

# Indications à la resynchronisation et techniques

**Serge Boveda** (Toulouse, FR; Brussels VUB, BE)  
sboveda@clinique-pasteur.com

A poster for the 24th Days of Rhythmology 2023. The background is a night view of the Avignon bridge over the Rhône river. The text is in white and orange. At the top, it says '24<sup>es</sup> Journées de Rythmologie' with a stylized orange heart icon. Below that, '27/29 septembre 2023'. Further down, 'GROUPE DE RYTHMOLOGIE ET DE STIMULATION CARDIAQUE DE LA SOCIÉTÉ FRANÇAISE DE CARDIOLOGIE'. At the bottom, 'Avignon' is written in a large, stylized orange font, with 'Palais des Congrès Cité des Papes' underneath. A yellow circular badge on the right says 'PROGRAMME'. The website 'www.rythmologie.fr' is at the bottom left. Logos for the Société Française de Cardiologie are at the bottom right. A small vertical copyright notice '©overcome - Juin 2023' is on the far right edge.

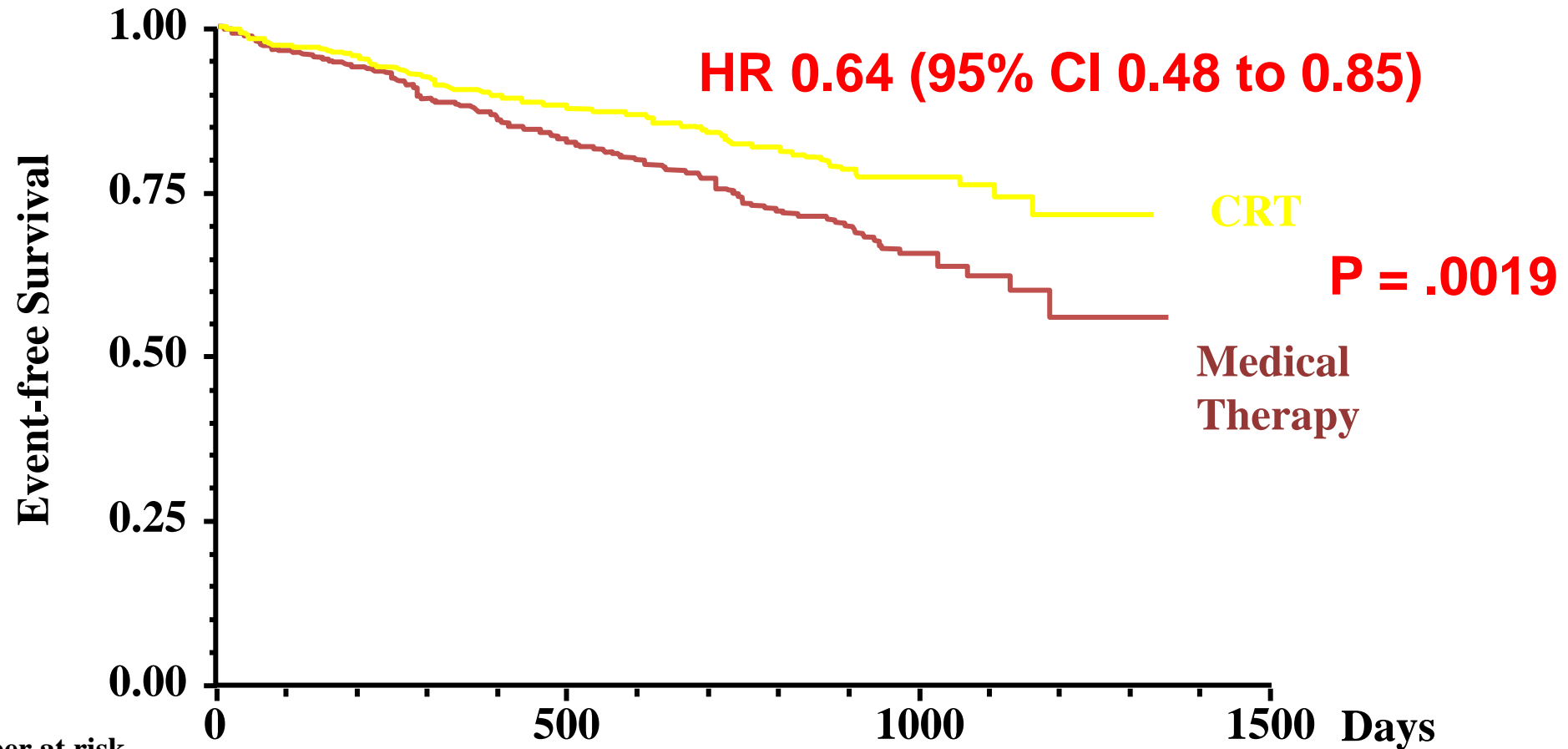
# Published CRT Studies: Inclusion Criteria

Study (n)	NYHA	QRS	LVEF	Rhythm	CRT-D?
MUSTIC SR (48)	III	>150	≤ 35%	Sinus	No
MUSTIC AF (37)	III	>200*	≤ 35%	AF	No
MIRACLE (453)	III, IV	≥130	≤ 35%	Sinus	No
MIRACLE ICD (369)	III,IV	≥130	≤ 35%	Sinus	Yes
MIRACLE ICD II (186)	II	≥130	≤ 35%	Sinus	No
PATH CHF (39)	III, IV	≥120	≤ 35%	Sinus	No
CONTAK CD (490)	II-IV	≥120	≤ 35%	Sinus	Yes
COMPANION (1520)	III, IV	≥120	≤ 35%	Sinus	Both
PATH CHF II (89)	II-IV	≥120	≤ 35%	Sinus	Both
CARE HF (814)	III, IV	≥120	≤ 35%	Sinus	No
RETHINQ (172)	III	<130	≤ 35%	Sinus	Yes
REVERSE (610)	I-II	≥120	≤40%	Sinus	Both
MADIT-CRT (1820)	I-II	≥130	≤30%	Sinus	Yes
RAFT (1798)	II-III	≥120	≤30%	Sinus & AF	Yes

