Une IRM a été prescrite à mon patient porteur de PM/DAI/ moniteur : Que dois je faire?

Jerome Taieb CH Aix en Provence

Lien d’interet

Aucun

- The rate of cardiac electronic implantable device (CEID) implantation is increasing every year

- MRI has become the reference imaging for the management of a large number of pathology.

Bradshaw Trends in the incidence and prevalence of cardiac pacemaker insertions in an ageing population. Open Heart 2014
OECD (2019), Magnetic resonance imaging (MRI) exams (indicator).

European Heart Journal (2013) **34**, 2281–2329
doi:10.1093/eurheartj/eht150

ESC GUIDELINES

2013 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy

The Task Force on cardiac pacing and resynchronization therapy of the European Society of Cardiology (ESC). Developed in collaboration with the European Heart Rhythm Association (EHRA).

Practice Guideline > Diagn Interv Imaging. 2020 Sep;101(9):507-517.
doi: 10.1016/j.diii.2020.02.003. Epub 2020 Feb 21.

Joint Position Paper of the Working Group of Pacing and Electrophysiology of the French Society of Cardiology (SFC) and the Société française d'imagerie cardiaque et vasculaire diagnostique et interventionnelle (SFICV) on magnetic resonance imaging in patients with cardiac electronic implantable devices

2017 HRS expert consensus statement on magnetic resonance imaging and radiation exposure in patients with cardiovascular implantable electronic devices

2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy

Developed by the Task Force on cardiac pacing and cardiac resynchronization therapy of the European Society of Cardiology (ESC)

With the special contribution of the European Heart Rhythm Association (EHRA)

ESC European Society of Cardiology
Europace (2022) **00**, 1–26
https://doi.org/10.1093/europace/euac040

POSITION PAPER

EHRA consensus on prevention and management of interference due to medical procedures in patients with cardiac implantable electronic devices

For the European Heart Rhythm Association (EHRA), Heart Rhythm Society (HRS), Latin America Heart Rhythm Society (LAHRS), Asian Pacific Heart Rhythm Society (APHRS)

MR-nonconditional devices
• Magnetic induced force and torque (generator) • Gradient Magnetic field induced electrical current → oversensing, myocardial rapid capture, arrhythmias • Transmission of RF field: tissue heating and damage, arrhythmias, change in capture or sensing thresholds • Oversensing→ pacing inhibition/inappropriate ICD therapy • Reset mode and emergency mode (usually VVI with risk of pacing inhibition by pulsed MR fields) • Reed switch → asynchronous pacing/inhibition of tachycardia detection • Battery depletion • Ventricular arrhythmia induced by asynchronous pacing mode (DOO/VOO) • Acute bradycardia in ODO/OOO mode • Inactivation of ICD therapy: absence of VT/VF treatment

Risque Théorique

For a long time, the presence of a CEID has been considered an absolute contra-indication for MRI

2 major evolutions have changed this paradigm

Non MRI conditional systems

2009-2014 Magnasafe registry rapported safety on patient with system integrity, referred for

- **1,5 tesla extrathoracic** MRI
- **non stimulodependant**

1000 MRI scan on 818 PM => VOO/DOO
500 MRI scan in 418 ICD => Deactivation of therapy

=> 6 cases (five patients), partial generator electrical reset occurred + 1 battery depletion

