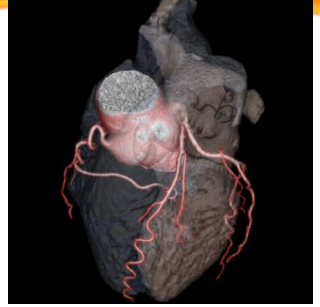

CARDIOMYOPATHIE DILATÉE (CMD) SCANNER ET IRM

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DIU Imagerie en coupes

Université de Poitiers

CHU de Poitiers

CARDIOMYOPATHIE DILATÉE IDIOPATHIQUE (CMD)

- Définition: Cardiomyopathie avec anomalie de structure et fonction du myocarde en l'absence de coronaropathie, de valvulopathie, de cardiopathie congénitale, de cardiomyopathie hypertrophique. Association d'un dysfonction systolique et d'une dilatation du VG sans cause ischémique ou de surcharge en pression.
- Le cas des myocardites sera traité dans le topo sur l'imagerie des myocardites
- Pour le bilan étiologique d'une CMD le scanner coronaire peut être une alternative à la coronarographie invasive pour s'assurer de l'absence de sténose coronaire, surtout en cas de probabilité faible ou intermédiaire de coronaropathie.

Ederhy S. Arch Cardiovasc Dis 2019
Japp AG. JACC 2016

CMD ET STÉNOSE CORONAIRE

- Prévalence de sténose coronaire significative : 28 à 46%
  (Boulmier D et al. Arch Cardiovasc Dis 2009)

	Echo	Coronaro	IRM	TDM
Volumes VG FEVG	++	+	++++	+++
Sténose coronaire	0	+++	0	++
Myocarde	+	0	++++	+
Valves	++++	++	+++	++
Veines coronaires	0	+	0	+++
Volume OG	+	0	+++	+++

EFFICACITÉ DU TDM / DÉTECTION STÉNOSE CORONAIRE > 50% (ANALYSE / PATIENT)

Table 2 Diagnostic performance of 64-slice computed tomography and dual-source computed tomography for the detection of significant coronary stenosis (luminal diameter >50%) on a per-patient basis

Author	Number of patients	Not evaluable (%)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Leschka *et al.*[53]	67	0	100 (47/47)	100 (20/20)	100 (47/47)	100 (20/20)
Leber *et al.*[44]	59[a]	23.7 (14/59)	88 (22/25)	85 (17/20)	88 (22/25)	85 (17/20)
Raff *et al.*[49]	70	0	95 (38/40)	90 (27/30)	93 (38/41)	93 (27/29)
Mollet *et al.*[46]	52	1.9 (1/52)	100 (38/38)	92 (12/13)	97 (38/39)	100 (12/12)
Ropers *et al.*[50]	84	3.6 (3/84)	96 (25/26)	91 (50/55)	83 (25/30)	98 (50/51)
Schuijf *et al.*[51]	61	1.6 (1/61)	94 (29/31)	97 (28/29)	97(29/30)	93 (27/29)
Ehara *et al.*[43]	69	2.9 (2/69)	98 (59/60)	86 (6/7)	98 (59/60)	86 (6/7)
Nikolaou *et al.*[47]	72	5.6 (4/72)	97 (38/39)	79 (23/29)	86 (38/44)	96 (23/24)
Weustink *et al.*[52]	77	0	99 (76/77)	87 (20/23)	96 (76/79)	95 (20/21)
Leber *et al.*[45]	90	2.2 (2/90)	95 (20/21)	90 (60/67)	74 (20/27)	99 (60/61)
Total	701	3.8 (27/701) (95% CI 2.6–5.6)	98 (394/404) (95% CI 95–99)	90 (263/293) (95% CI 86–93]	93 (394/424) (95% CI 90–95)	95 (263/273) (95% CI 93–98)