# The CARE-HF Study

## Cardiac Resynchronisation in Heart Failure

### All-Cause Mortality

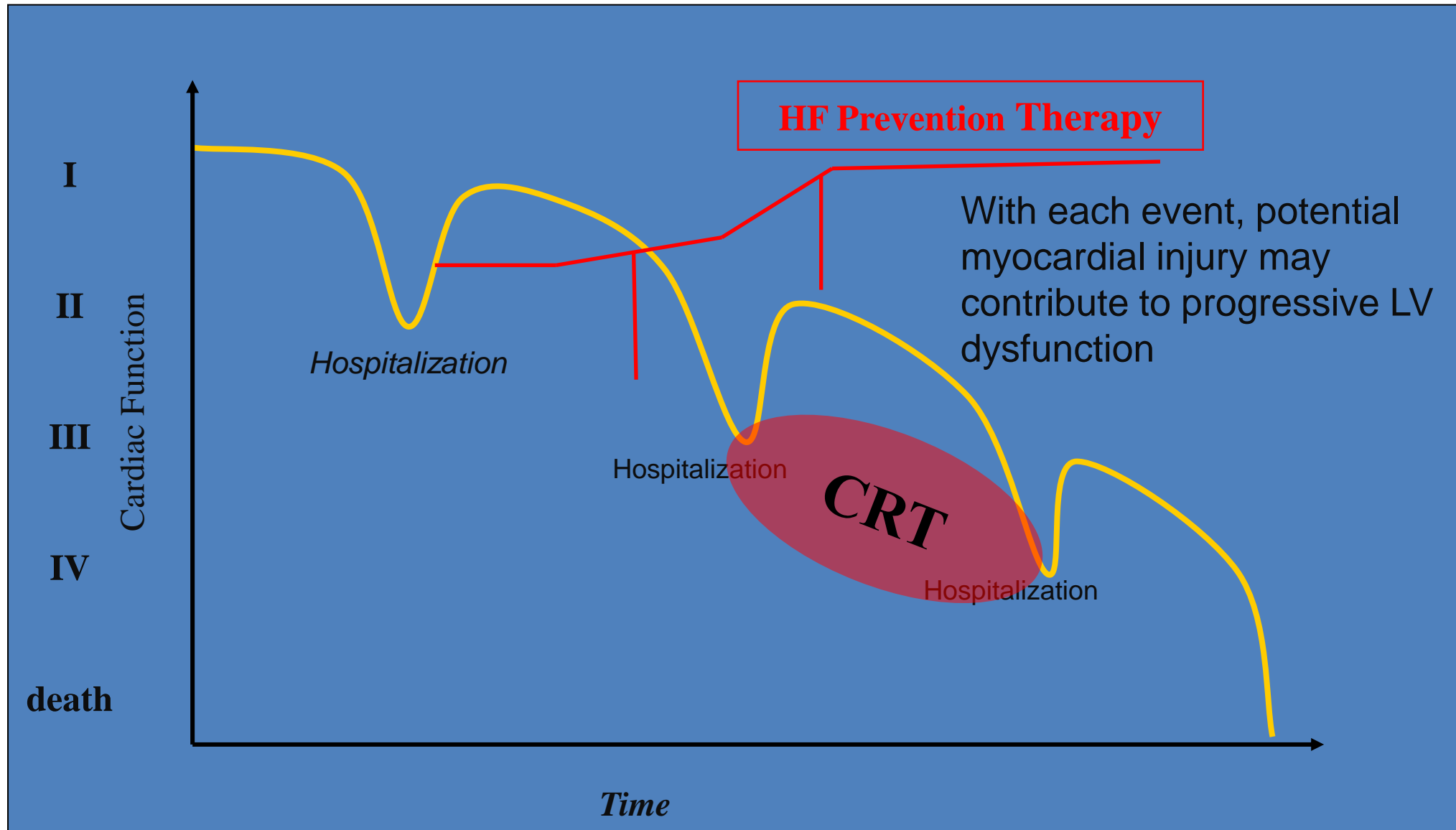


Number at risk

CRT	409	376	351	213	89	8
Medical Therapy	404	365	321	192	71	5

NEJM March 2005

# Intérêt de l'implantation précoce d'un CRT



# Indications for CRT in SR

## 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)

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>
<b>LBBB QRS morphology</b>		
CRT is recommended for symptomatic patients with HF in SR with LVEF $\leq 35\%$ , QRS duration $\geq 150$ ms, and LBBB QRS morphology despite OMT, in order to improve symptoms and <u>reduce morbidity and mortality</u> . <sup>37,39,40,254–266,283,284</sup>	<b>I</b>	<b>A</b>
CRT should be considered for symptomatic patients with HF in SR with LVEF $\leq 35\%$ , QRS duration 130–149 ms, and LBBB QRS morphology despite OMT, in order to improve symptoms and <u>reduce morbidity and mortality</u> . <sup>37,39,40,254–266,283,284</sup>	<b>IIa</b>	<b>B</b>

### Non-LBBB QRS morphology

CRT should be considered for symptomatic patients with HF in SR with LVEF  $\leq 35\%$ , QRS duration  $\geq 150$  ms, and non-LBBB QRS morphology despite OMT, in order to improve symptoms and reduce morbidity.<sup>37,39,40,254–266,283,284</sup>

**IIa**

**B**

CRT may be considered for symptomatic patients with HF in SR with LVEF  $\leq 35\%$ , QRS duration 130–149 ms, and non-LBBB QRS morphology despite OMT, in order to improve symptoms and reduce morbidity.<sup>273–278,281</sup>

**IIb**

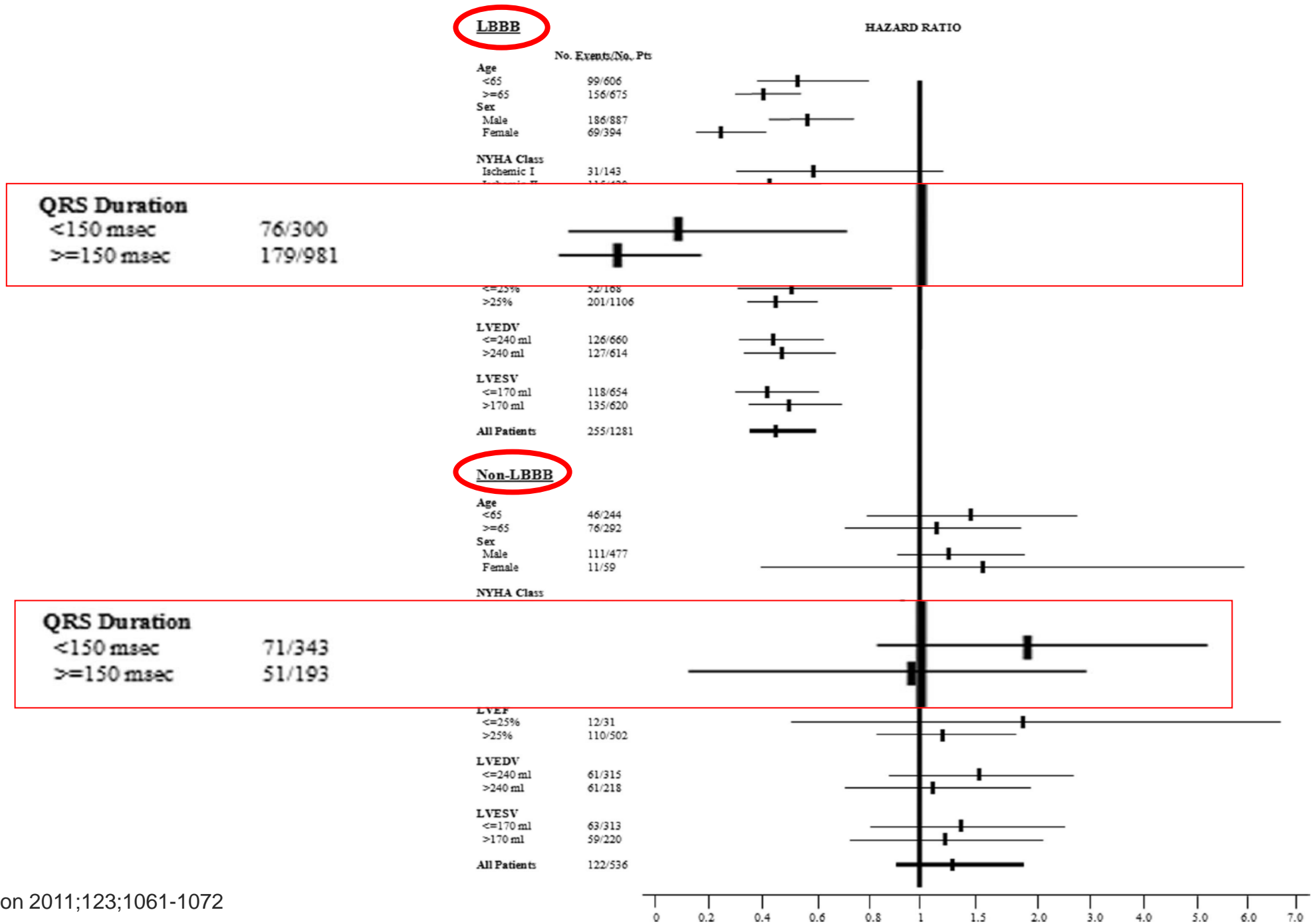
**B**

### QRS duration

CRT is not indicated in patients with HF and QRS duration  $< 130$  ms without an indication for RV pacing.<sup>264,282</sup>