Magnasafe registry Russo RJ, et al. *N Engl J Med.* 2017

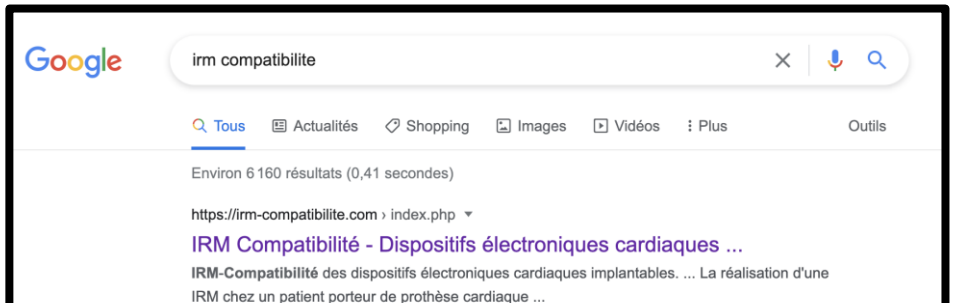
MRI-conditional systems

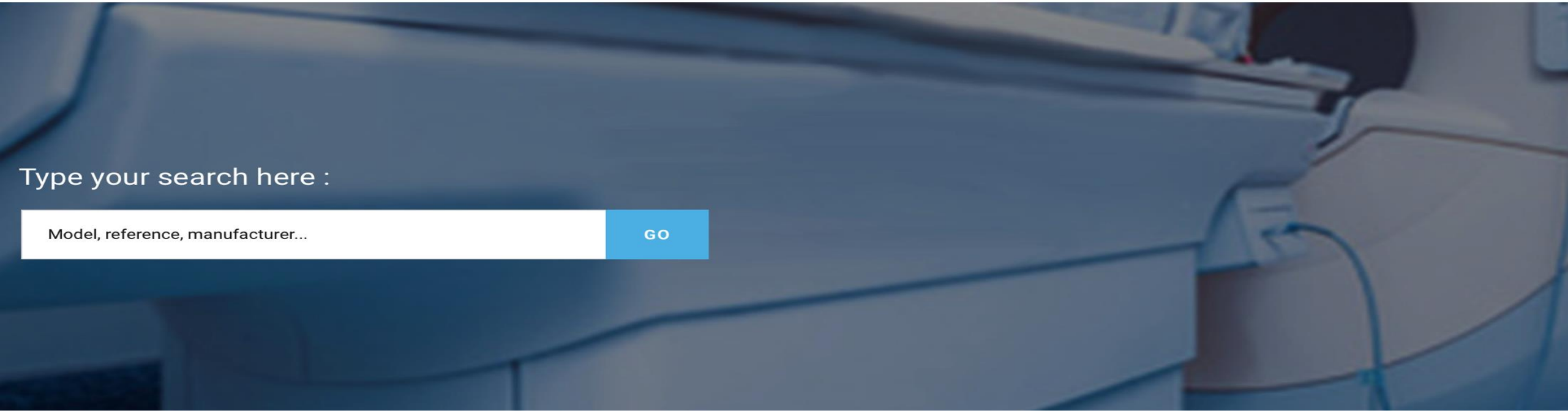
"garanti constructeur si conditions respectées"

- MR conditional system refers to **both CIED generator and leads approved** by the manufacturer

- The updated list of "MR-conditional" CEID is provided at the website www.irm-compatibilite.com

created with the support of the Working Group of Pacing and Electrophysiology of the French Society of Cardiology





SEARCH / FILTERING

ADVISA MRI (A3DR01, A3SR01, A2DR01)

Field strength 1,5T full body
3T full body

Exclusion zone No exclusion zone

Specific conditions In combination with Medtronic/Vitatron MRI compatible leads

Last update Monday, 30 September 2019

IRM Compatibilité

Dispositifs électroniques cardiaques implantables

Avec le soutien du groupe de rythmologie de la Société Française de Cardiologie

| | Notice légale | Politique de confidentialité | Contact

Entrez ici votre recherche :

Modèle de boitier/sonde, référence, fabricant...

L'accès de ce site et les données renseignées sont réservés aux professionnels de santé.

Je n'ai pas de compte : JE CRÉE MON ACCÈS

J'ai déjà un compte :

