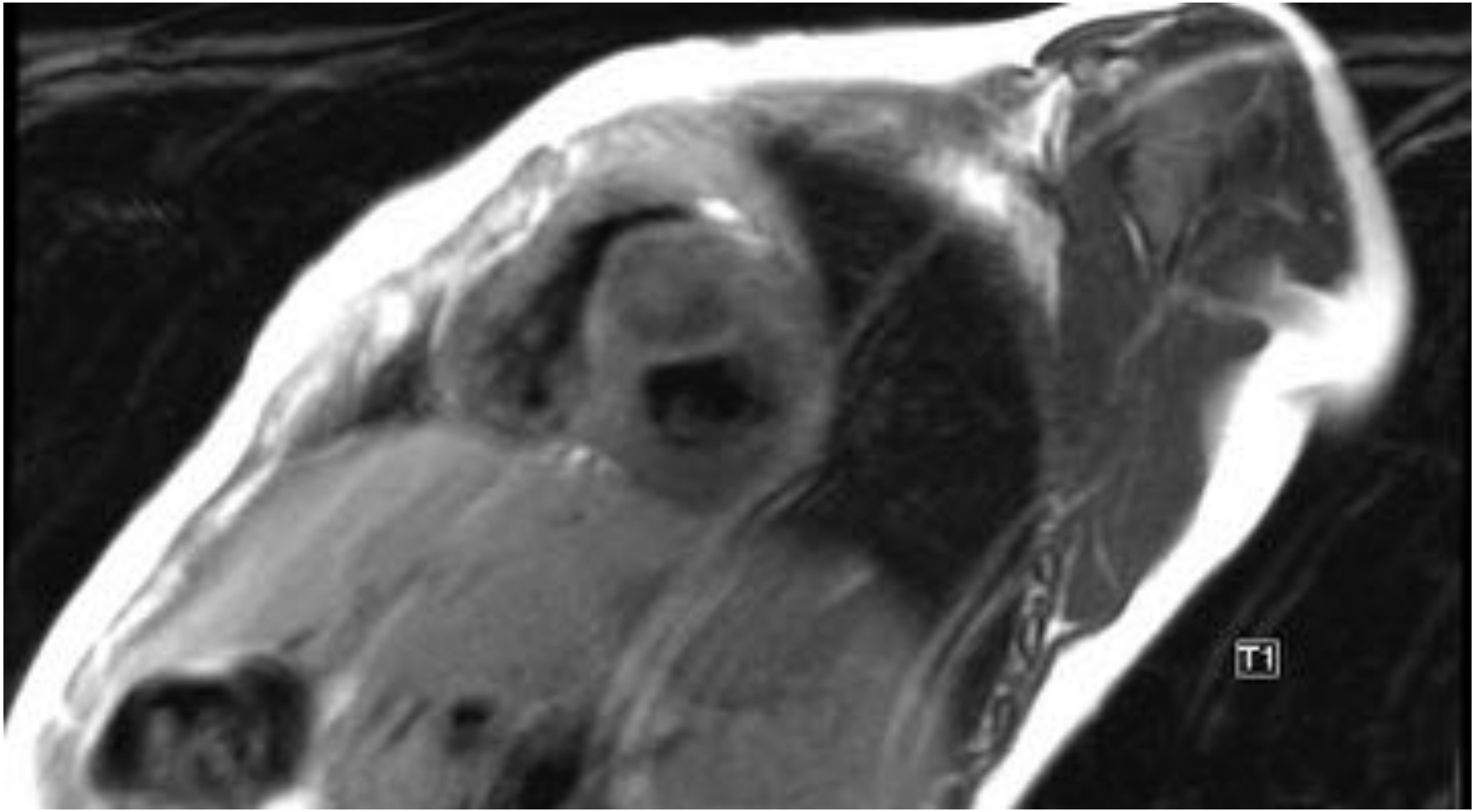
TABLE 1: Cardiac MRI Findings of Cardiac Tumors

			Imaging Sequence				
Tumor	Morphology	Most Common Location	Steady-State Free Precession	T2-Weighted	Fat Saturation	T1-Weighted Before / After Contrast Administration	Delayed Enhancement
Benign							
Myxoma	Lobular, pedicle	Left atrium, intracavitary, interatrial septum	Usually mobile	High	No change	Isointense / moderate (heterogeneous)	High (heterogeneous)
Lipoma	Smooth	Any chamber, intra-myocardial or intracavitary	May be mobile	Low	Signal dropout	High / minimal	None
Papillary fibroelastoma	Smooth, pedicle	Valvular	Usually mobile	High	No change	Isointense / high	High
Fibroma	Smooth, calcification, broad base	Ventricles, intramyocardial	Intramyocardial	Low	No change	Isointense / minimal	Intense
Rhabdomyoma	Smooth, broad base	Ventricles, intramyocardial	Intramyocardial	High	No change	Isointense / moderate	High
Hemangioma	Lobular, broad base	Any chamber, intracavitary	Usually mobile	High	No change	Isointense / intense	None
Malignant							
Angiosarcoma	Lobular, broad base	Right atrium	Intramyocardial	Heterogeneous	No change	Isointense / heterogeneous	Heterogeneous
Undifferentiated sarcoma	Lobular, broad base	Left atrium	Intramyocardial, involves valves	Isointense	No change	Low	—
Leiomyosarcoma	Lobular, broad base	Left atrium, posterior wall	Intramyocardial	High	No change	Isointense / high	—
Fibrosarcoma	Lobular, broad base	Left atrium, pericardium	Intramyocardial	—	No change	Isointense / —	—
Liposarcoma	Lobular, broad base	Left or right atrium, pericardium	Intramyocardial	—	Signal dropout	Isointense / —	—
Osteosarcoma	Lobular, calcification	Left atrium	Intramyocardial	High	No change	Isointense / —	—
Lymphoma	Lobular, pericardial effusion	Right atrium	Intramyocardial	High	No change	Isointense / variable	High
Metastases	Smooth, lobular	Variable, pericardial effusion	Intramyocardial	High	No change	Low	High