**III**

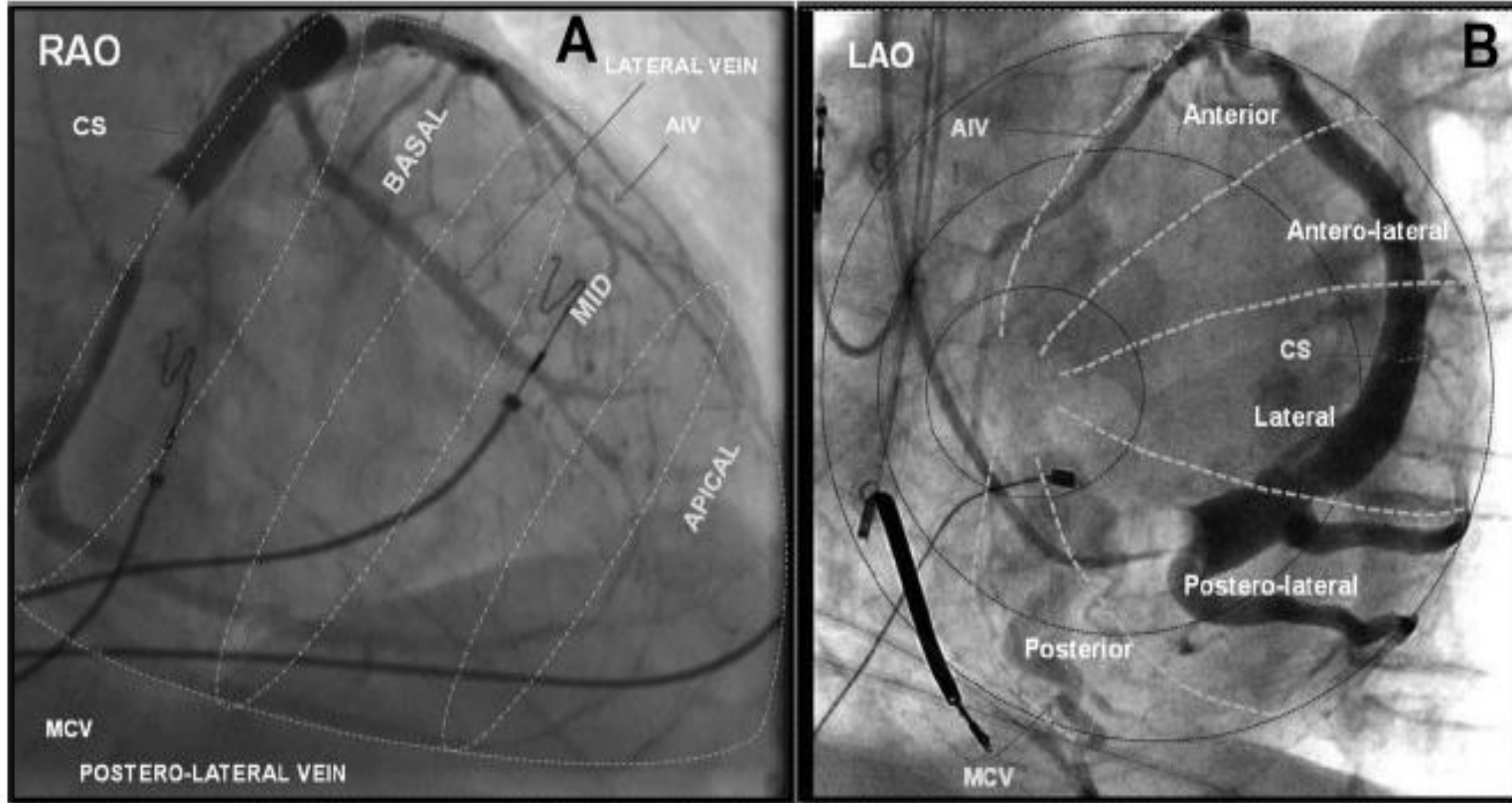
**A**



# Left Ventricular Lead Position and Clinical Outcome in the Multicenter Automatic Defibrillator Implantation Trial–Cardiac Resynchronization Therapy (MADIT-CRT) Trial

Jagmeet P. Singh, MD, DPhil\*; Helmut U. Klein, MD\*; David T. Huang, MD; Sven Reek, MD; Malte Kuniss, MD; Aurelio Quesada, MD; Alon Barsheshet, MD; David Cannom, MD; Ilan Goldenberg, MD; Scott McNitt, MS; James P. Daubert, MD; Wojciech Zareba, MD; Arthur J. Moss, MD

## *Position de la sonde VG*



**Figure 1.** Angiographic classification of left ventricular lead position. A, Right anterior oblique (RAO) view representative of the long axis of the heart. This view enables segmentation of the heart into basal, midventricular (MID), and apical segments. B, Left anterior oblique (LAO) view used to divide the left ventricular wall along the short axis of the heart into 5 equal parts; anterior, antero-lateral, lateral, postero-lateral, and posterior. For the analysis, the anterolateral, lateral, and postero-lateral segments were grouped together as the lateral wall. AIV indicates anterior interventricular vein; CS, coronary sinus; and MCV, middle cardiac vein.

# Left Ventricular Lead Position and Clinical Outcome in the Multicenter Automatic Defibrillator Implantation Trial–Cardiac Resynchronization Therapy (MADIT-CRT) Trial

Jagmeet P. Singh, MD, DPhil\*; Helmut U. Klein, MD\*; David T. Huang, MD; Sven Reek, MD; Malte Kuniss, MD; Aurelio Quesada, MD; Alon Barsheshet, MD; David Cannom, MD; Ilan Goldenberg, MD; Scott McNitt, MS; James P. Daubert, MD; Wojciech Zareba, MD; Arthur J. Moss, MD

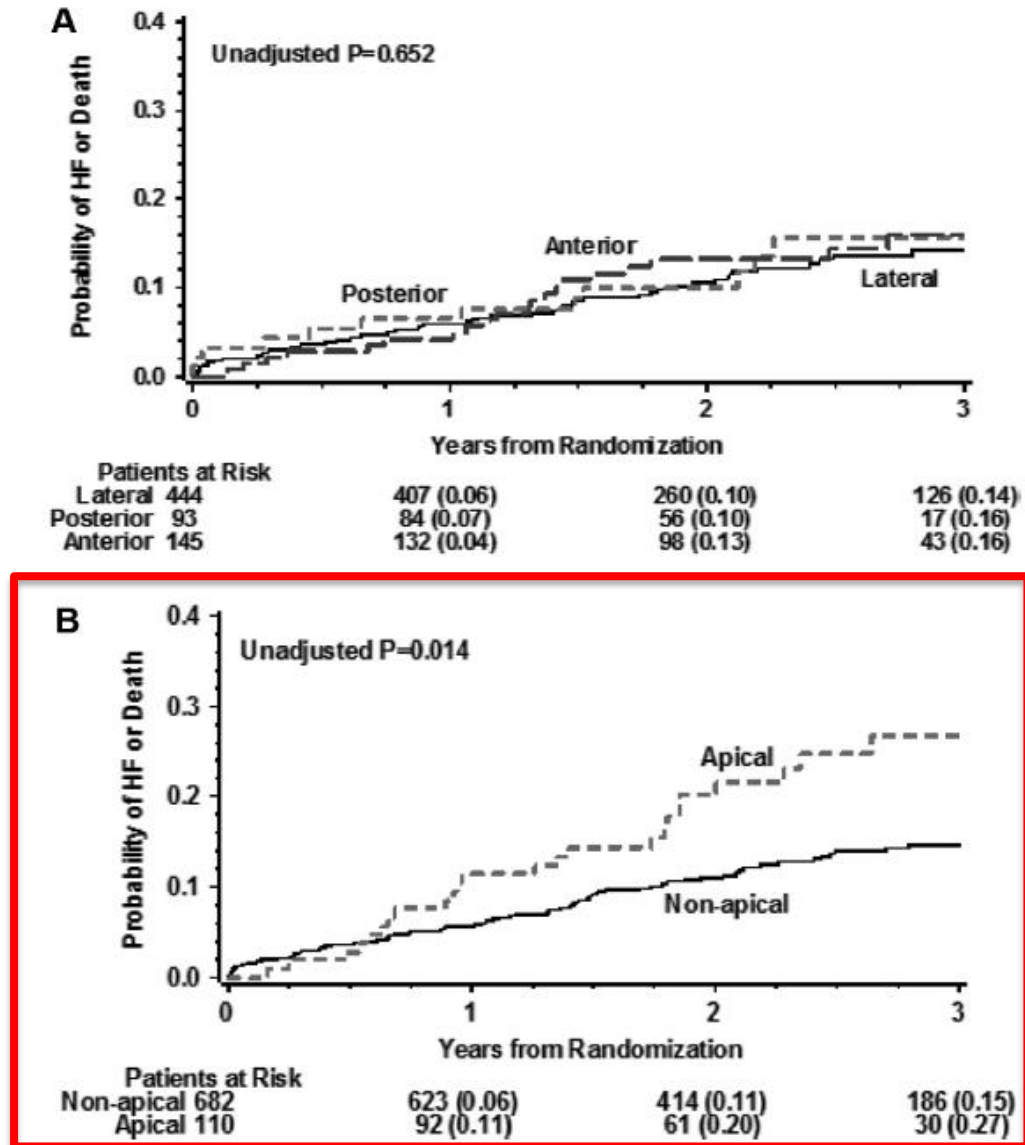


Figure 3. Kaplan-Meier estimates of the probability of survival free of heart failure (HF) or death. A, There was no difference in the estimate of survival free of heart failure or death between leads positioned along the anterior, posterior, or lateral wall, excluding the apical position (unadjusted  $P=0.65$  by the log-rank test). B, There was a significant difference in the estimate of survival free of heart failure or death between the left ventricular leads positioned in the apical vs the nonapical location (unadjusted  $P=0.01$  by the log-rank test).