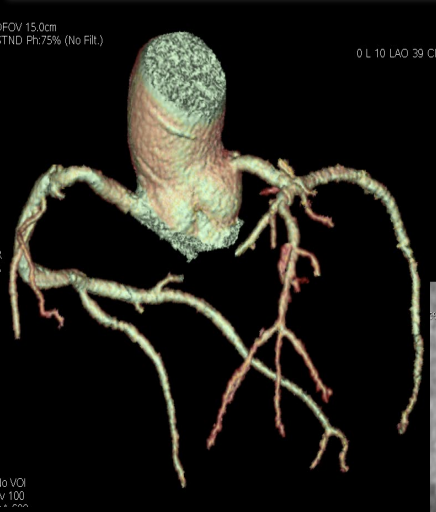
All values are expressed as per cent with absolute numbers in parentheses.
95% CI, 95% confidence interval; NPV, negative predictive value; PPV, positive predictive value.
[a]Exclusion of patients with stents.

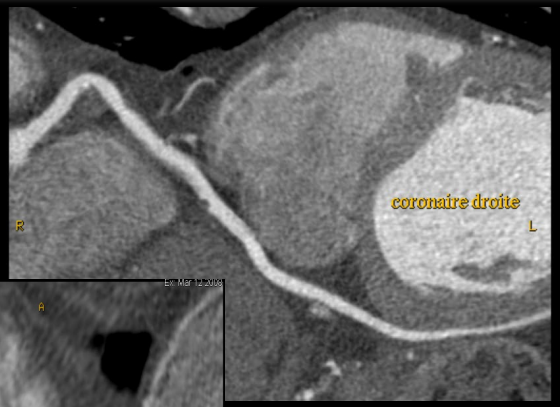
Working Group
Eur Heart J 2008

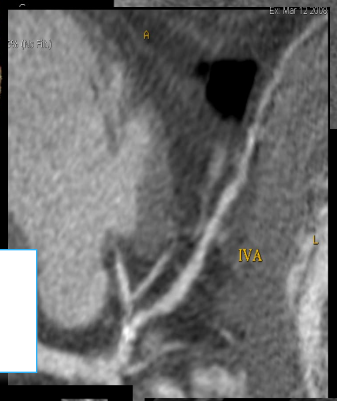
Intérêt du scanner / bilan de CMD: coronaires, thrombus intra Vg, réseau veineux coronaire
Volume VG et VD, FEVG et FEVD si acquisition rétrospective

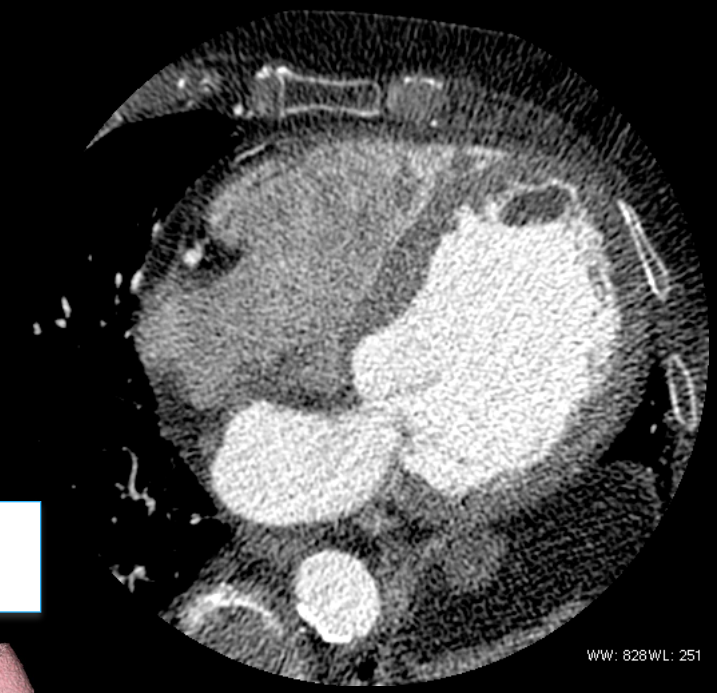
Patiente de 68 ans, CMD de découverte récente et BBG