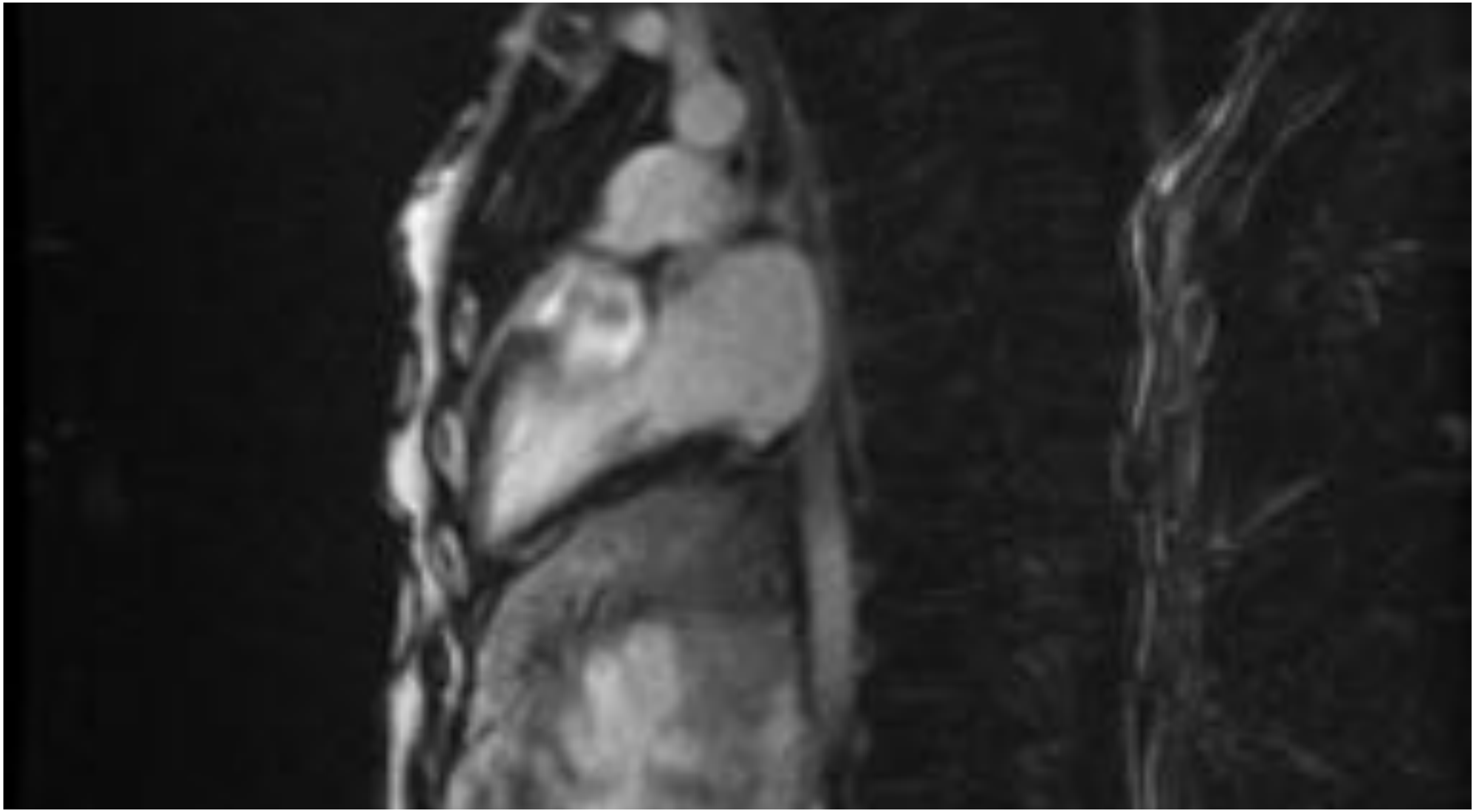
Fibrome



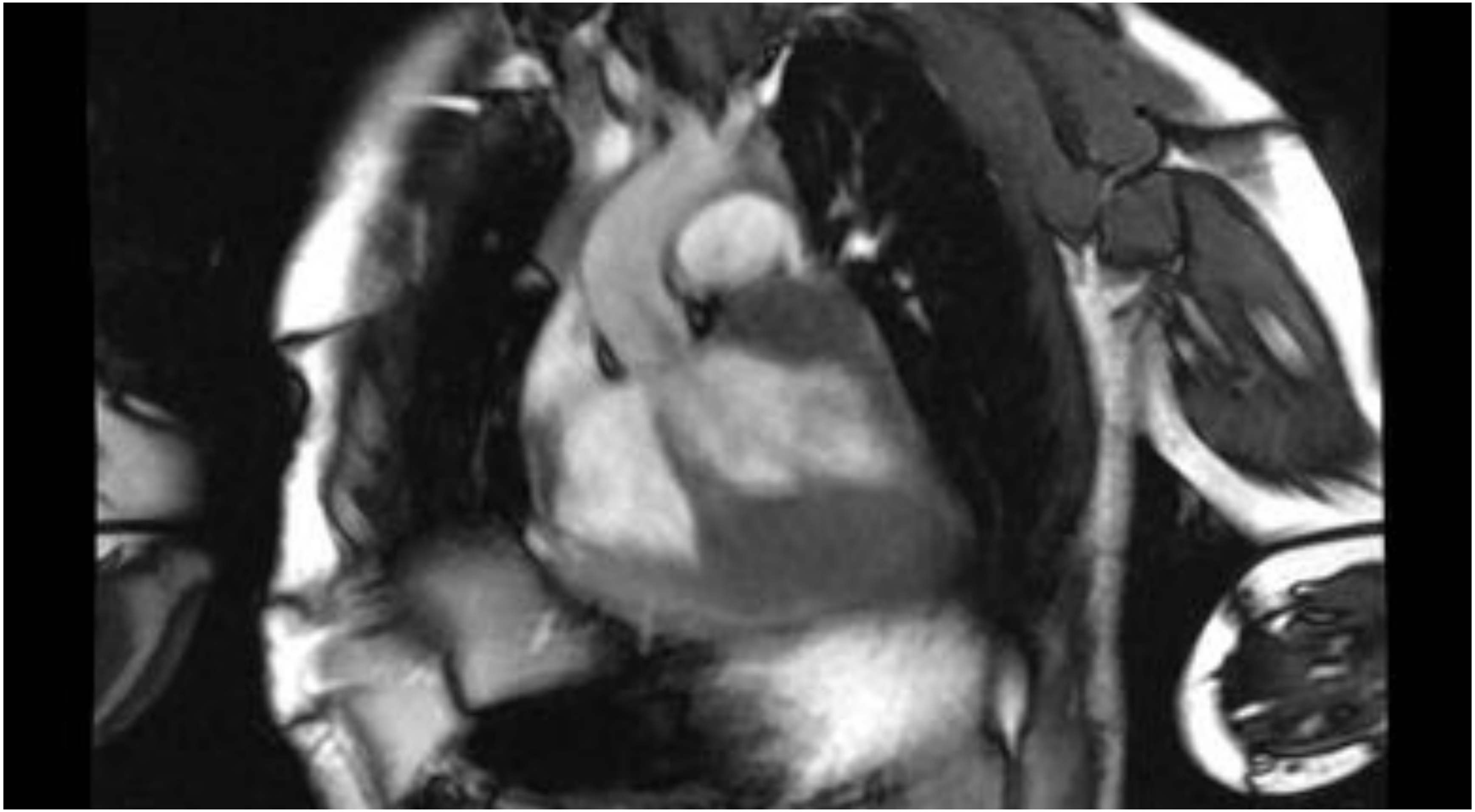
Fibrome



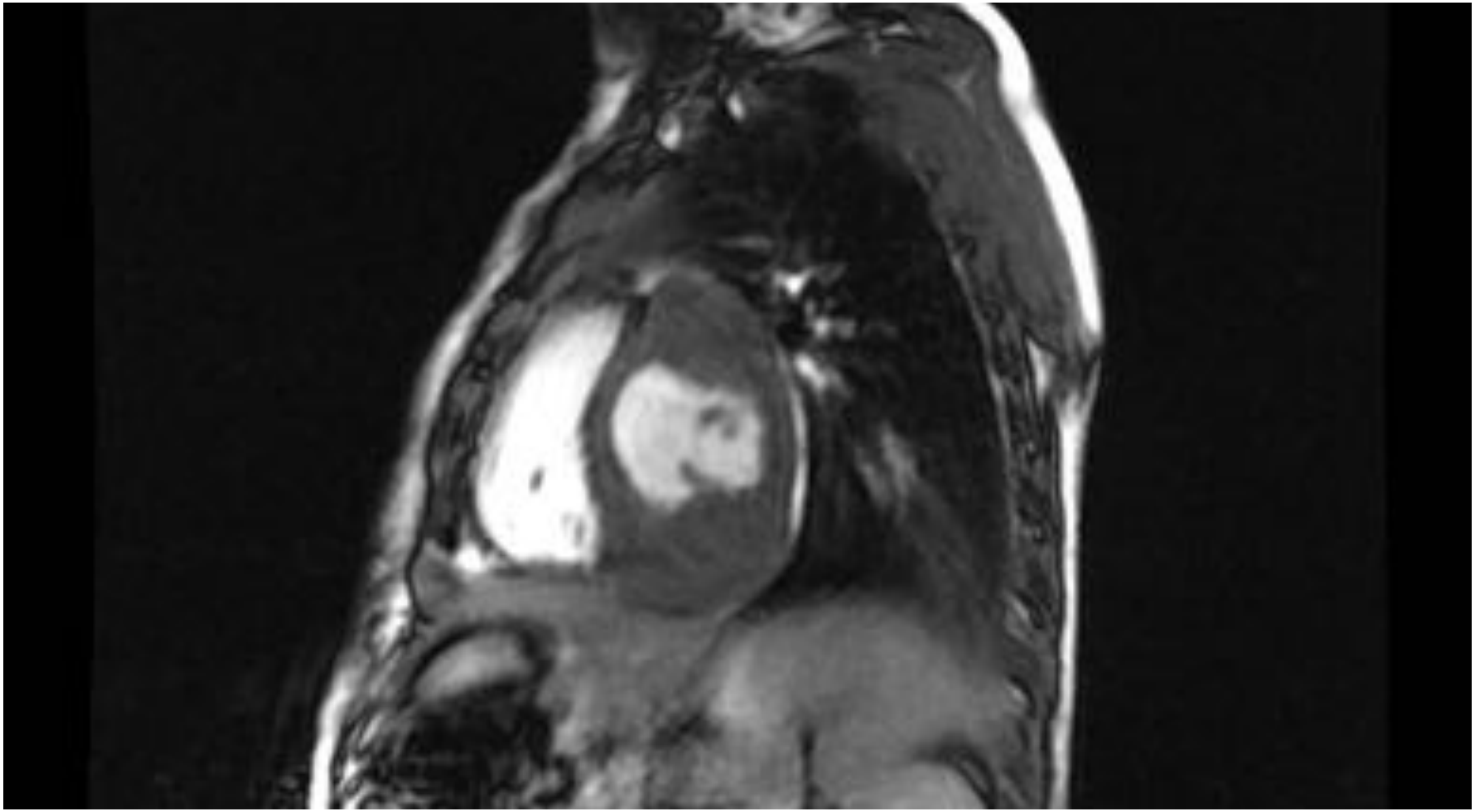
Fibrome



Fibrome



Fibrome



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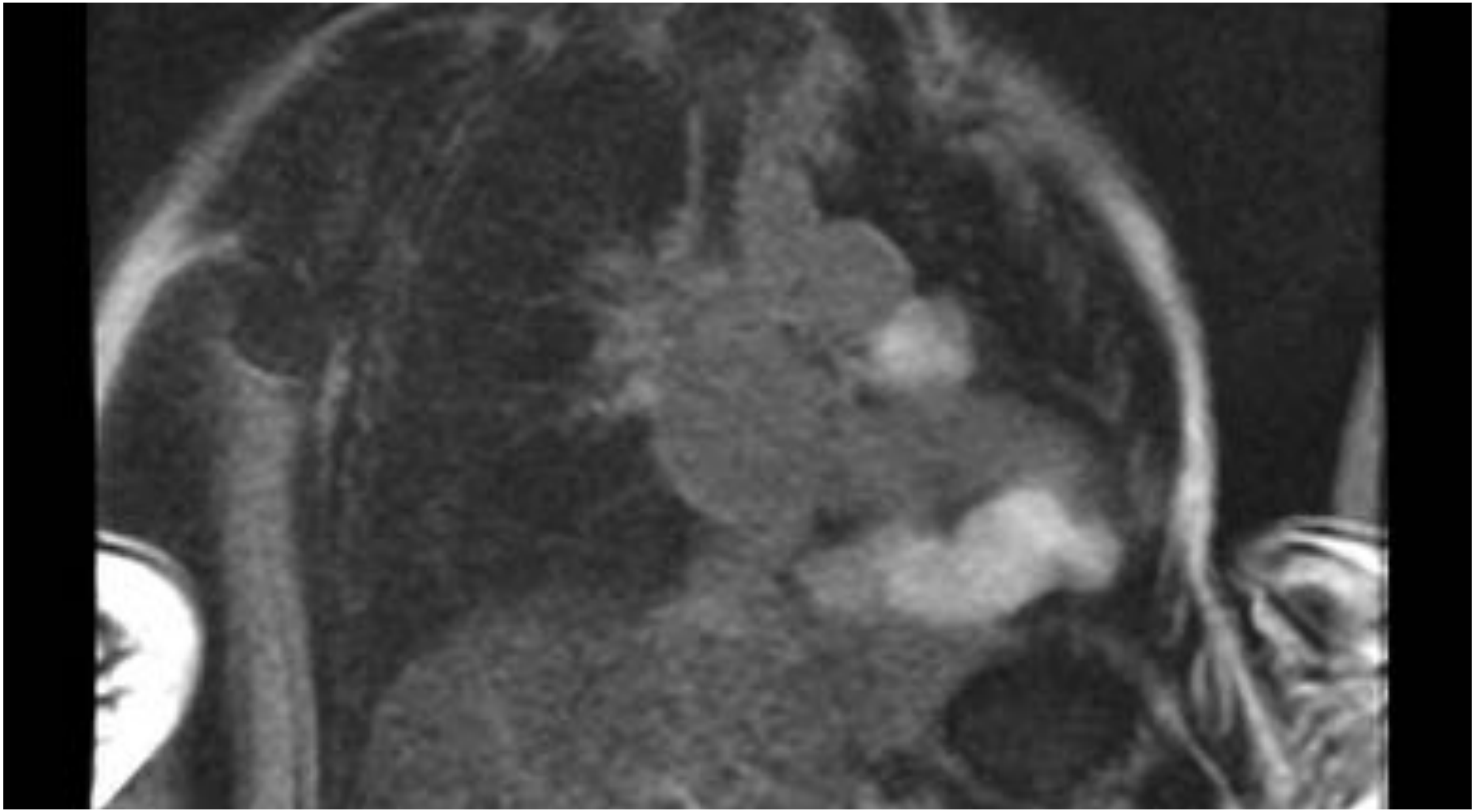