# Indications for CRT in AF

## 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)

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>
<b>1) In patients with HF with permanent AF who are candidates for CRT:</b>		
<b>1A)</b> CRT should be considered for patients with HF and LVEF $\leq 35\%$ in NYHA class III or IV despite OMT if they are in AF and have intrinsic QRS $\geq 130$ ms, provided a strategy to ensure biventricular capture is in place, in order to improve symptoms and reduce morbidity and mortality. <sup>302,306,307,322</sup>	<b>IIa</b>	<b>C</b>
<b>1B)</b> AVJ ablation should be added in the case of incomplete biventricular pacing (<90–95%) due to conducted AF. <sup>297–302</sup>	<b>IIa</b>	<b>B</b>

## 2) In patients with symptomatic AF and an uncontrolled heart rate who are candidates for AVJ ablation (irrespective of QRS duration):

<b>2A)</b> CRT is recommended in patients with HF <sub>r</sub> EF. <sup>196,197,306,308</sup>	<b>I</b>	<b>B</b>
<b>2B)</b> CRT rather than standard RV pacing should be considered in patients with HF <sub>m</sub> rEF.	<b>IIa</b>	<b>C</b>
<b>2C)</b> RV pacing should be considered in patients with HF <sub>p</sub> EF. <sup>188,196,323</sup>	<b>IIa</b>	<b>B</b>
<b>2D)</b> CRT may be considered in patients with HF <sub>p</sub> EF.	<b>IIb</b>	<b>C</b>

# ***CRT and upgrade or with conventional PM indications***

## **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)

Recommendation	Class <sup>a</sup>	Level <sup>b</sup>
Patients who have received a conventional pacemaker or an ICD and who subsequently develop symptomatic HF with LVEF ≤35% despite OMT, and who have a significant <sup>c</sup> proportion of RV pacing, should be considered for upgrade to CRT. <sup>37,148,185,190,324–352</sup>	<b>IIa</b>	<b>B</b>

Recommendation	Class <sup>a</sup>	Level <sup>b</sup>
CRT rather than RV pacing is recommended for patients with HFrEF (<40%) regardless of NYHA class who have an indication for ventricular pacing and high-degree AVB in order to reduce morbidity. This includes patients with AF. <sup>183,190,196,268,313,323,357–359,361,362</sup>	<b>I</b>	<b>A</b>

# CRT-P vs CRT-D

## 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)

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>
In patients who are candidates for an ICD and who have CRT indication, implantation of a CRT-D is recommended. <sup>260,369,370,381</sup>	I	A
In patients who are candidates for CRT, implantation of a CRT-D should be considered after individual risk assessment and using shared decision-making. <sup>382,383</sup>	IIa	B

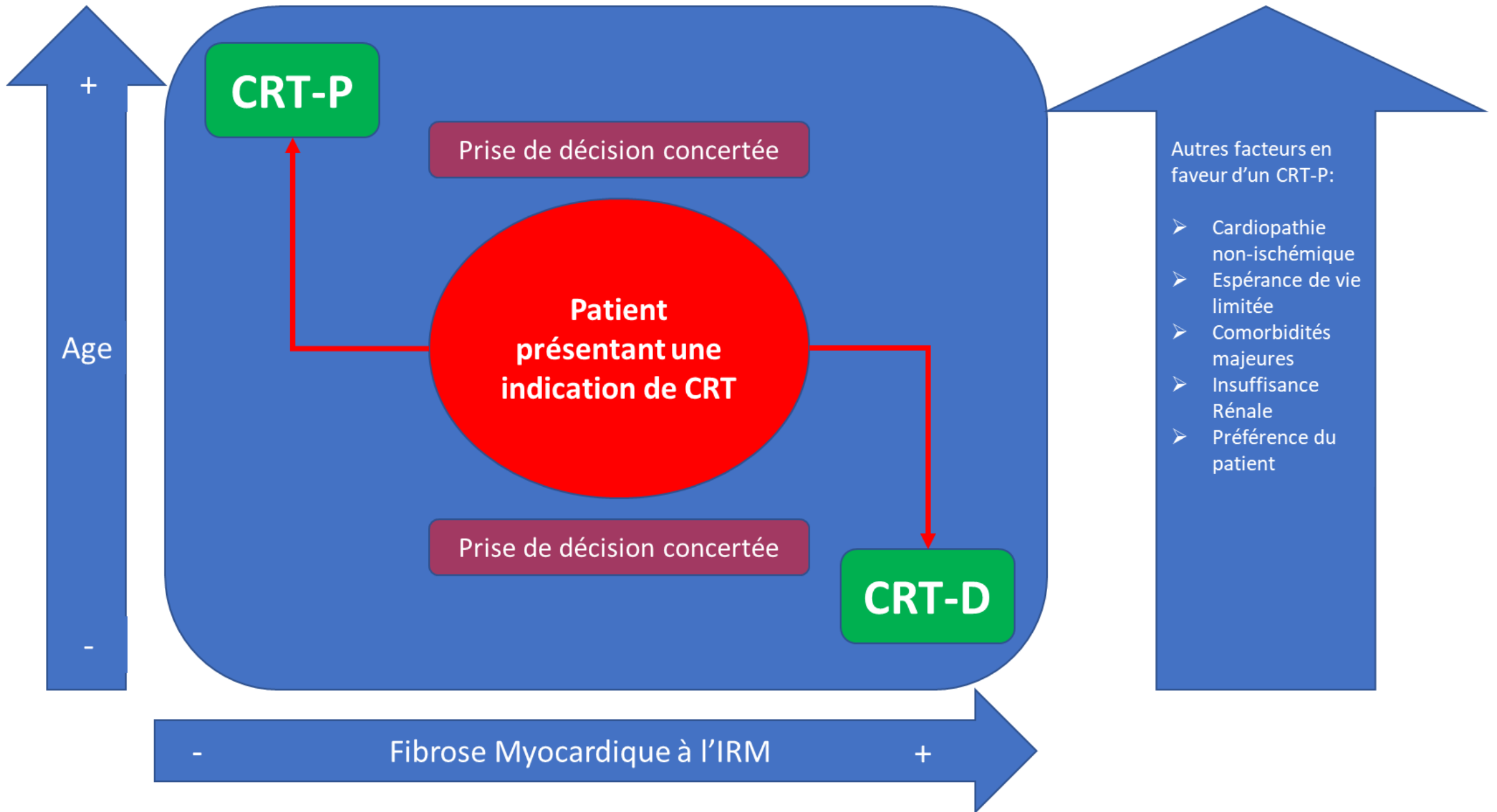
2013 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy

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).

Authors/Task Force Members: Michele Brignole (Chairperson) (Italy)\*, Angelo Auricchio (Switzerland), Gonzalo Baron-Esquivias (Spain), Pierre Bordachar (France), Giuseppe Boriani (Italy), Ole-A Breithardt (Germany), John Cleland (UK), Jean-Claude Deharo (France), Victoria Delgado (Netherlands), Perry M. Elliott (UK), Bulent Gorenek (Turkey), Carsten W. Israel (Germany), Christophe Leclercq (France), Cecilia Linde (Sweden), Lluis Mont (Spain), Luigi Padeletti (Italy), Richard Sutton (UK), Panos E. Vardas (Greece)

## Table 17 Clinical guidance to the choice of CRT-P or CRT-D in primary prevention

Factors favouring CRT-P	Factors favouring CRT-D
Advanced heart failure	Life expectancy >1 year
Severe renal insufficiency or dialysis	Stable heart failure, NYHA II
Other major co-morbidities	Ischaemic heart disease (low and intermediate MADIT risk score)
Frailty	Lack of comorbidities
Cachexia	



**Meilleurs  
Répondeurs**

QRS large, BBG,  
CMD, Femme

QRS  
intermédiaire,  
CMI, Homme

**Mauvais  
Répondeurs**

QRS fins, non-BBG

***Clinical factors influencing the likelihood to respond to CRT***

# Take home messages



➤ Evidence forte de l'efficacité du CRT en classe I/II (MADIT-CRT/RAFT...)

Recommandations 2013 et au-delà...

➤ Retour au « basique » :

- Efficacité fonction de la largeur du QRS++

- Etudes négatives sur les QRS fins

- BBG large+++

- Rôle du type de BB, sexe, position sonde VG...

- Notion de super-réponse : QRS large, CMD

- Rôle de l'échographie : très décevant (pré et post)