Score calcique 158



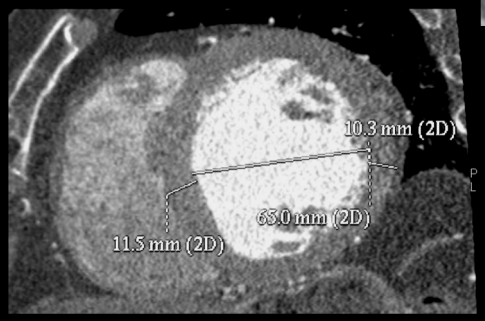


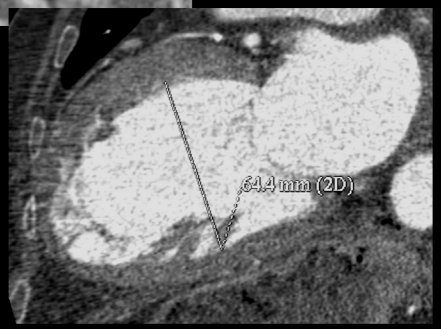


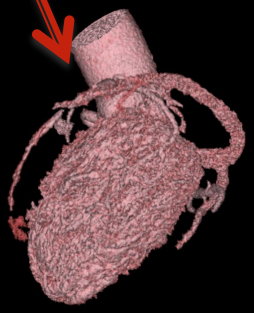


Pas de sténose coronaire significative

Réseau veineux / resynchronisation



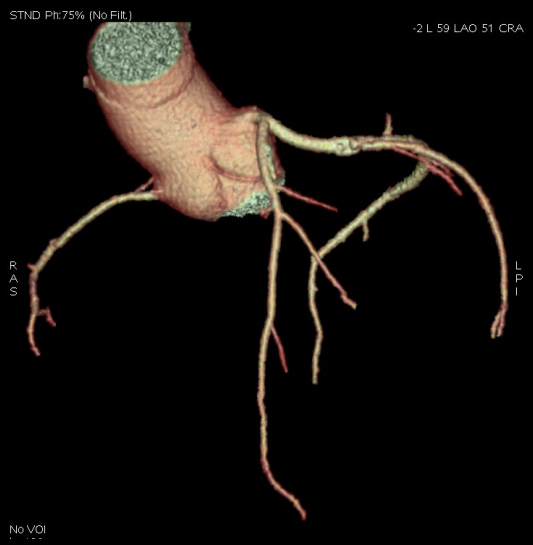


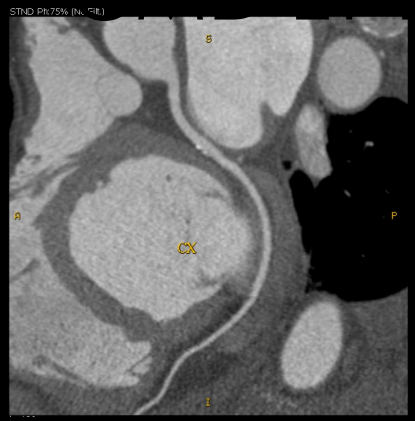


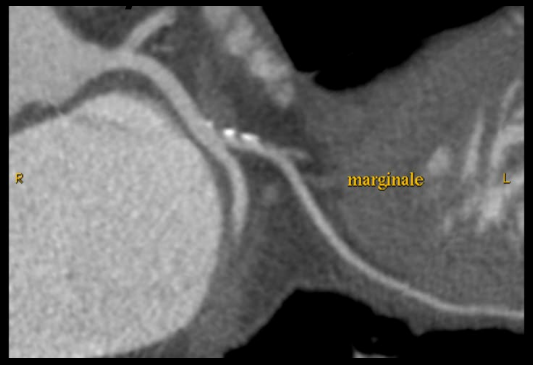
Découverte d' un thrombus apical

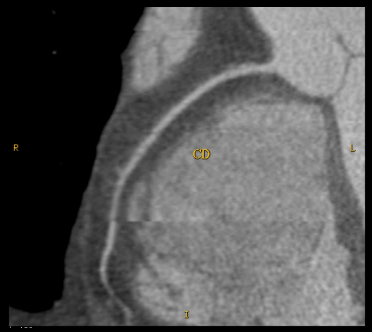
VG Diastole: 140 ml/m²
FEVG 29%

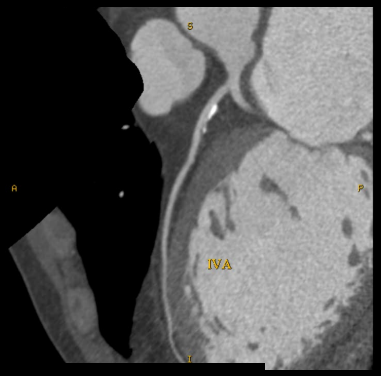
Autre exemple: Homme 58 ans, CMD, score Ca 346