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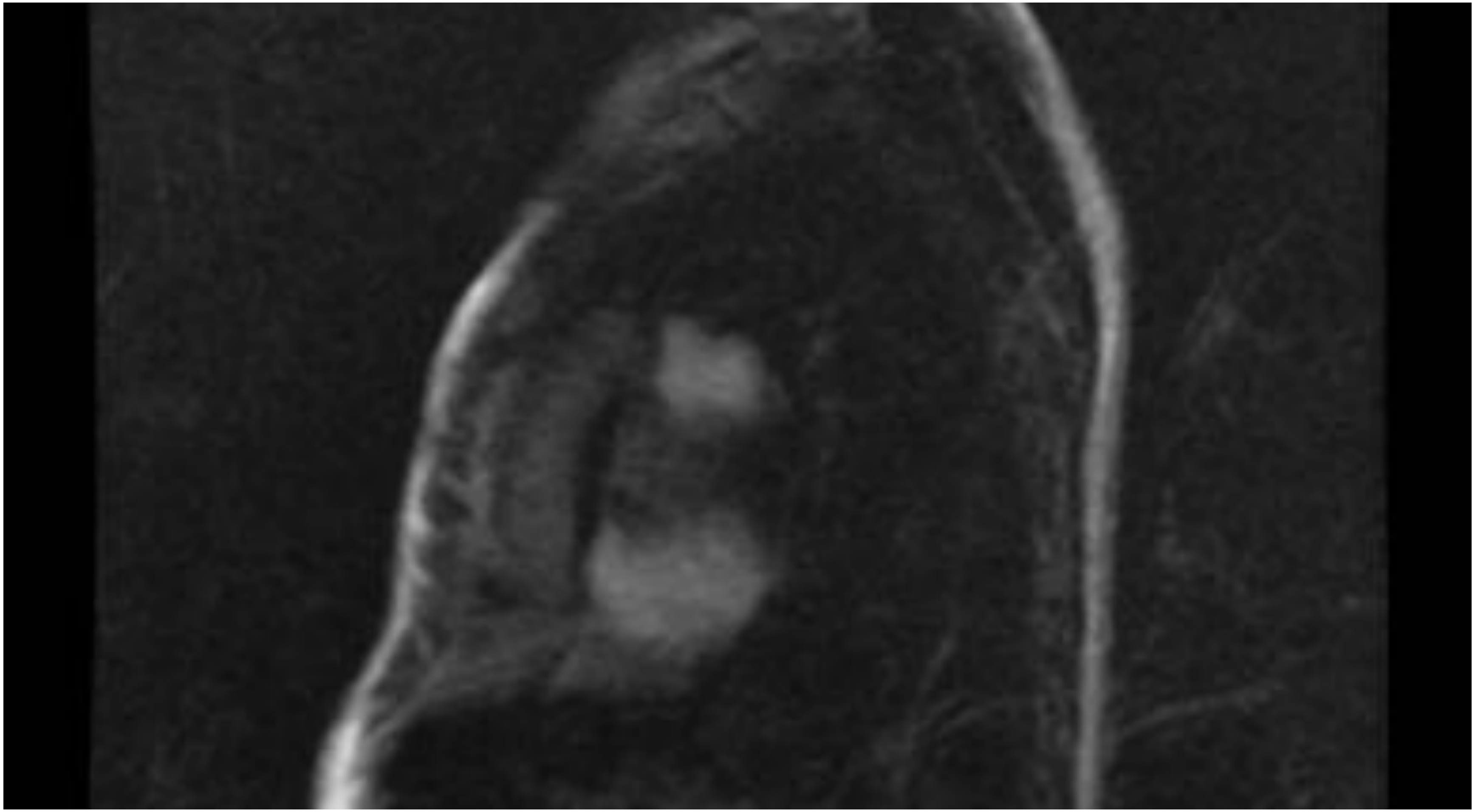