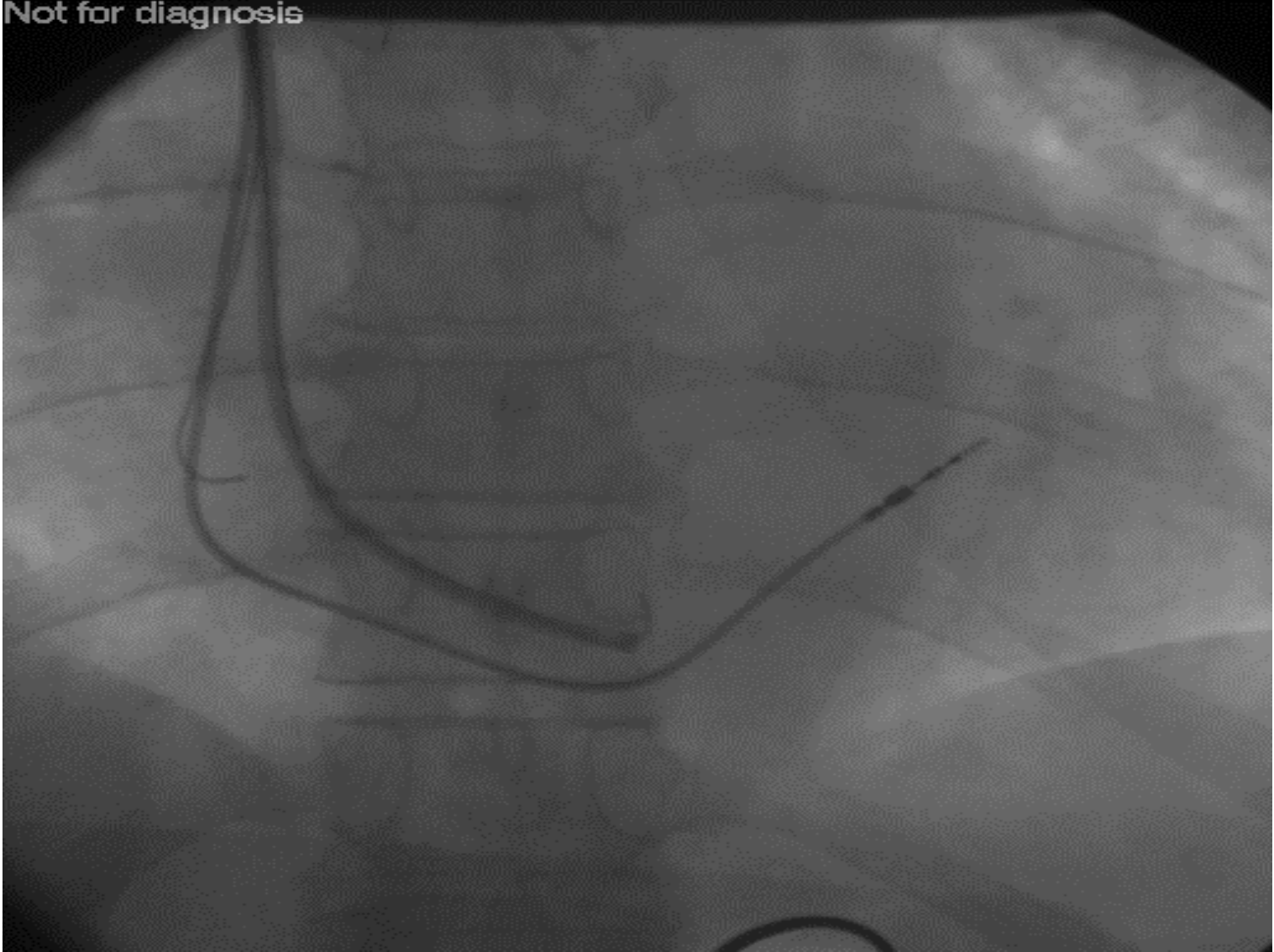
➤ *Avenir : comment diminuer la non réponse?? Multisite VG, endocarde VG... ou plutôt CSP???*

# *Implant Procedure*

- 1. Venous access**
- 2. RV lead placement**
- 3. Cannulate coronary sinus**
- 4. Perform venograms**
- 5. Select target vein and leads**
- 6. Place leads**
- 7. Measure electricals**
- 8. Right atrial lead**
- 9. Remove implant tools**
- 10. Measure final electricals and program device**

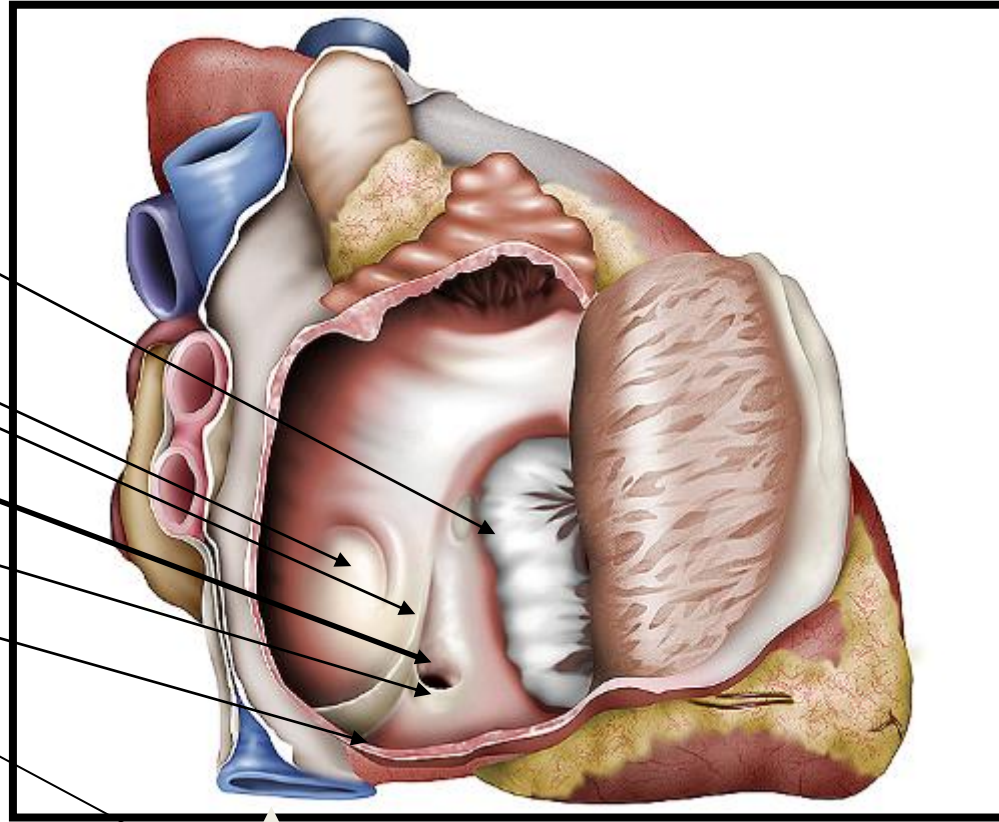


**Steps 1 + 2: Venous access + RV Lead Placement**



# *Right Atrial Anatomical Features*

- Tricuspid annulus
- Fossa ovalis
- Eustachian ridge
- **Coronary sinus**
- Thebesian valve
- Eustachian fossa
- Inferior vena cava

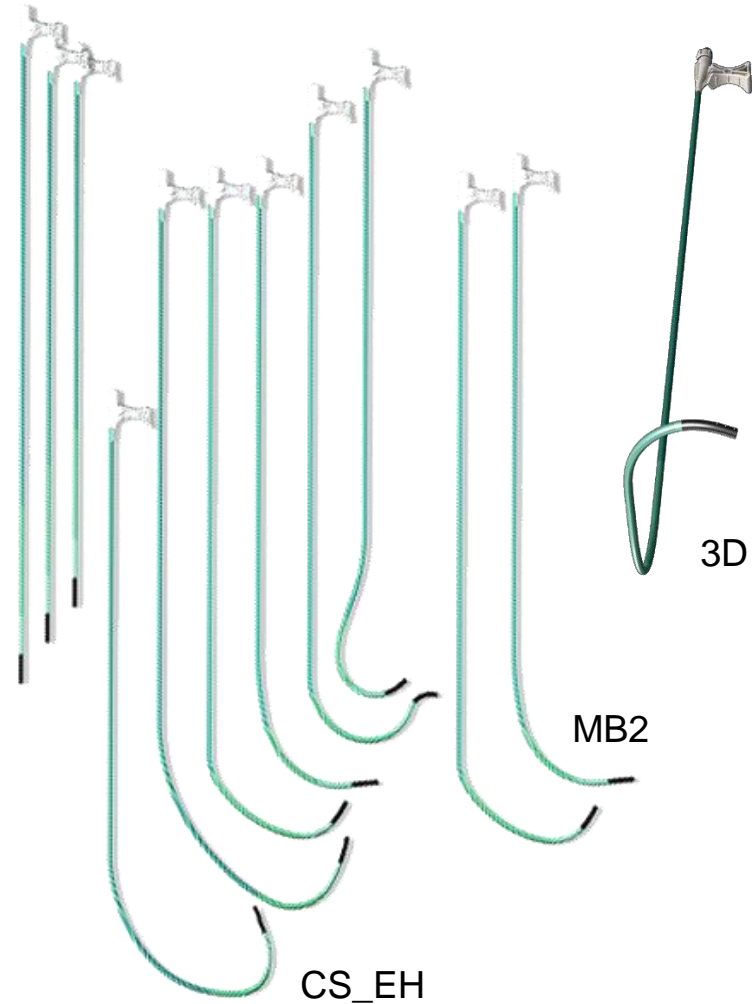


# CS Cannulation Catheters

- **Attain Command™ family** features a hydrophilic coating for deep seating into the coronary sinus