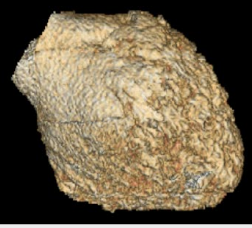












147 ml/m²

FEVG = 28%

CMD scanner IRM L Christiaens

CMD: TDM VERSUS CORONAROGRAPHIE

Boulmier D, Arch Cardiovasc Dis 2009

TDM 64 GE: bilan de CMD, n = 59, 56 +/- 13 ans

- collimation 64 x 0.6mm;
- rotation 0.33 s;
- pitch 0.16 à 0.24;
- voltage 120 kV;
- ampères 300 and 750 mA;
- injection triphasique 115mL de produit iodé à 350 mg/mL

97% des segments coronaires analysables
3% de sténose / segment analysable
12% de patients avec sténose significative
Analyse par patient avec inclusion des segments non analysables:

Sensibilité	100%
Spécificité	79%
VPN	100%
VPP	55%,

Cornilly JC, Eur J Radiol 2007

La coronarographie pourrait être évitée

dans 78% des patients avec score calcique < 1000 (75% des patients)

dans 22% des patients avec score calcique > 1000

PRÉCAUTIONS

Résultats / Expérience Poitiers TDM 64 détecteurs (2006)

Pas d' antécédent de coronarographie	Sténoses significatives	Pas de sténose significative	Score calcique supérieur à 1000	Non contributif
Patients sans antécédent de coronaropathie (n = 488)	18%	66%	12%	4%
cardiomyopathie dilatée (n = 83)	29%	47%	12%	12%
CMH (n = 19)	21%	74%	5%	0%
troubles de rythme (n = 50)	16%	60%	14%	10%
troponine positive (n = 14)	21%	78%	0%	0%
Total (n = 636)	**20%**	**63%**	**12%**	**5%**

CMD scanner IRM L Christiaens

CMD ET TDM

- Précautions ++ avant TDM
  - Rythme sinusal
  - Pas d'urgence
  - Ralentir le rythme cardiaque
    - Bêta-bloquants si la FEVG > 50% et clinique stable
    - Ivabradine
  - Diminuer les extrasystoles
  - Score calcique
  - CR détaillé justifiant l'irradiation si acquisition rétrospective
    - Coronaires, volumes, FEVg, thrombus, veines coronaires

Cardiac imaging in patients with suspected or established heart failure (2)

Recommendations	Class	Level
Non-invasive stress imaging (CMR, stress echocardiography, SPECT, PET) may be considered for the assessment of myocardial ischaemia and viability in patients with HF and CAD (considered suitable for coronary revascularization) before the decision on revascularization.	IIb	B
Invasive coronary angiography is recommended in patients with HF and angina pectoris recalcitrant to pharmacological therapy or symptomatic ventricular arrhythmias or aborted cardiac arrest (who are considered suitable for potential coronary revascularization) in order to establish the diagnosis of CAD and its severity.	I	C
Invasive coronary angiography should be considered in patients with HF and intermediate to high pre-test probability of CAD and the presence of ischaemia in non-invasive stress tests (who are considered suitable for potential coronary revascularization) in order to establish the diagnosis of CAD and its severity.	IIa	C
Cardiac CT may be considered in patients with HF and low to intermediate pre-test probability of CAD or those with equivocal non-invasive stress tests in order to rule out coronary artery stenosis.	IIb	C
Reassessment of myocardial structure and function is recommended using non-invasive imaging: – in patients presenting with worsening HF symptoms (including episodes of AHF) or experiencing any other important cardiovascular event; – in patients with HF who have received evidence-based pharmacotherapy in maximal tolerated doses, before the decision on device implantation (ICD, CRT); – in patients exposed to therapies which may damage the myocardium (e.g. chemotherapy) (serial assessments).	I	C