jtaieb@ch-aix.fr

••••••••••••••

CONNEXION

J'ai oublié mon mot de passe : RÉINITIALISATION

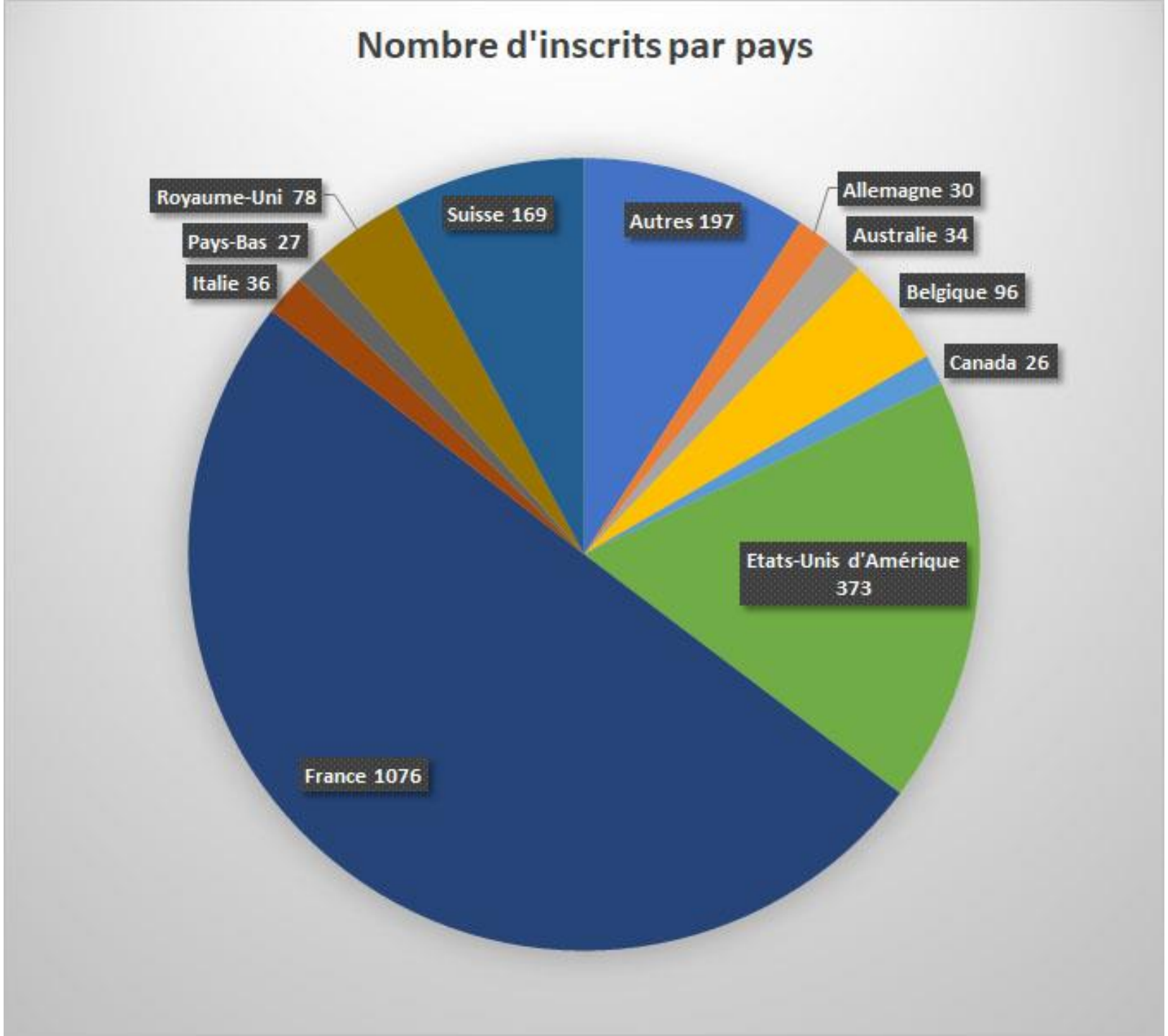
Accueil

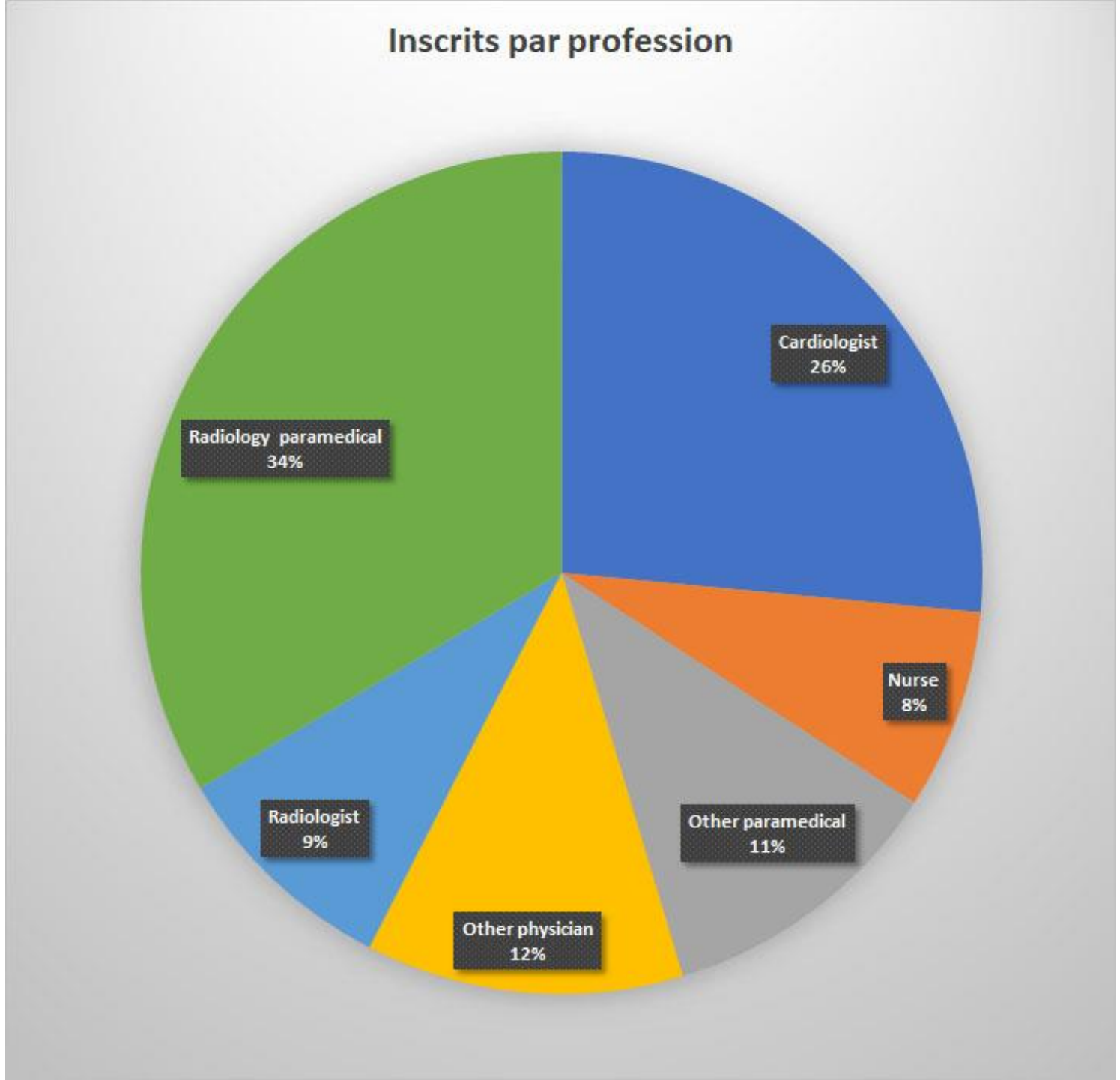
Ce site répertorie l'ensemble des matériels de stimulation et de défibrillation (sondes et prothèses) et moniteur implantable IRM-compatibles.
Il est mis à jour de manière régulière par les fabricants.