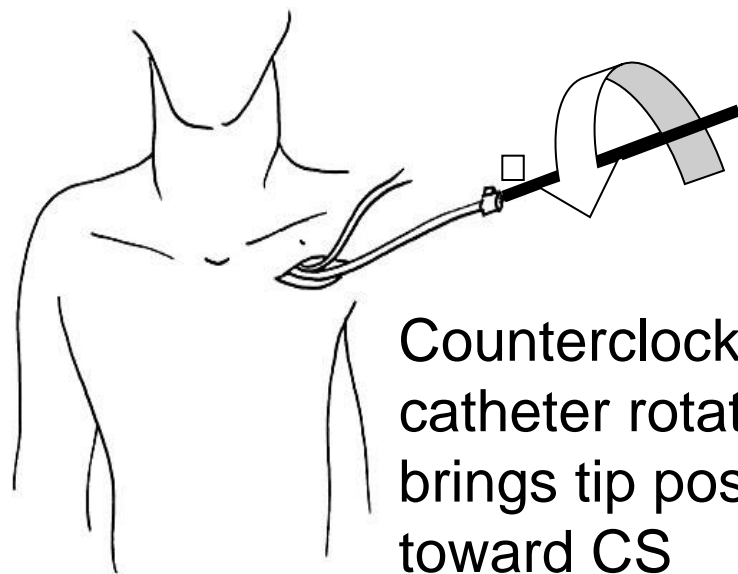
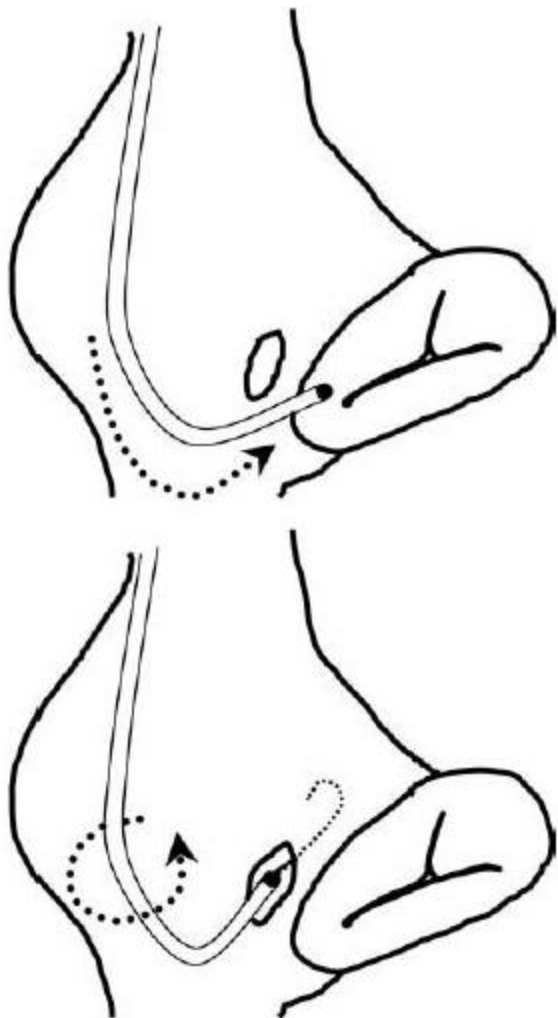
Attain Deflectable