European Heart Journal (2016) **37**, 2129-2200 - doi:10.1093/eurheartj/ehw 128

CARDIOPATHIES DILATÉES ET IRM

IRM: gold standard pour volumes et FE

CMD ET IRM

- Rôle majeur de l'IRM pour l'évaluation des volumes, des masses et des fractions d'éjection VG et VD
- Rôle majeur dans la recherche de fibrose intramyocardique
- Rôle majeur dans l'évaluation du pronostic (mortalité globale, insuffisance cardiaque, tr du R ventriculaires graves)
- Impact dans la décision de pose de DAI (défibrillateur automatique implantable)

Protocol

1. **Anatomy** module
2. **LV function** module
3. **Edema** module
4. **RV function** module
5. **LGE** module

Report

1. **Dimensions** (corrected for BSA) and **function**
   - LV: EDV, ESV , SV, EF, end-diastolic diameter
   - RV: EDV, ESV, SV, EF
2. Presence and severity of **valvular regurgitation**
3. Presence, location, and extent of **fibrosis**

CMR Pocket Guide

2013

Cardiovascular Magnetic Resonance
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LV Volumes, Function and Mass Male Adults

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Absolute Values	<35 years	≥35 years
EDV (ml)	173 ± 29 (115–231)	149 ± 25 (99–199)
ESV (ml)	7 ± 15 (27–87)	43 ± 13 (17–69)
SV (ml)	118 ± 18 (82–154)	106 ± 19 (68–144)
EF (%)	67 ± 5 (57–77)	71 ± 6 (59–83)
Mass (g)	131 ± 21 (89–173)	120 ± 23 (74–166)

Indexed to BSA	<35 years	≥35 years
EDV/BSA (ml/m^2)	90 ± 11 (68–112)	75 ± 11 (53–97)
ESV/BSA (ml/m^2)	30 ± 7 (16–44)	22 ± 6 (10–34)
SV/BSA (ml/m^2)	60 ± 8 (44–76)	53 ± 8 (37–69)
Mass/BSA (g/m^2)	67 ± 10 (47–87)	60 ± 9 (42–78)

LV Volumes, Function and Mass Female Adults

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Absolute Values	<35 years	≥35 years
EDV (ml)	137 ± 25 (87–187)	128 ± 23 (82–174)
ESV (ml)	43 ± 11 (21–65)	40 ± 12 (16–64)
SV (ml)	96 ± 18 (60–132)	89 ± 16 (57–121)
EF (%)	69 ± 6 (57–81)	69 ± 6 (57–81)
Mass (g)	92 ± 20 (52–132)	92 ± 19 (54–130)

Indexed to BSA	<35 years	≥35 years
EDV/BSA (ml/m^2)	80 ± 9 (62–98)	73 ± 11 (51–95)
ESV/BSA (ml/m^2)	25 ± 6 (13–37)	23 ± 6 (11–35)
SV/BSA (ml/m^2)	55 ± 6 (43–67)	51 ± 8 (35–67)
Mass/BSA (g/m^2)	53 ± 9 (35–71)	52 ± 9 (34–70)

RV Volumes, Function and Mass Male Adults

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Absolute Values	<35 years	≥35 years
EDV (ml)	203 ± 33 (137–269)	181 ± 28 (125–237)
ESV (ml)	87 ± 20 (47–127)	71 ± 17 (37–105)
SV (ml)	116 ± 19 (78–154)	110 ± 18 (74–146)
EF (%)	57 ± 5 (47–67)	61 ± 6 (49–73)
Mass (g)	42 ± 8 (26–58)	39 ± 7 (25–53)

Indexed to BSA	<35 years	≥35 years
EDV/BSA (ml/m²)	104 ± 15 (74–134)	89 ± 11 (67–111)
ESV/BSA (ml/m²)	44 ± 9 (26–62)	34 ± 7 (20–48)
SV/BSA (ml/m²)	59 ± 9 (41–77)	55 ± 8 (39–71)
Mass/BSA (g/m²)	22 ± 4 (14–30)	20 ± 3 (14–26)