La réalisation d'une IRM chez un patient porteur de prothèse cardiaque (stimulateur / défibrillateur) doit tenir compte du rapport bénéfice risque. La décision sera prise in fine par le rythmologue qui tiendra compte de l'indication et du type d'IRM, des recommandations constructeurs, et des recommandations médicales.

RECOMMANDATIONS EUROPÉENNES :

RECOMMANDATIONS US :

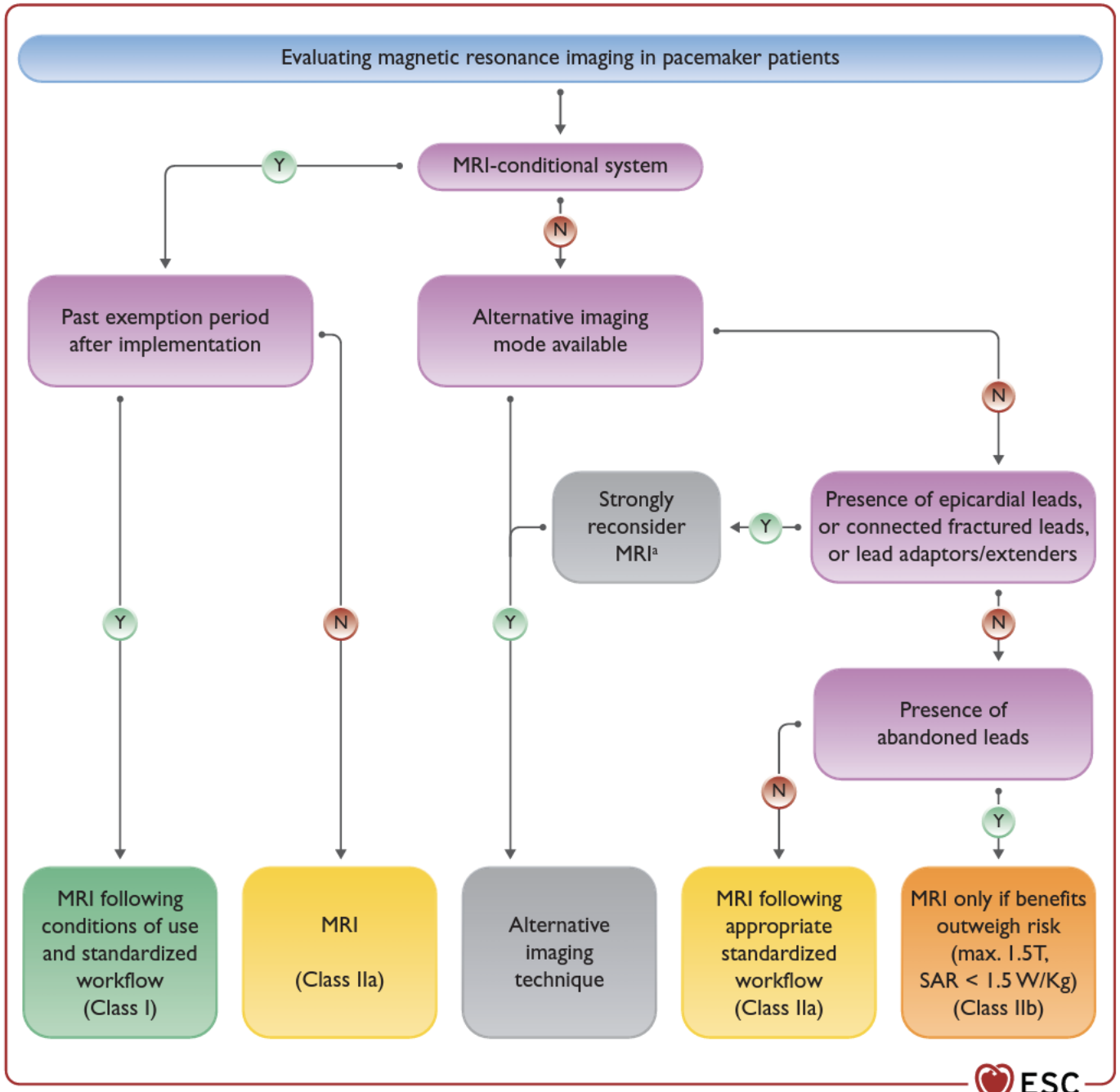

Nombre d'inscrits par pays
Autres 197
Allemagne 30
Australie 34
Belgique 96
Canada 26
Etats-Unis d'Amérique 373
France 1076
Italie 36
Pays-Bas 27
Royaume-Uni 78
Suisse 169

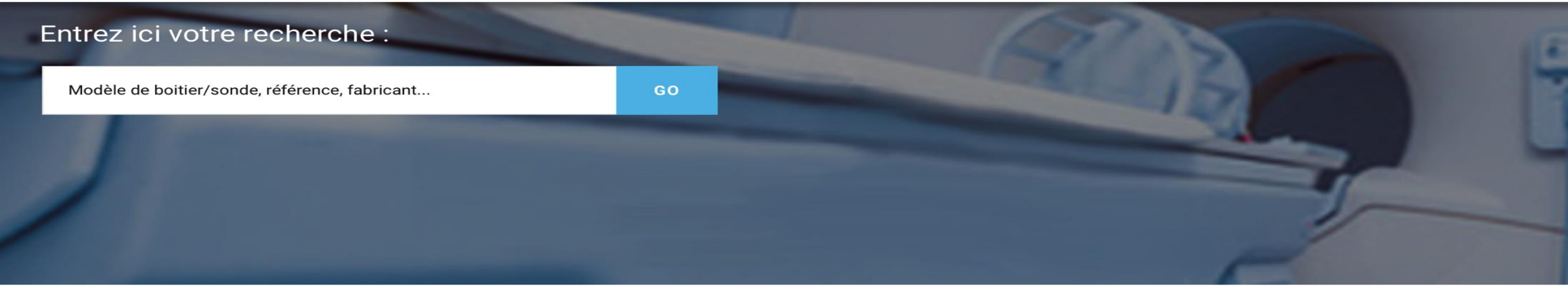

Inscrits par profession
Cardiologist
26%
Nurse
8%
Other paramedical
11%
Other physician
12%
Radiologist
9%
Radiology paramedical
34%

MR-nonconditional devices	MR-conditional devices under specific conditions
• Magnetic induced force and torque (generator) • Gradient Magnetic field induced electrical current → oversensing, myocardial rapid capture, arrhythmias • Transmission of RF field: tissue heating and damage, arrhythmias, change in capture or sensing thresholds • Oversensing→ pacing inhibition/inappropriate ICD therapy • Reset mode and emergency mode (usually VVI with risk of pacing inhibition by pulsed MR fields) • Reed switch → asynchronous pacing/inhibition of tachycardia detection • Battery depletion • Ventricular arrhythmia induced by asynchronous pacing mode (DOO/VOO) • Acute bradycardia in ODO/OOO mode • Inactivation of ICD therapy: absence of VT/VF treatment	• Ventricular arrhythmia induced by asynchronous pacing mode (DOO, VOO) • Acute bradycardia in ODO/OOO mode • Inactivation of ICD therapy: absence of VT/VF treatment

Management considerations	2013	2021
In patients with MRI-conditional pacemaker systems[c], MRI can be performed safely following manufacturer instructions.	IIa	I
In patients with non-MRI-conditional pacemaker systems, MRI should be considered if no alternative imaging mode is available and if no epicardial leads, abandoned or damaged leads, or lead adaptors/extenders are present.	IIb	IIa

Brignole M, et al. 2013 ESC guidelines on cardiac pacing and cardiac resynchronization therapy: the task force on cardiac pacing and resynchronization therapy of ESC in collaboration with EHRA. Europace 2013;15:1070–118.
Indik JH et al. 2017 HRS expert consensus statement on magnetic resonance imaging and radiation exposure in patients with cardiovascular implantable electronic devices. Heart Rhythm 2017;14:e97–153.