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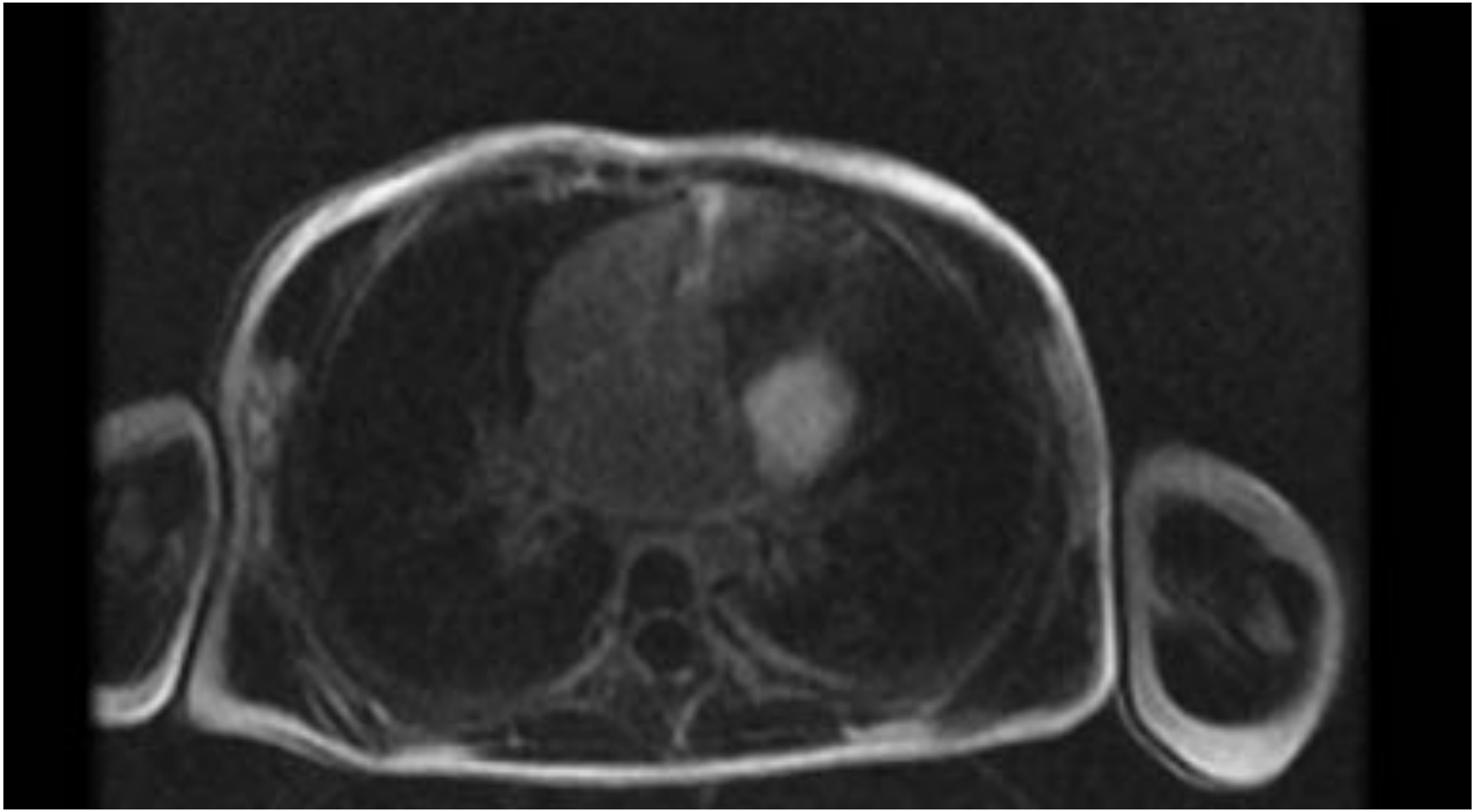
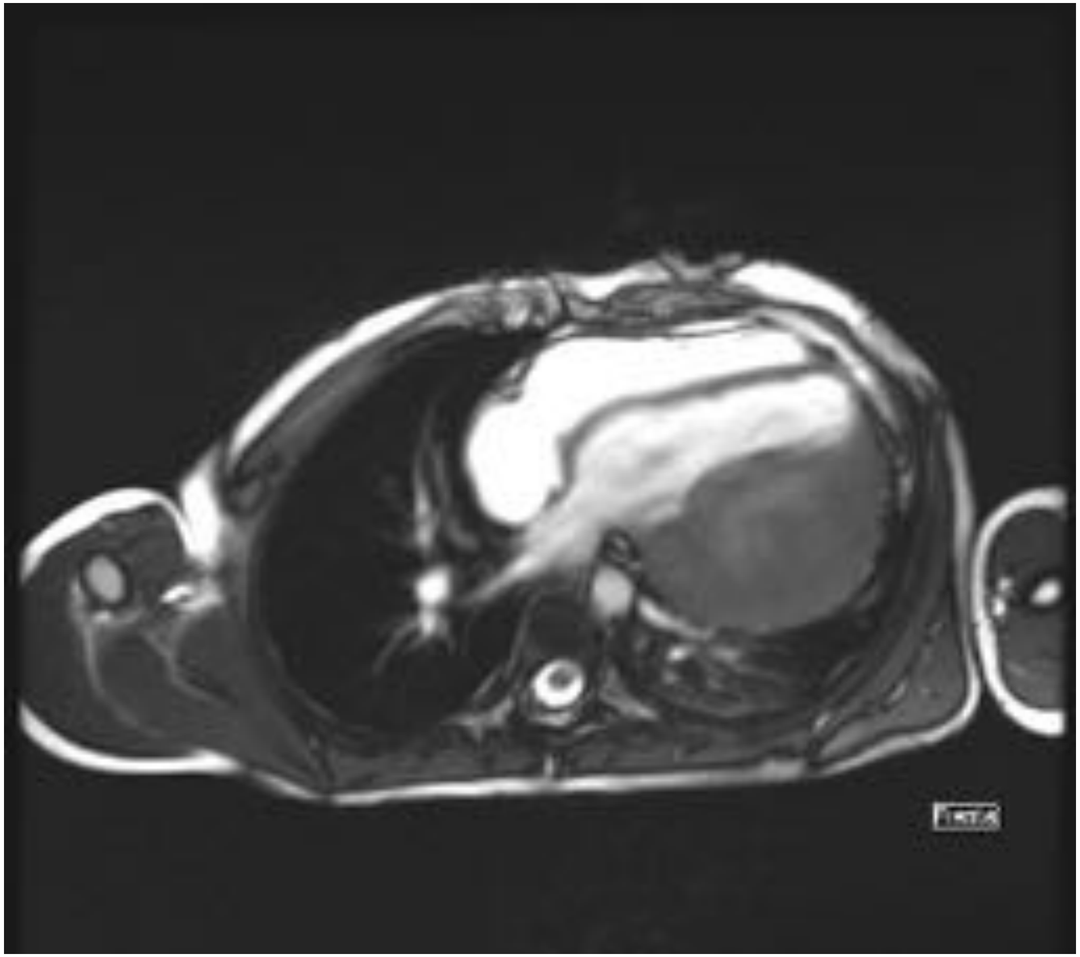
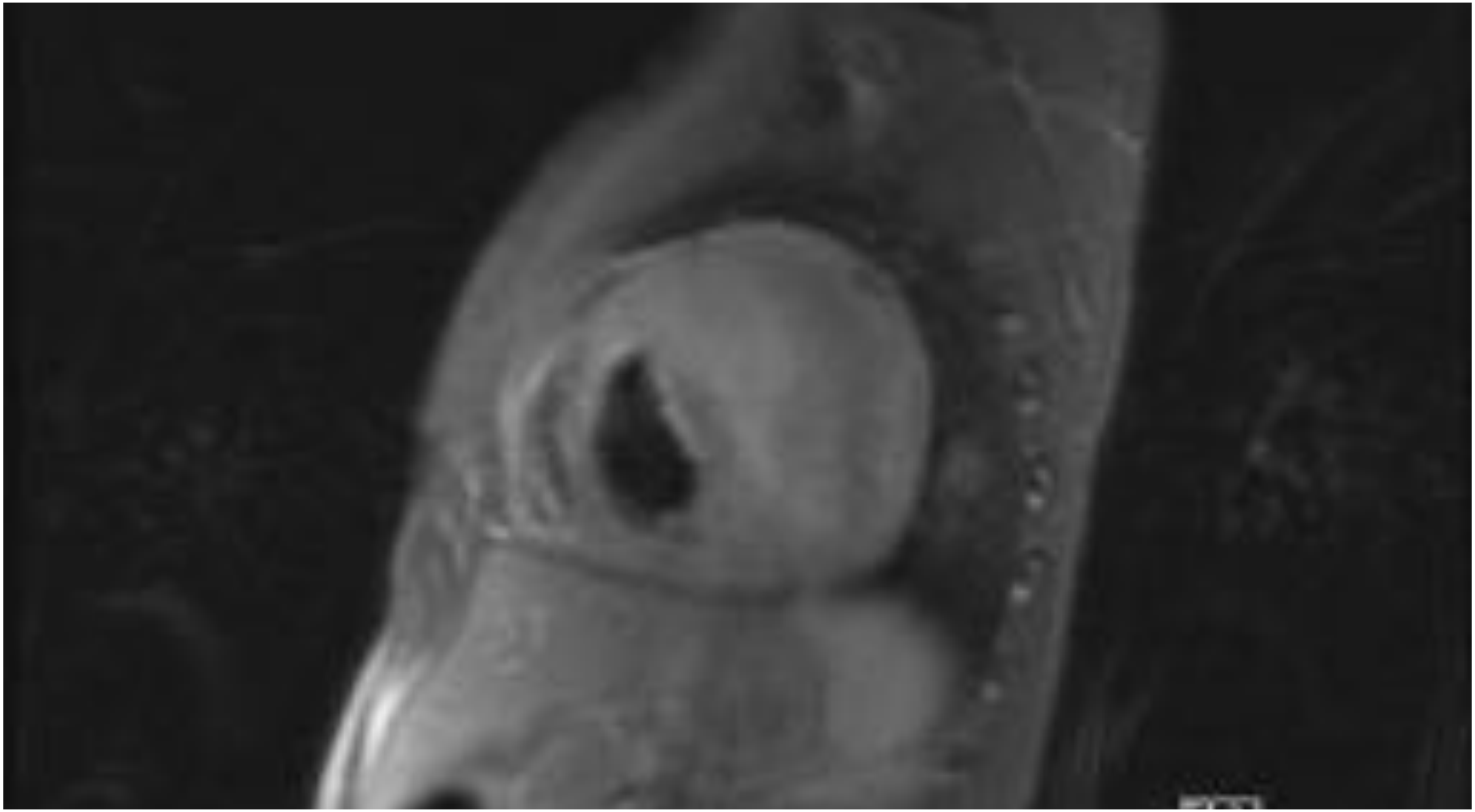