RV Volumes, Function and Mass Female Adults

Cardiovascular Magnetic Resonance
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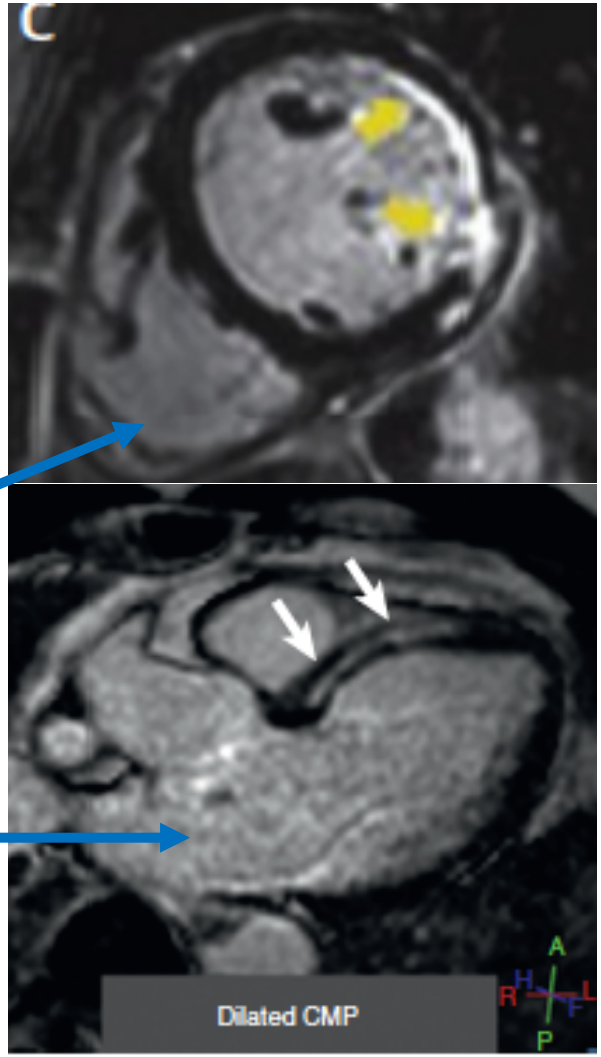
Absolute Values	<35 years	≥35 years
EDV (ml)	152 ± 27 (98–206)	140 ± 37 (66–214)
ESV (ml)	59 ± 12 (35–83)	52 ± 22 (8–96)
SV (ml)	93 ± 17 (59–127)	93 ± 17 (50–126)
EF (%)	61 ± 3 (55–67)	64 ± 7 (50–78)
Mass (g)	36 ± 7 (22–50)	33 ± 7 (19–47)

Indexed to BSA	<35 years	≥35 years
EDV/BSA (ml/m^2)	89 ± 11 (67–111)	80 ± 19 (42–118)
ESV/BSA (ml/m^2)	35 ± 5 (25–45)	30 ± 12 (6–54)
SV/BSA (ml/m^2)	54 ± 7 (40–68)	54 ± 7 (32–68)
Mass/BSA (g/m^2)	21 ± 3 (15–27)	19 ± 3 (13–25)

CMD ET IRM

- L' absence de lésion angiographique significative en coronarographie ne suffit pas à exclure une participation ischémique en cas de CMD
- 0 à 13% des « CMD » à coronaires non sténosées présentent un réhaussement tardif sous endocardique ou transmural en faveur d' une atteinte ischémique.
- Karamitsos T JACC 2009, Marrow BA JACC 2020
- Jusqu'à 30% des patients avec CMD présentent un réhaussement tardif intramyocardique (SIV ++) (Midwall LGE)
- Patel and Kramer JACC Cvi 2017