Evaluating magnetic resonance imaging in pacemaker patients
MRI-conditional system
Y
N
Past exemption period after implementation
Alternative imaging mode available
N
Strongly reconsider MRI[a]
Y
Presence of epicardial leads, or connected fractured leads, or lead adaptors/extenders
Y
N
Y
N
Presence of abandoned leads
N
Y
MRI following conditions of use and standardized workflow (Class I)
MRI (Class IIa)
Alternative imaging technique
MRI following appropriate standardized workflow (Class IIa)
MRI only if benefits outweigh risk (max. 1.5T, SAR < 1.5 W/Kg) (Class IIb)
ESC



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RECOMMANDATIONS EUROPÉENNES :
TÉLÉCHARGER L'ALGORITHME DÉCISIONNEL
TÉLÉCHARGER LE TABLEAU
TÉLÉCHARGER LE DOC RÉFÉRENCE

RECOMMANDATIONS US :
TÉLÉCHARGER LE DOCUMENT

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Before MRI

- Validate the clinical benefit of the MRI and programming/IRM (center protocol rythmo radio)

- Exclude contra-indications:
  - epicardial, fractured and abandoned leads as well as adapters and lead extensions (chest X-ray if necessary)
  - high capture thresholds > 2V/0.4 ms
  - out of range impedance values < 200 ohms or > 1500 ohms .
  - Elective replacement indicator (ERI) or end of service (EOS)

- MR-conditional system?

- PM/ICD: Pacing-dependency?

- ICD: primary or secondary indication?

- Specific MR-pacing programmation:
  - MRI Non conditional CIED: ODO/OVO if >40/mn, VOO/ DOO if <40/mn
  - MRI conditional CIED: MRI mode

- Deactivate tachycardia detection (ICDs)

Practice Guideline > Diagn Interv Imaging. 2020 Sep;101(9):507-517.
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SFICV

Société Française de Cardiologie
Rythmologie - Stimulation cardiaque

Patient Name: .....

ID

Indication for device implantation: .....

GENERATOR

Date of implantation: ___/___/_____
Brand and model: .....

LEADS

Brand and model:	Date of implantation
Atrial lead:	___/___/_____
RV lead:	___/___/_____
LV lead:	___/___/_____

Is the system ☐ MRI-conditional
☐ MRI-nonconditional

Is the patient pacing-dependent?	☐ YES	☐ NO	☐ NA
Are there abandoned lead(s)?	☐ YES	☐ NO	☐ NA
Are there epicardial lead(s)?	☐ YES	☐ NO	☐ NA

If ICD : ☐ Primary prevention ☐ Secondary prevention or history of appropriate therapy

Recommendations for MRI

MRI 1.5T full body ☐ MRI 1.5T with thoracic exclusion ☐
MRI 3T full body ☐ MRI 3T with thoracic exclusion ☐
MRI contra-indicated ☐

Presence of the device specialist within premises required	☐ YES	☐ NO
MR-mode programing in cardiology department possible	☐ YES	☐ NO
Device MR-programming: MRI mode possible	☐ YES	☐ NO

☐ VOO/DOO ☐ ODO/OOO ☐ VVI/DDI ☐ ICD therapy deactivation

Reprogramming of the device after MRI necessary: ☐ YES ☐ NO

Name and signature of cardiologist: ..... Date: ___/___/_____

Risk of programmation for MRI (MRI conditional or not)

- While the CIED is being programmed for scanning, there is a potential for
  - Absence of bradycardia pacing (OOO, ODO mode) = stim OFF
  - Arythmia induced by pacing (VOO/DOO)= Asynchro
  - Untreated tachyarrhythmias= Def OFF

- *Monitoring of the patient should be continued as long as the programmed mode is active* and CPR should be available.

2017 HRS expert consensus statement on magnetic resonance imaging and radiation exposure in patients with cardiovascular implantable electronic devices

During MRI

- Monitoring (cardiac frequency by pulse oximetry + ECG monitoring + visual monitoring) by physician or qualified personal
- Presence of a defibrillator and emergency material on site
- Physicians with the skill to perform resuscitation available immediately
- Physicians with the skill of programming devices *present on site or available immediately* depending on the device and patient dependency

After MRI

- Device control (battery, sensing, impedance, pacing threshold)
- Reprogramming of baseline settings, reactivation of tachycardia detection (ICDs)
  - Except Automatic/ temporary mode

Questions du cardiologue

- Puis je programmer un mode IRM au cabinet?
  - Mode asynchrone ou OFF permanent = Non
  - Mode détection champ magnétique et switch en mode IRM Asynchrone ou OFF (Microport , Biotronik PM) Oui

- Est-ce qu'un patient peut être longtemps en mode asynchrone, stimulation OFF, Défibrillation OFF? Non