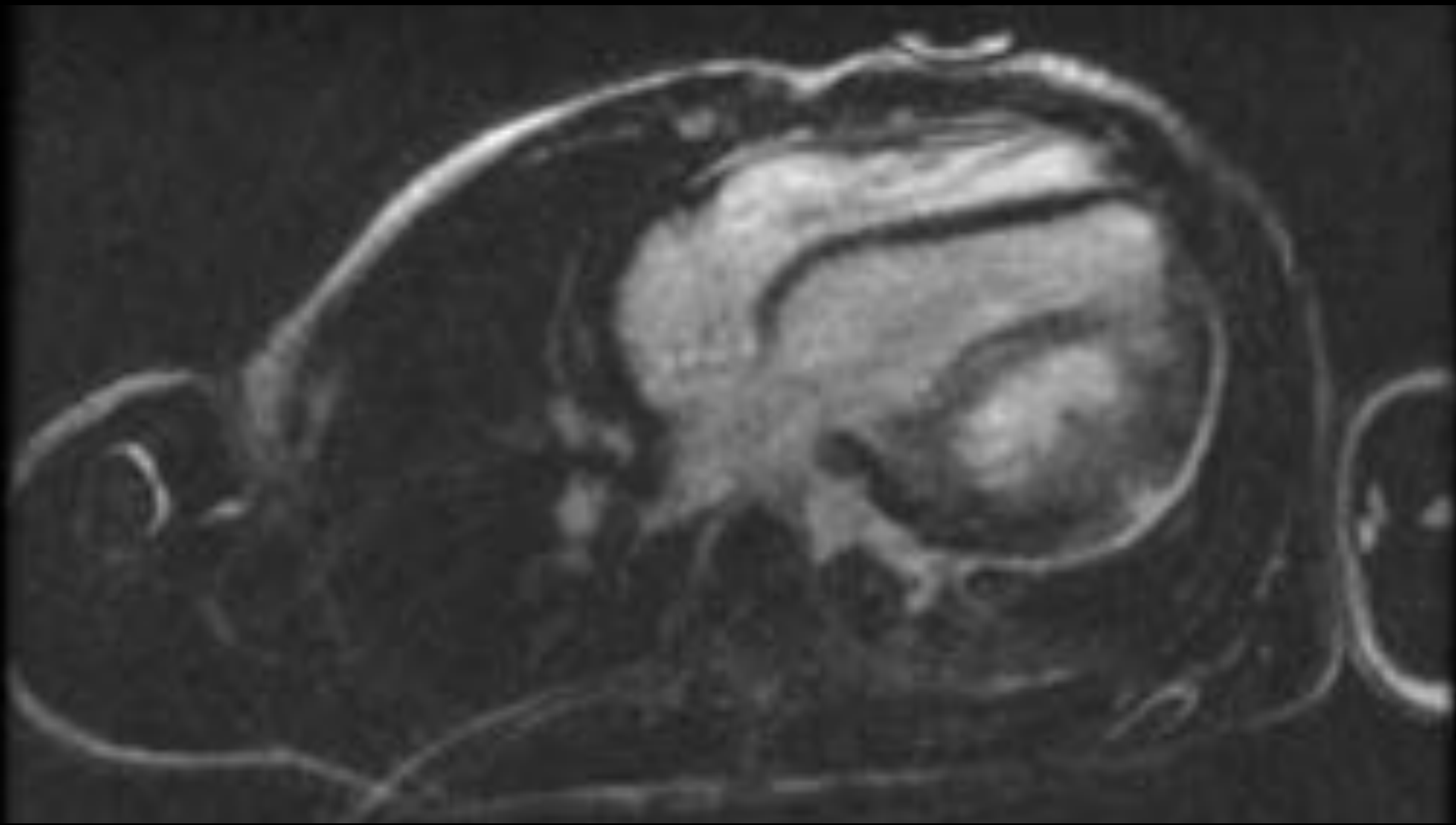
Rabdomyome

Rabdomyome



Rabdomyome





Tumeurs

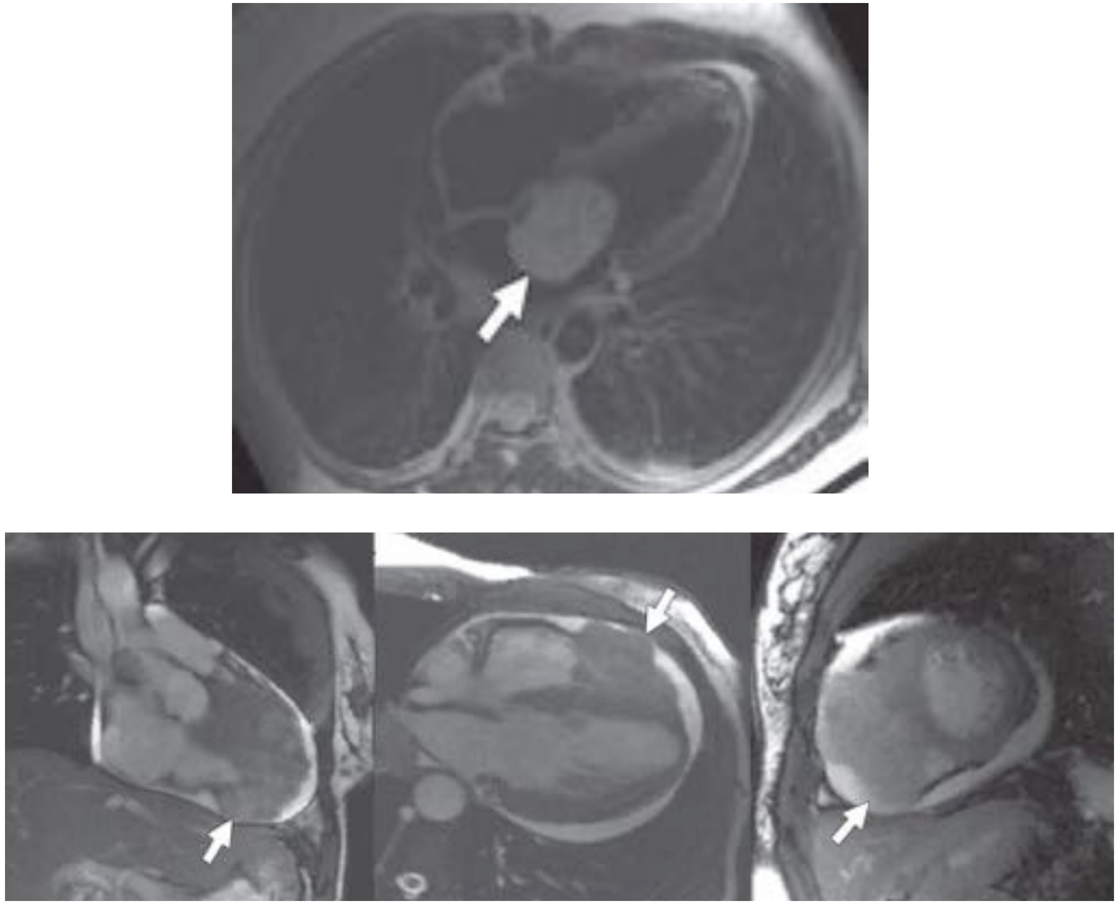


Fig. 1—Examples of sequences used for cardiac tumor assessment on cardiac MRI.
A, 62-year-old man with progressive dyspnea. Axial fast spin-echo image quickly allows identification of mass (*arrow*), enabling subsequent sequences to be targeted to left atrium in this case. Left atrial myxoma was proven at surgery.
B, 43-year-old woman with previously resected cutaneous malignant melanoma. Two-chamber (*left*), four-chamber (*middle*), short-axis (*right*) steady-state free precession images. Tumor (*arrows*) is accurately located using all three image planes. Presumed diagnosis is malignant melanoma metastases. (See also Fig. S1, cine images, in supplemental data at www.ajronline.org.)

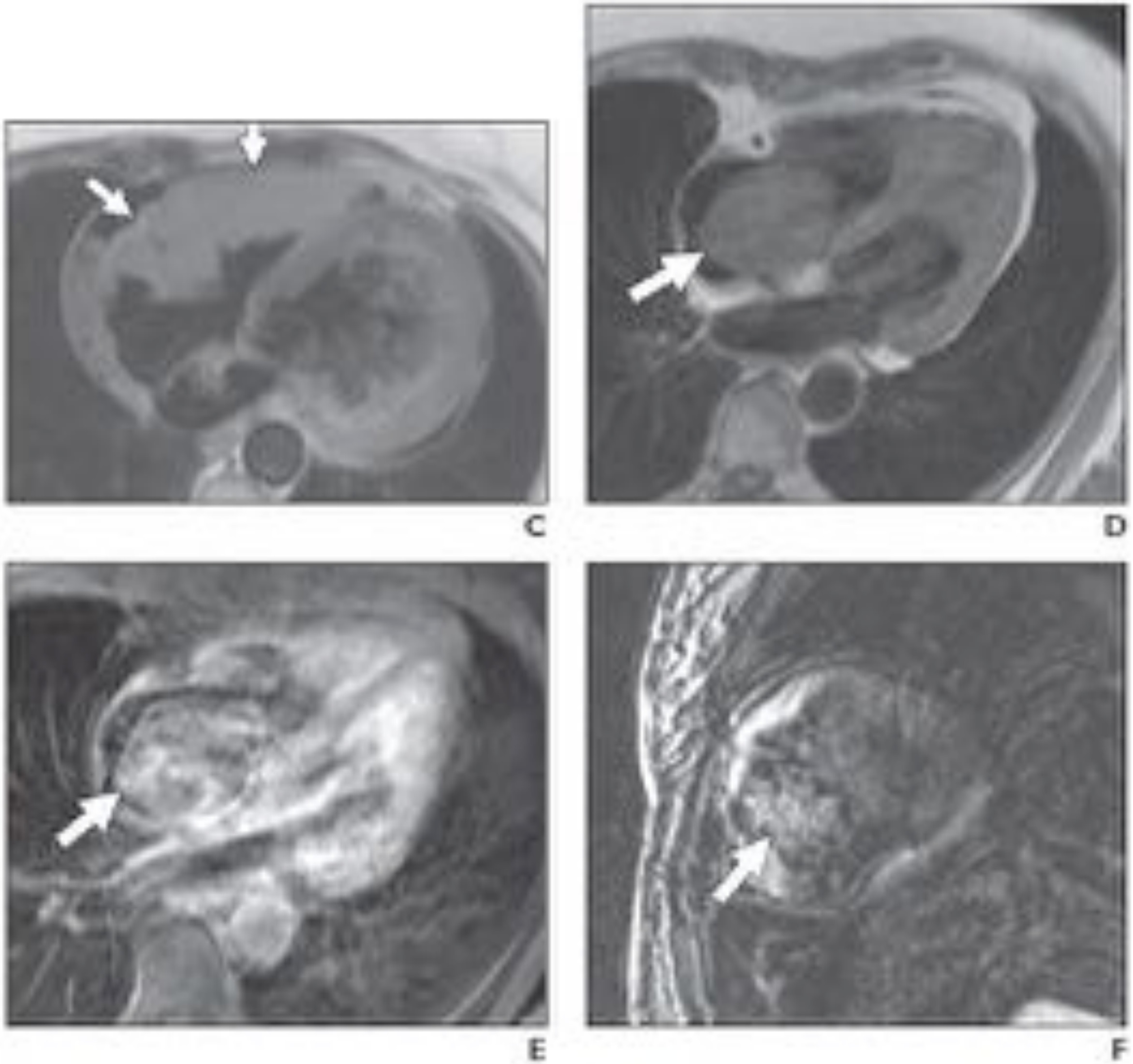
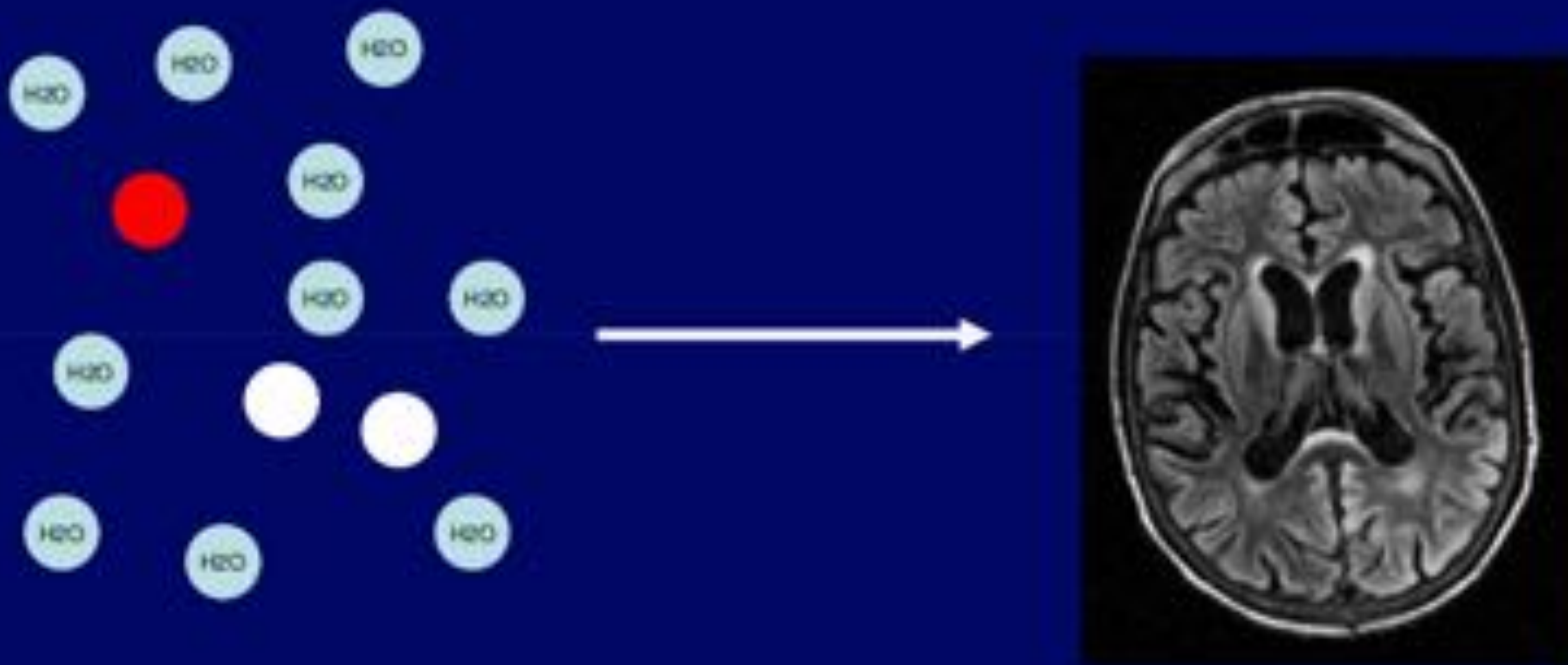