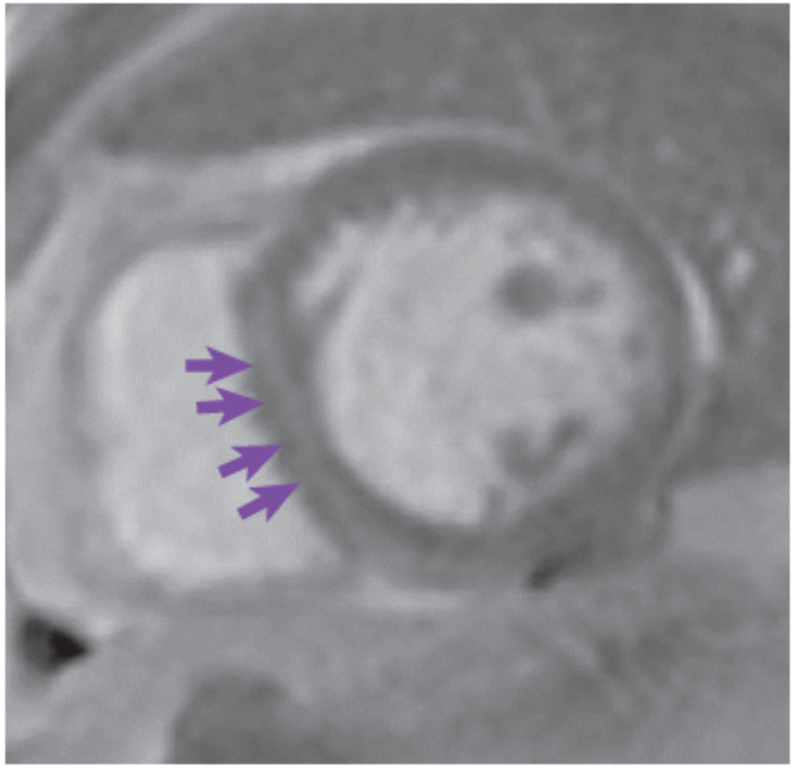


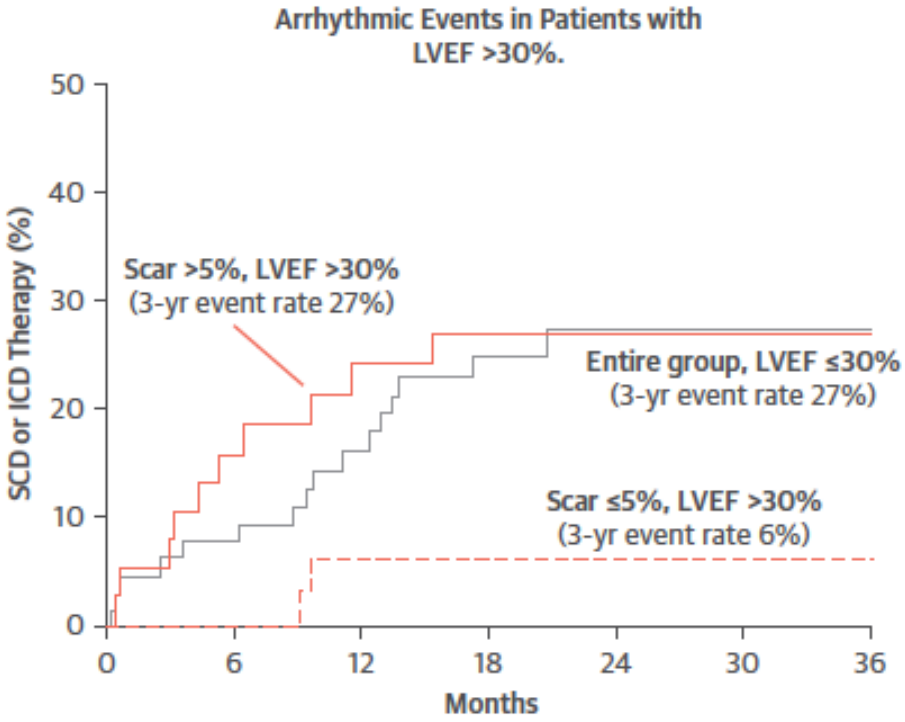
CMD / RÉHAUSSEMENT TARDIF POST GADOLINIUM

- Si réhaussement tardif étendu (> 5%): moins bonne réponse au traitement médical de l'ICFEA et plus de troubles du rythme ventriculaires et de mort subite.
- Prédicteur de mortalité globale, indépendant de la FEVG et de la présence de TV inductible
  - LGE > 5%: mort subite ou de TdR ventriculaire grave: 20% par an
  - Si FEVG > 40% présence de midwall LGE: risque x 9 de mort subite récupérée ou non / patients sans LGE
  - Important paramètre pour la décision de DAI
- Moindre validité actuellement pour le rôle pronostique du T1 mapping natif. ECV (volume extracelulaire) en évaluation.