- Est il facile d'obtenir une IRM chez un porteur de PM/ DAI?
  - Dépend de l'organisation du centre et de la collaboration radiologue rythmologue.
    => Prescription
    ⇒ allo service radio
    ⇒ récupération carte PM/ DAI et sonde
    ⇒ Vérification du système par service de cardiologie (Compatible ou non)
    ⇒ Filtre « IRM conditional » ou non
    ⇒ Organisation RDV programmation avant (creneaux)
    ⇒ Rx de thorax / CR implantation pour éliminer sonde abandonnée ou épicardique
- Délai pour IRM après implantation obligatoire? Non si IRM nécessaire
- IRM sur sonde abandonnée possible? Oui si IRM indispensable (1, 5 T extra T)
- Moniteurs implantables: Aucune contre indication ni précaution

Conclusion

- L'IRM n'est plus une contre-indication chez les patients porteurs de PM/DAI mais risque non égal à zéro.
  - I si garanti constructeur (Non MRI conditional system)
  - IIa si non garanti constructeur (MRI conditional system)

- Les centres doivent disposer d'un protocole local pour simplifier les demandes justifiées et minimiser le risque

Thanks to Estelle Grandjbackh and Working Group of Pacing and Electrophysiology of the French Society of Cardiology

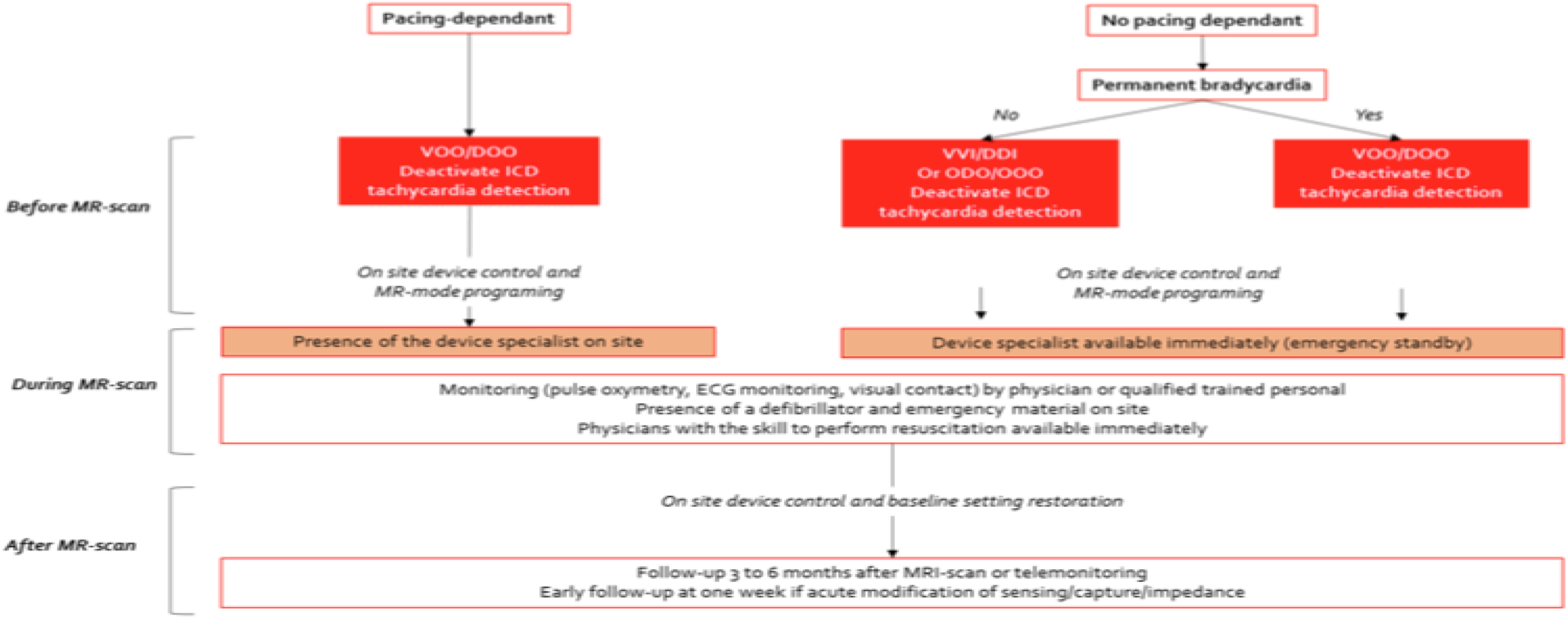
MR conditional MRI system

I	A	MR conditional devices should be considered MR conditional only when the product labeling is adhered to, which includes programming the appropriate “MR mode” and scanning with the prerequisites specified for the device.
I	B-R	It is recommended for patients with an MR conditional system that personnel with the skill to perform advanced cardiac life support, including expertise in the performance of CPR, arrhythmia recognition, defibrillation, and transcutaneous pacing, be in attendance with the patient for the duration of time the patient’s device is reprogrammed, until assessed and declared stable to return to unmonitored status.
I	C-EO	It is recommended for patients with an MR conditional system that personnel with the skill to program the CIED be available as defined by the institutional protocol.
I	A	It is recommended for patients with an MR conditional system that ECG and pulse oximetry monitoring be continued until baseline, or until other clinically appropriate CIED settings are restored.