Fig. 1 (continued)—Examples of sequences used for cardiac tumor assessment on cardiac MRI.
C, 42-year-old woman with chest pain and palpitations. Four-chamber T2-weighted image shows high signal in extensive right ventricular free wall mass (arrows). Cardiac lymphoma was proven at biopsy. (See also Figs. S1 and S2, cine images, in supplemental data at www.ajronline.org.)
D and **E**, 47-year-old woman with progressive dyspnea. Axial T1-weighted images before (**D**) and after (**E**) administration of gadolinium show heterogeneous enhancement of right atrial mass (arrows). Right atrial myxoma was proven at surgery.
F, 43-year-old woman with previously resected cutaneous malignant melanoma (same patient as in **B**). Short-axis delayed enhanced sequence shows enhancement (arrow) of tumor.

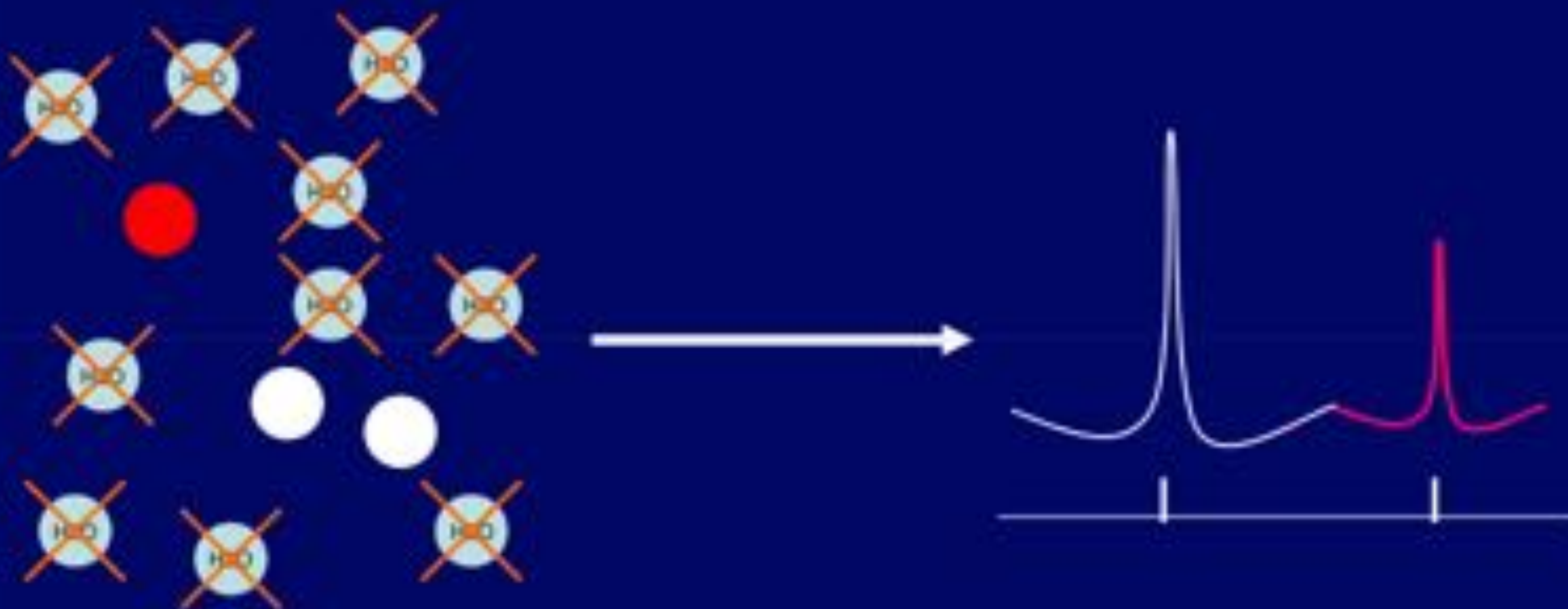
Analyse tissulaire complexe

SPECTROMETRIE

Principe général de l'IRM



Principe général de la SRM



En résumé:

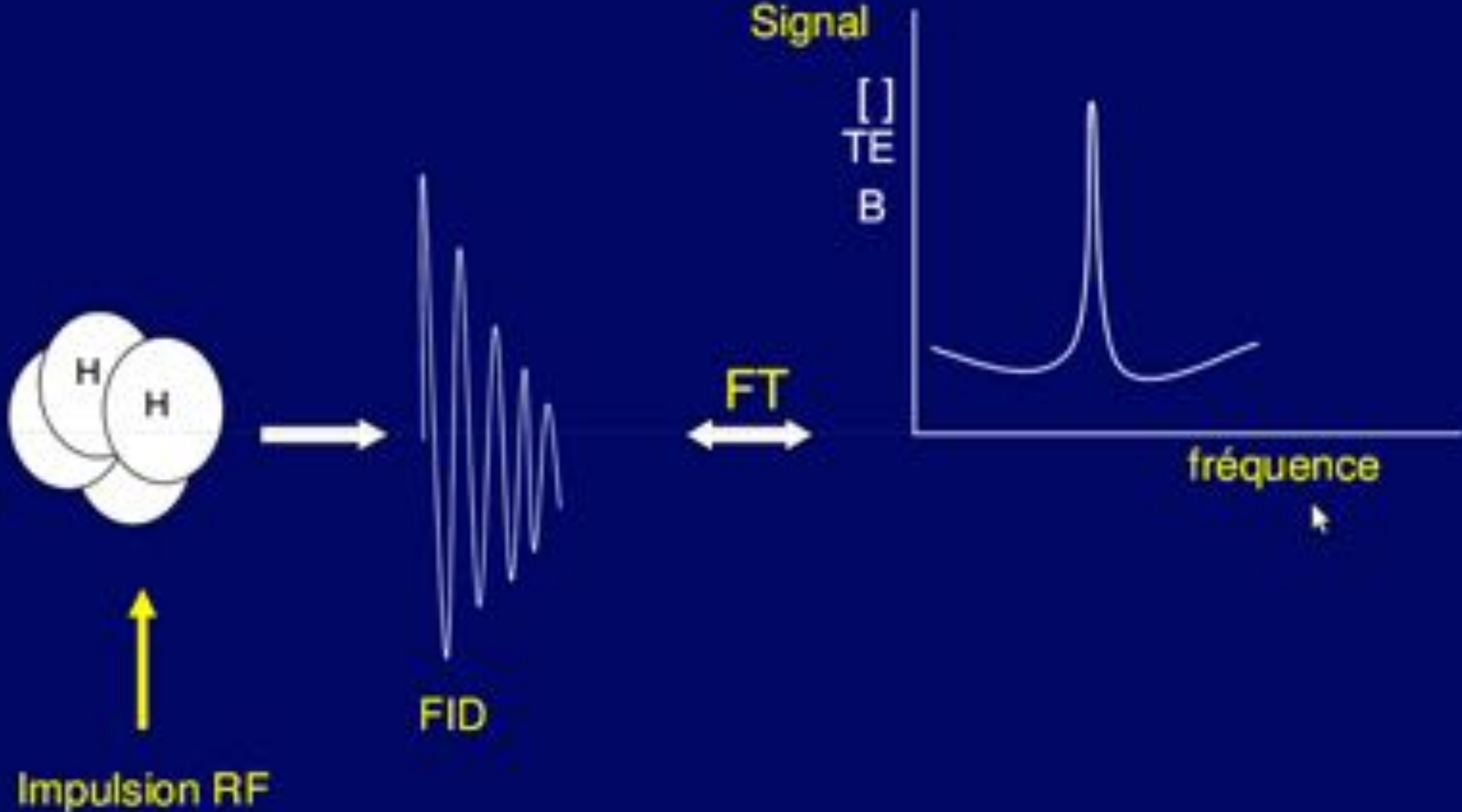
- IRM : recueil du signal des molécules d 'eau

  $\longrightarrow$ image

- SRM :
- suppression du signal de l 'eau
- recueil du signal des molécules dissoutes