Attain Command

# Cannulate Coronary Sinus

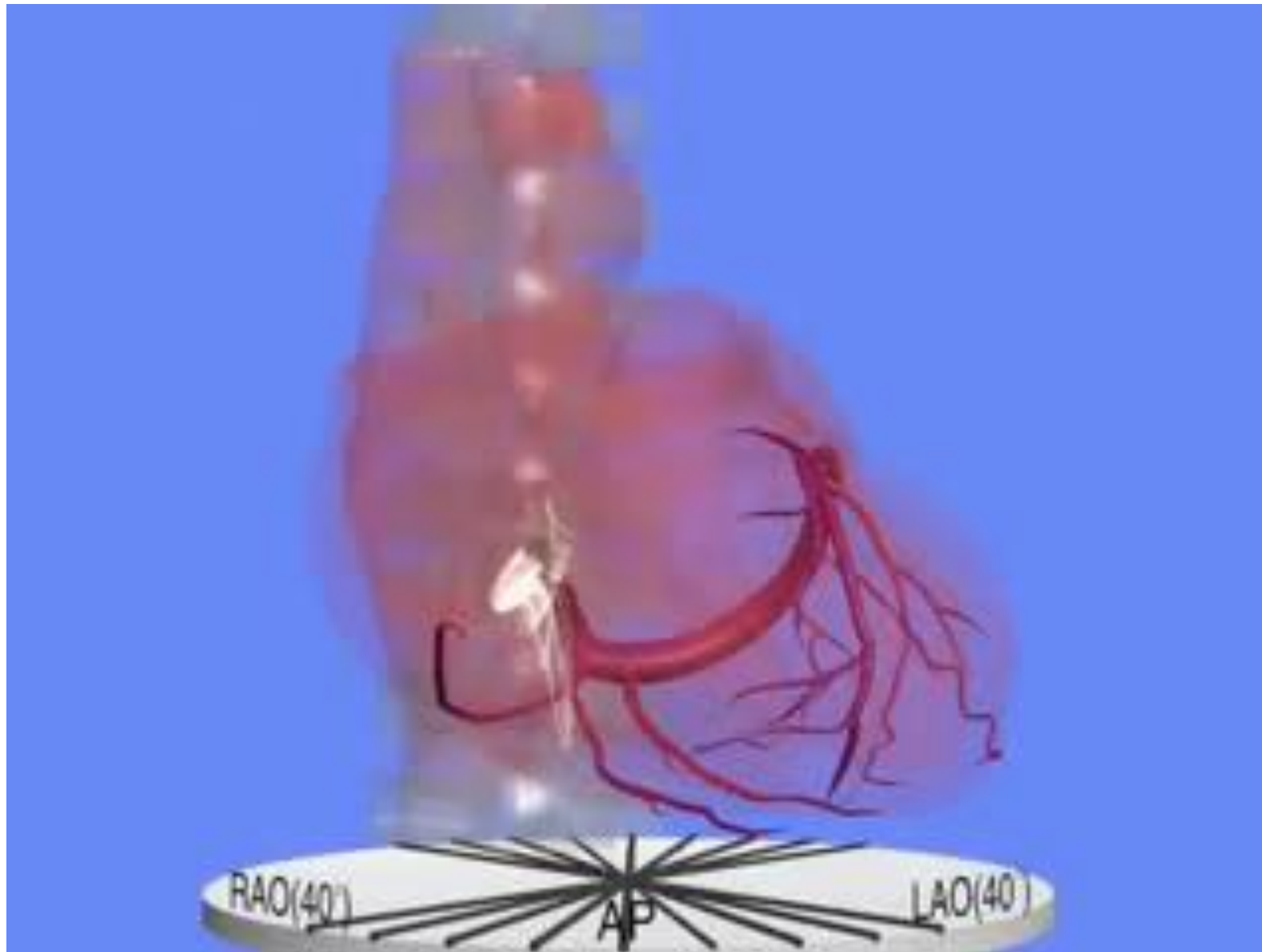
## Counterclockwise Rotation



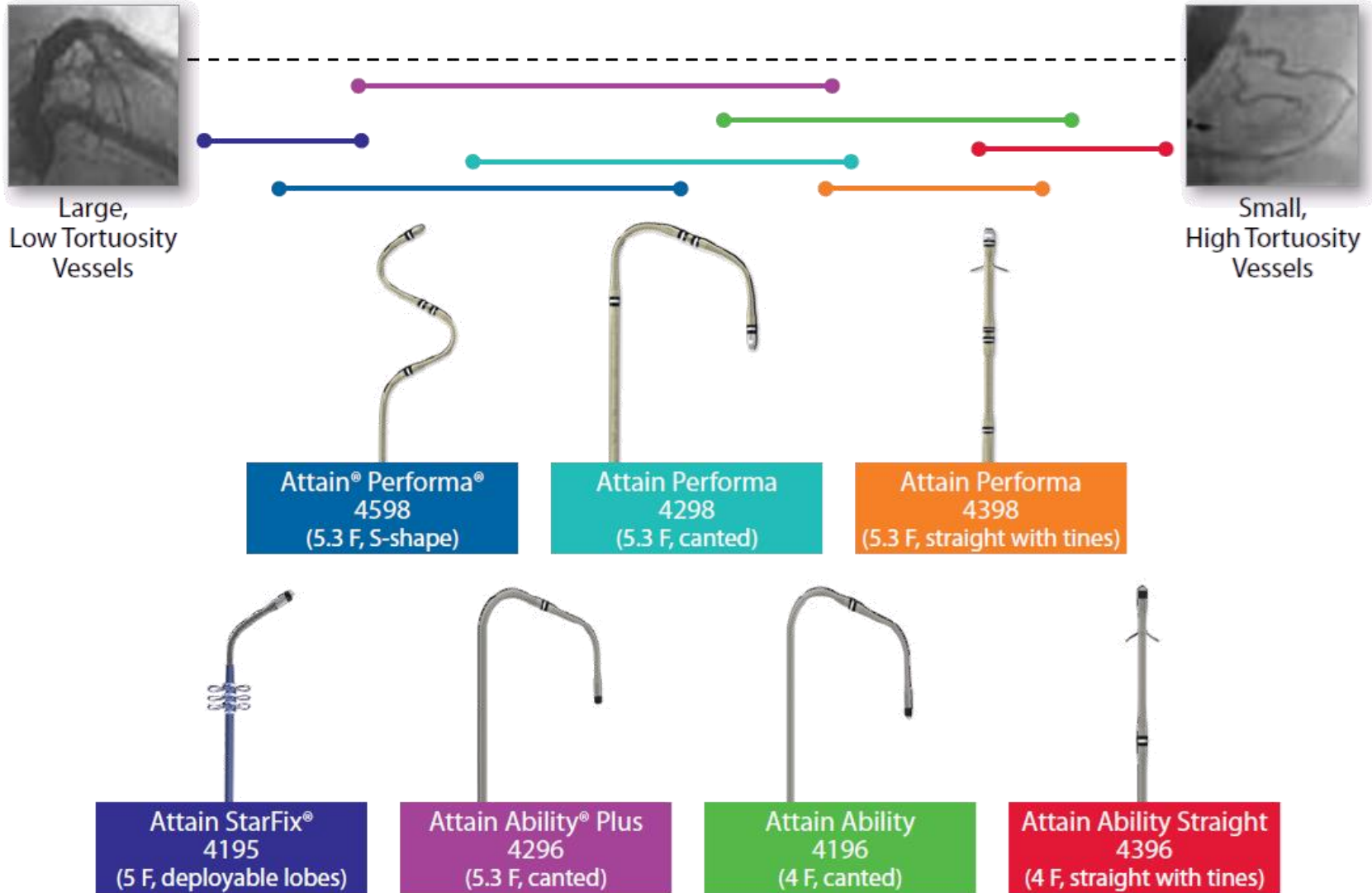
Counterclockwise catheter rotation brings tip posterior toward CS

Clockwise rotation if implanting from the right side

# *Cardiac Venous Anatomy*



# Select the LV Lead for the Anatomy



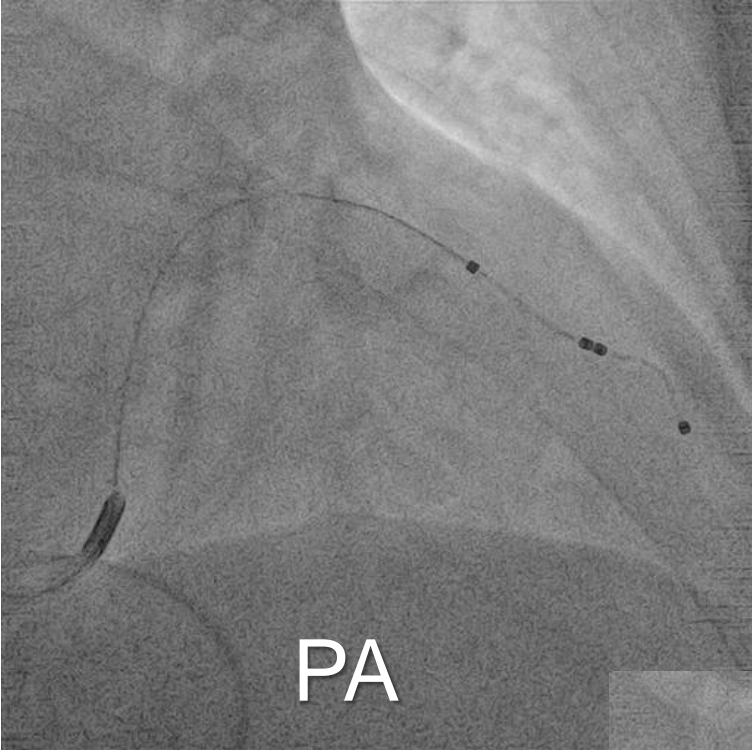
# *Guidewire Positioning*



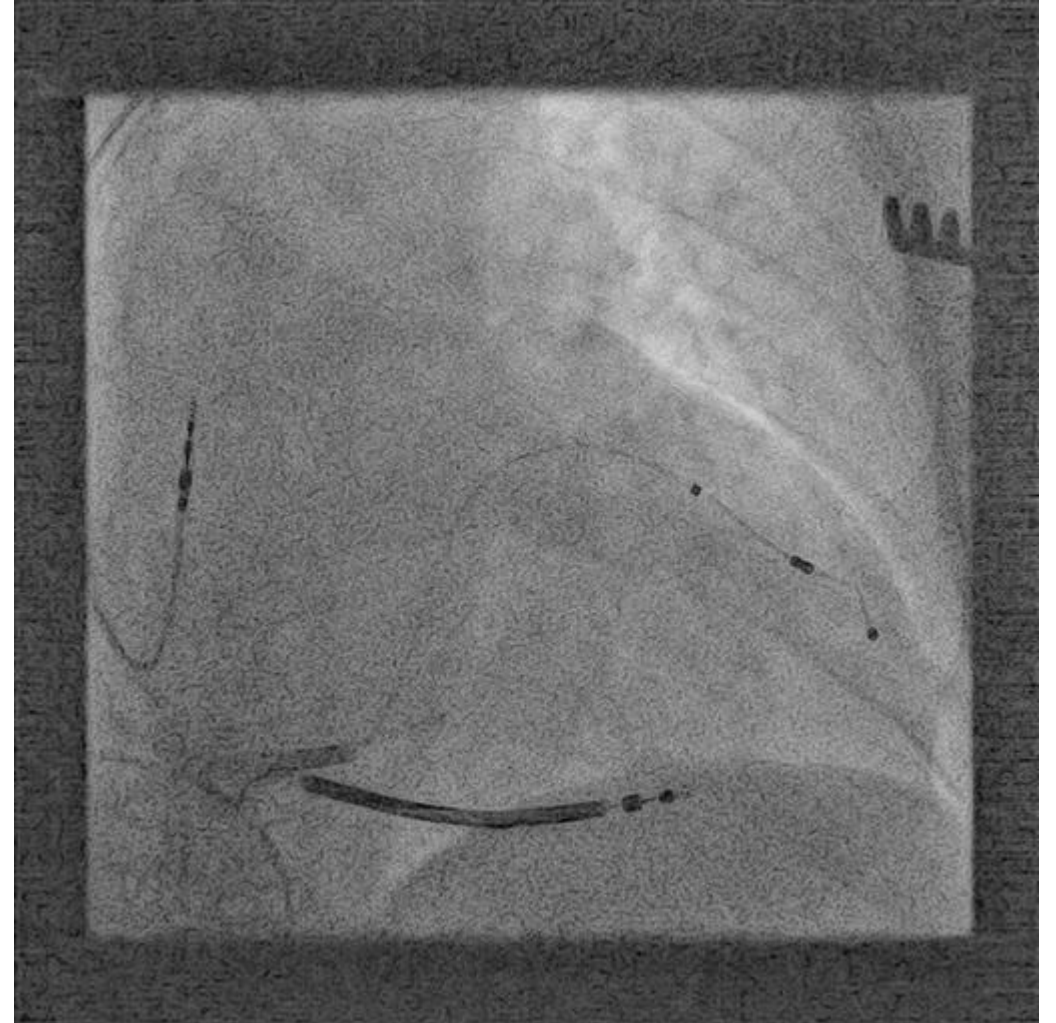
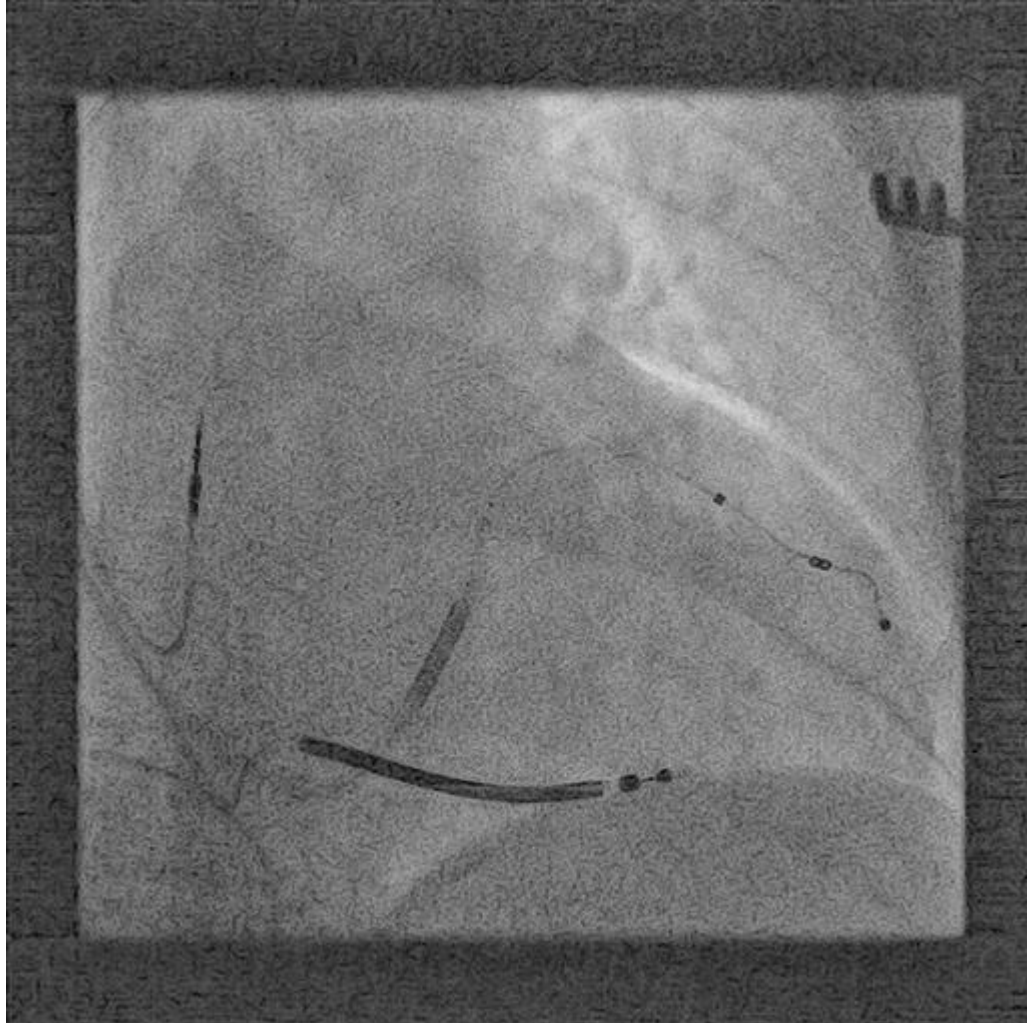
# *LV Lead Positioning*