Non conditional MRI system

I	B-NR	It is recommended for the patient with an MR nonconditional CIED that device evaluation be performed immediately pre- and post-MRI with documentation of pacing threshold(s), P- and R-wave amplitude, and lead impedance using a standardized protocol.
I	B-NR	A defibrillator/monitor (with external pacing function) and a manufacturer-specific device programming system should be immediately available in the holding area adjacent to the MR scanner room while an MR nonconditional CIED is reprogrammed for imaging
I	B-NR	It is recommended that personnel with the skill to perform advanced cardiac life support, including expertise in the performance of CPR, arrhythmia recognition, defibrillation, and transcutaneous pacing, accompany the patient with an MR nonconditional CIED for the duration of time the patient's device is reprogrammed, until assessed and declared stable to return to unmonitored status.
IIa	B-NR	It is reasonable for patients with an MR nonconditional CIED system to undergo MR imaging if there are no fractured, epicardial, or abandoned leads; the MRI is the best test for the condition; and there is an institutional protocol and a designated responsible MR physician and CIED physician.
IIa	B-NR	It is reasonable to perform an MR scan immediately after implantation of a lead or generator of an MR nonconditional CIED system if clinically warranted.
IIa	C-LD	For patients with an MR nonconditional CIED, it is reasonable to perform repeat MRI when required, without restriction regarding the minimum interval between imaging studies or the maximum number of studies performed.

MR-nonconditional CEIDs



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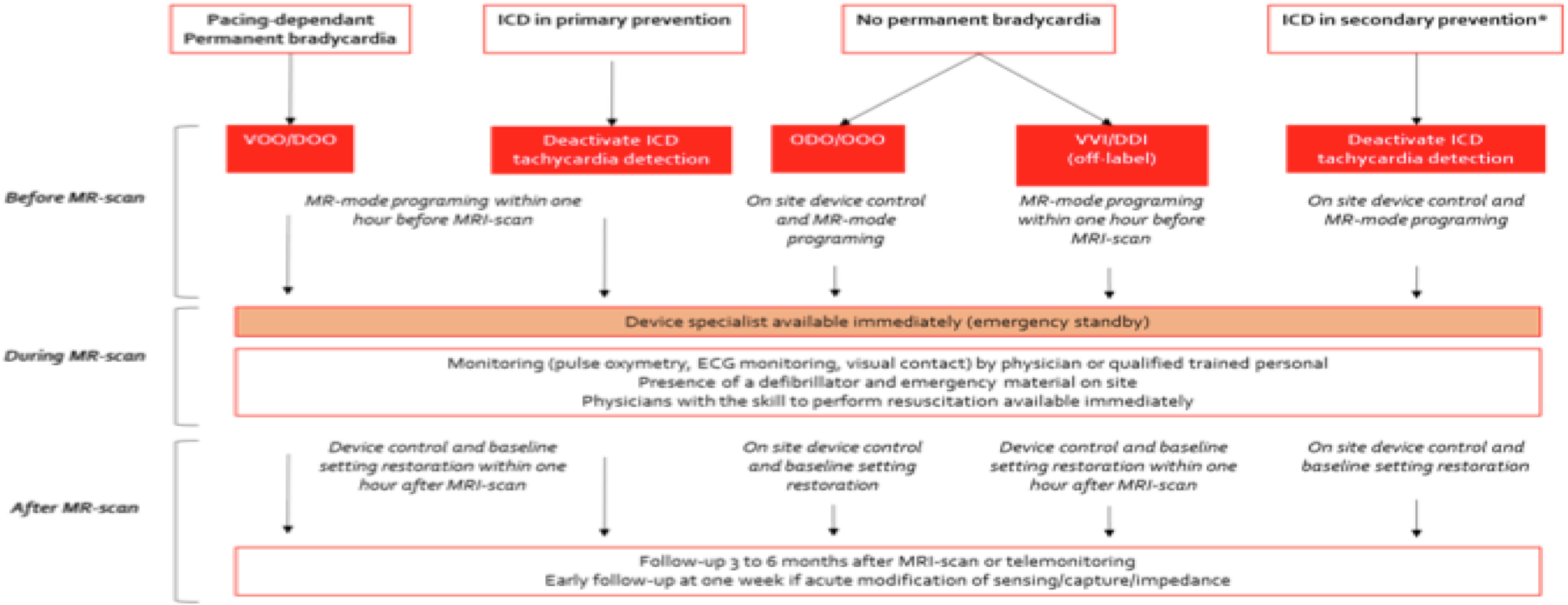
MR-conditional CEIDs



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Workflow

MR-examination should be integrated into a standardized workflow specific to the center

Workflow has to be defined in an institutional protocol involving both radiologists and device-specialists