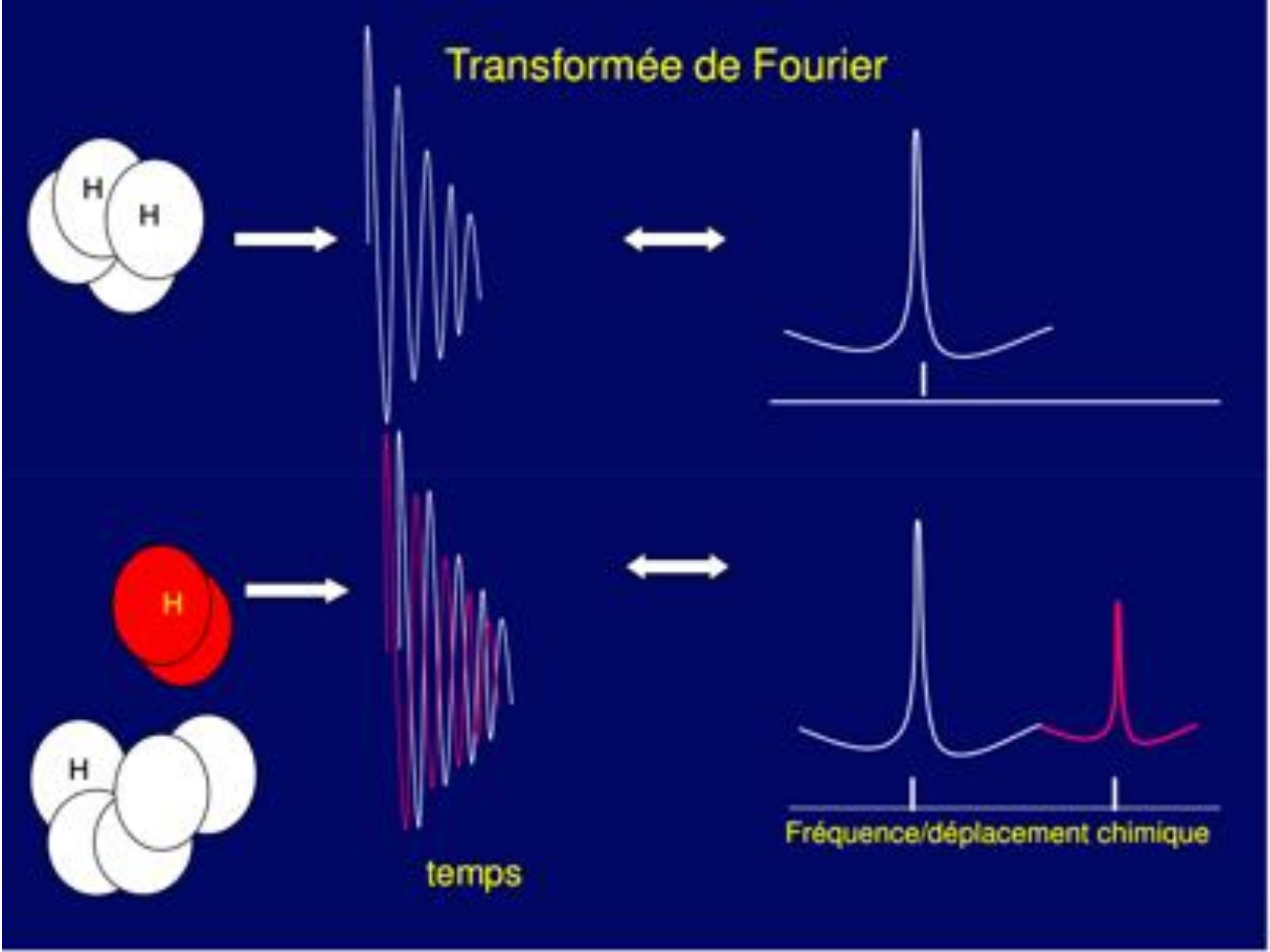
  $\longrightarrow$ caractérisation métabolique

- Même appareil, même examen



Signal
[ ]
TE
B
H
H
FT
fréquence
FID
Impulsion RF

Principe: utilisation des différences de fréquence de résonance des protons des différentes molécules



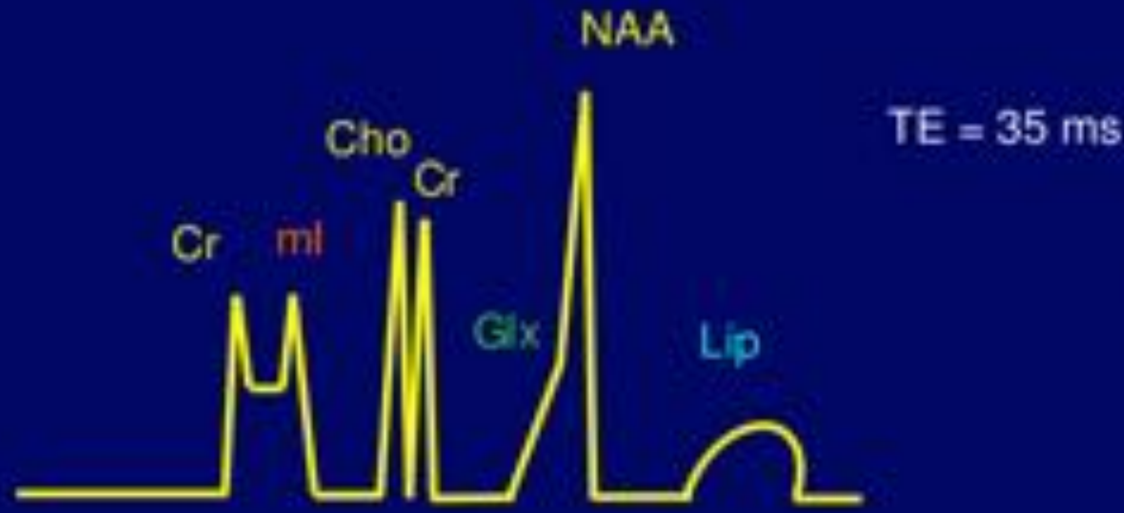
Transformée de Fourier
H
H
H
H
temps
Fréquence/déplacement chimique

NAA (N-Acetyl-Aspartate) : index de souffrance ou de mort neuronale

CHO (Choline) : marqueur des membranes (lésions, renouvellement), de la myéline ou d 'une inflammation (bétaïne)

Cr/PCr (Créatine-Phosphocréatine) : marqueur de densité cellulaire

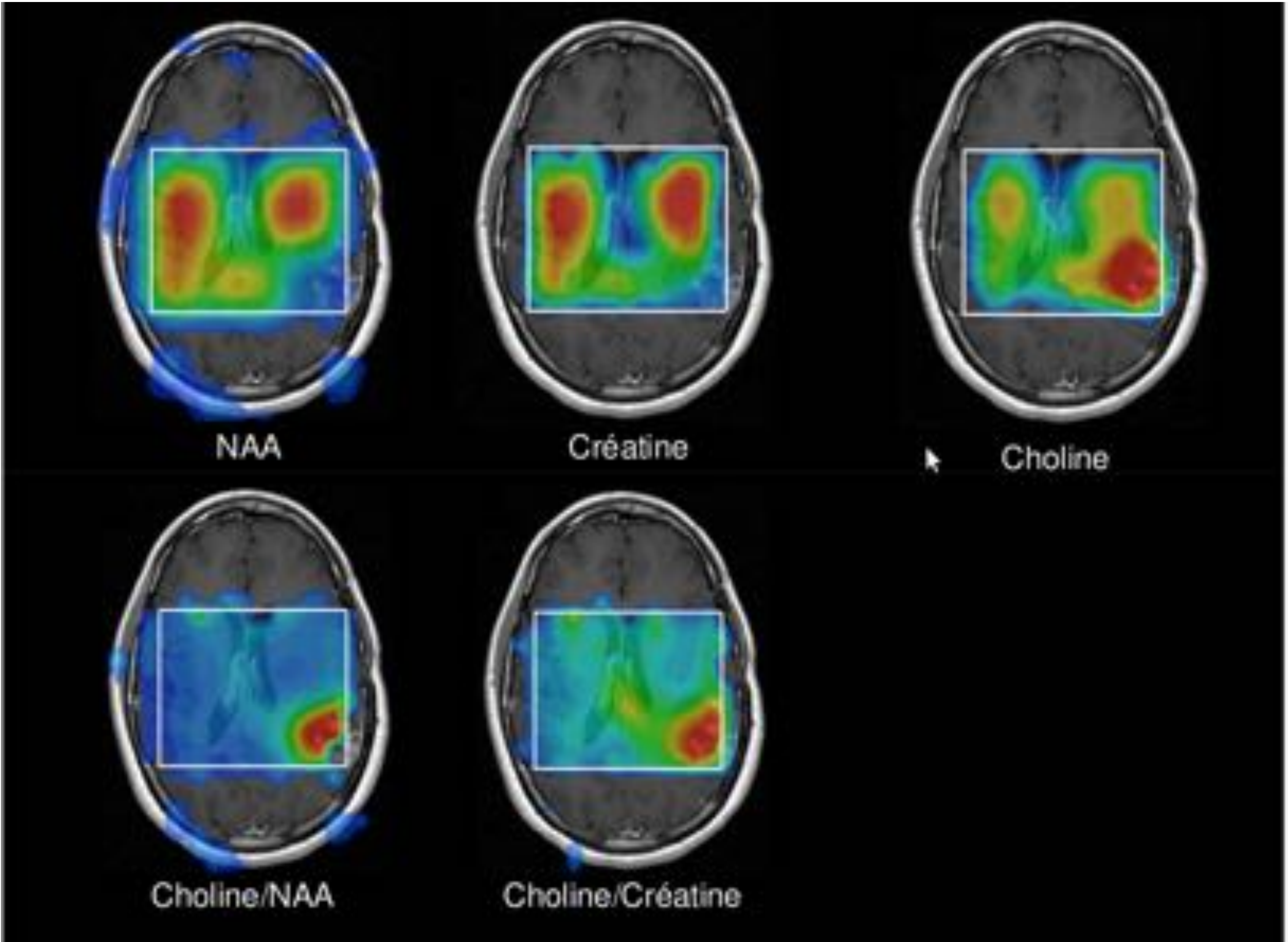
Lac (Lactate) : témoin d 'un processus ischémique, d 'un dysfonctionnement mitochondrial ou d 'une infiltration macrophagique