Puntmann VO, et al. JACC Cvi 2016;9:40-50
Kober Let al. N Engl J Med 2016;375:1221-30
Marrow BA, et al. JACC 2020;75:1196-207

CMD ET IRM





Klem I, et al. Assessment of myocardial scarring improves risk stratification in patients evaluated for cardiac defibrillator implantation. J Am Coll Cardiol 2012;60:408–20.
Malhotra S, et al. Structural and Physiological Imaging to Predict the Risk of Lethal Ventricular Arrhythmias and Sudden Death. J Am Coll Cardiol Img 2019;12:2049–64

Key Points

1. Mid-wall fibrosis indicative of DCM
2. **Risk factors for sudden cardiac death:**
   - LV impairment, EF <35%
   - Frequent repetitive NSVT
   - Presence end extent of mid-wall fibrosis

CMR Pocket Guide

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2013

Tips & Tricks

1. Use **acceleration techniques** to reduce breath-hold times
2. **Consider unrecognized CAD** if you identify:
   - Marked regional wall motion abnormalities
   - Subendocardial or transmural hyperenhancement on LGE
3. Consider abnormal vascular connections / shunts
4. **Tagging** may help identify wall motion abnormalities
5. Perfusion imaging can be difficult to interpret (thin myocardium, presence of scar and slower flow)

Cardiac imaging in patients with suspected or established heart failure (1)

Recommendations	Class	Level
TTE is recommended for the assessment of myocardial structure and function in subjects with suspected HF in order to establish a diagnosis of either HFrEF, HFmrEF or HFpEF.	I	C
TTE is recommended to assess LVEF in order to identify patients with HF who would be suitable for evidence-based pharmacological and device (ICD, CRT) treatment recommended for HFrEF.	I	C
TTE is recommended for the assessment of valve disease, right ventricular function and pulmonary arterial pressure in patients with an already established diagnosis of either HFrEF, HFmrEF or HFpEF in order to identify those suitable for correction of valve disease.	I	C
TTE is recommended for the assessment of myocardial structure and function in subjects to be exposed to treatment which potentially can damage myocardium (e.g. chemotherapy).	I	C
Other techniques (including systolic tissue Doppler velocities and deformation indices, i.e. strain and strain rate), should be considered in a TTE protocol in subjects at risk of developing HF in order to identify myocardial dysfunction at the preclinical stage.	IIa	C
CMR is recommended for the assessment of myocardial structure and function (including right heart) in subjects with poor acoustic window and patients with complex congenital heart diseases (taking account of cautions/contra-indications to CMR).	I	C
CMR with LGE should be considered in patients with dilated cardiomyopathy in order to distinguish between ischaemic and nonischaemic myocardial damage in case of equivocal clinical and other imaging data (taking account of cautions/contra-indications to CMR).	IIa	C
CMR is recommended for the characterization of myocardial tissue in case of suspected myocarditis, amyloidosis, sarcoidosis, Chagas disease, Fabry disease non-compaction cardiomyopathy, and haemochromatosis (taking account of cautions/ contra-indications to CMR).	I	C

POINTS CLÉS

- Scanner: efficace pour dépister l'absence de sténose significative dans le bilan des CMD sous couvert d'une préparation adéquate du patient et veines coronaires (+/- FEVG et FEVD si acquisition rétrospective mais exposition aux rayons X augmentée ++)
  - Indication IIb (guidelines ESC 2016)

- IRM: dépistage d'une atteinte ischémique et des zones de fibrose intramyocardique + FEVG et FEVD (indications de classe I ou IIa)

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