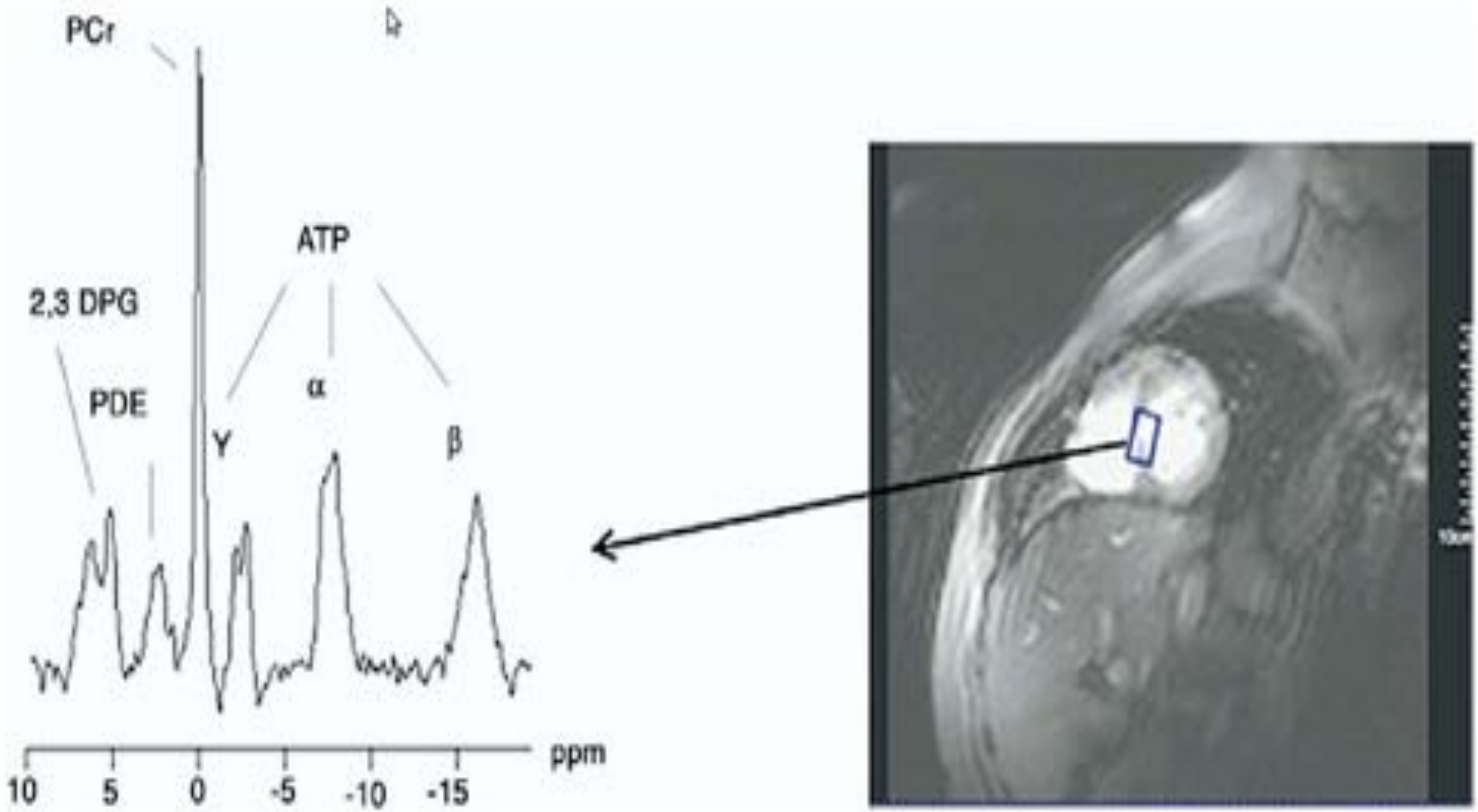


mI: myoinositol, glie normale

Glx: glutamine-glutamate, « neurotransmetteurs »

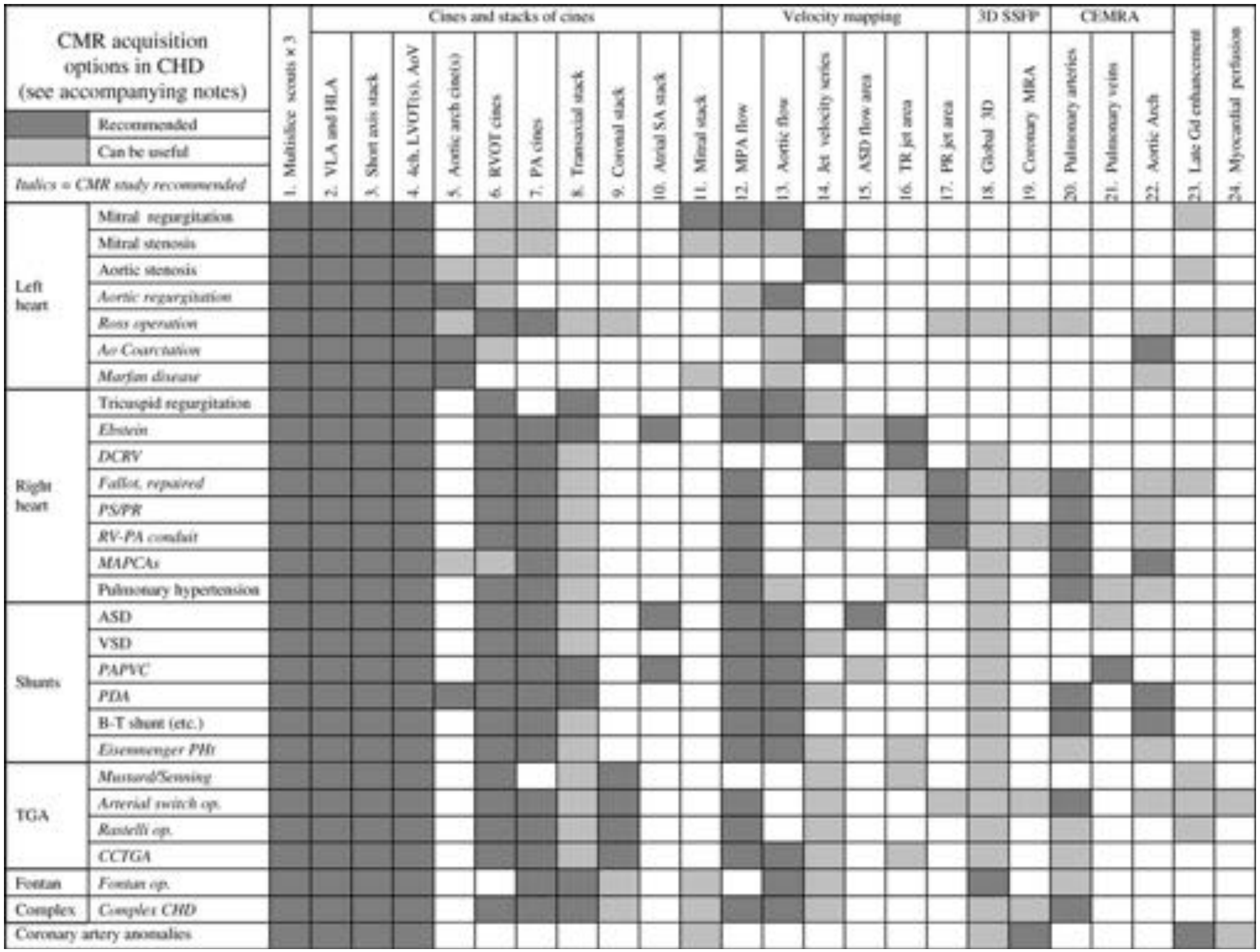
Lip: lipides, nécrose ou contamination (scalp)


NAA
Créatine
Choline
Choline/NAA
Choline/Créatine

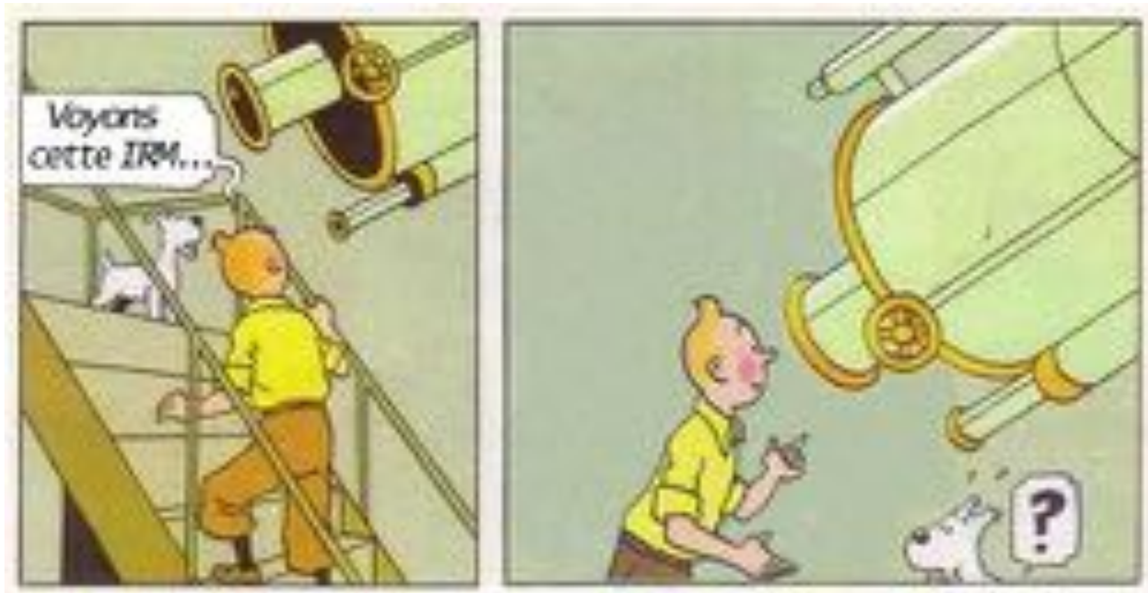


^{31}P Magnetic Resonance Spectroscopy in a Healthy Volunteer

Role de l'IRM dans les CC



Eur Heart J. Apr 2010



Merci pour votre attention…