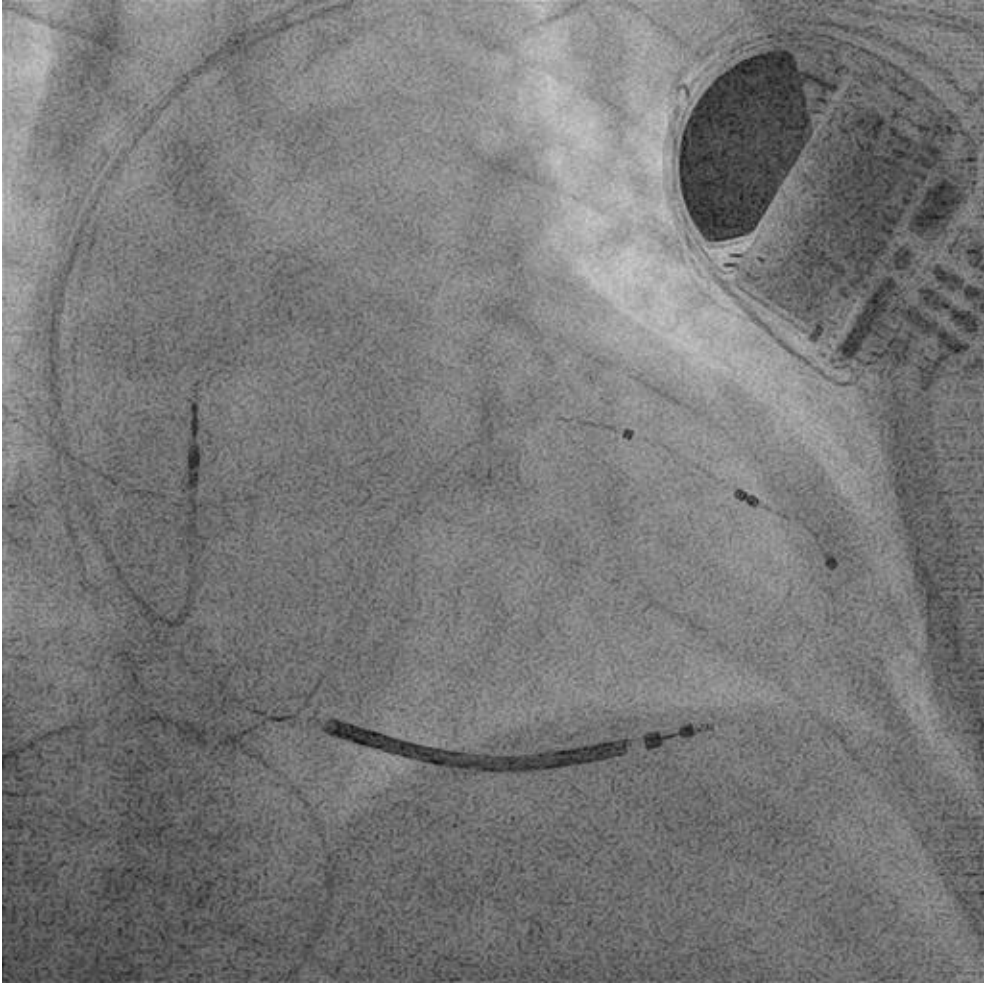




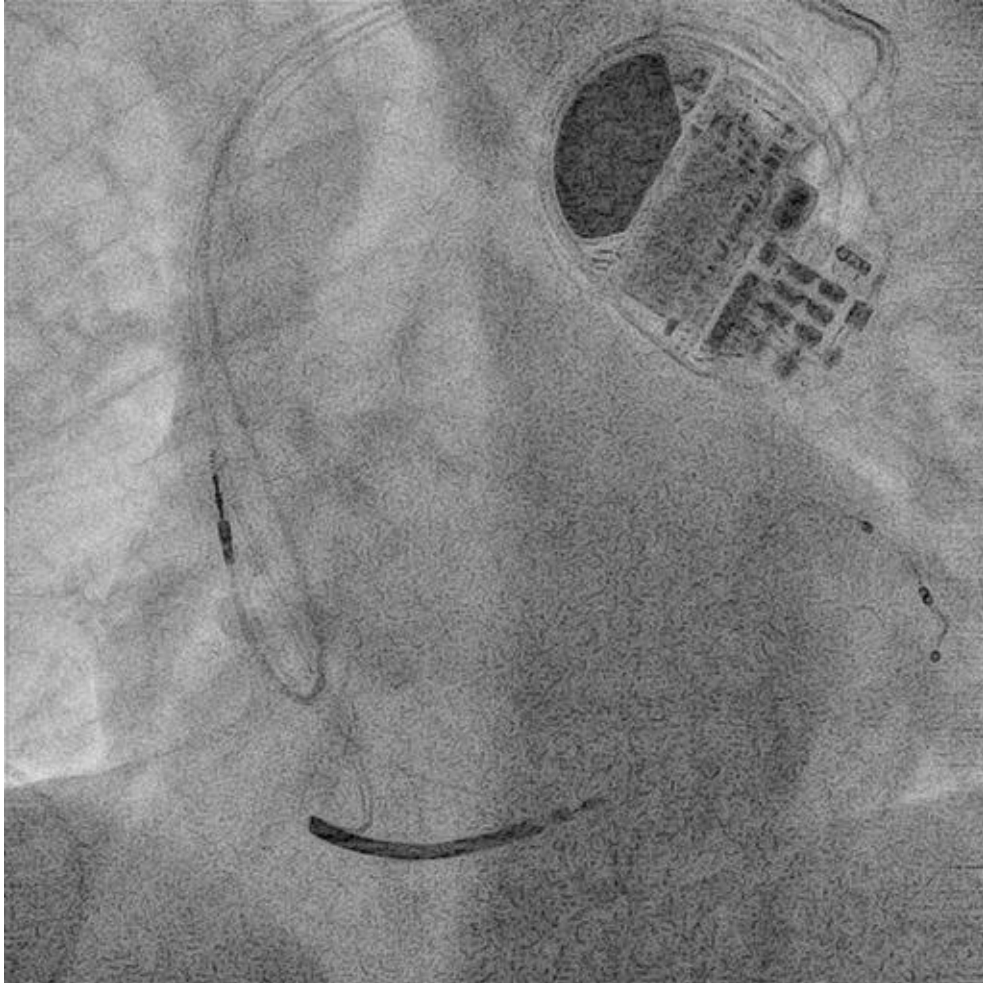
# *Slitting Procedure*



# *Check Leads*

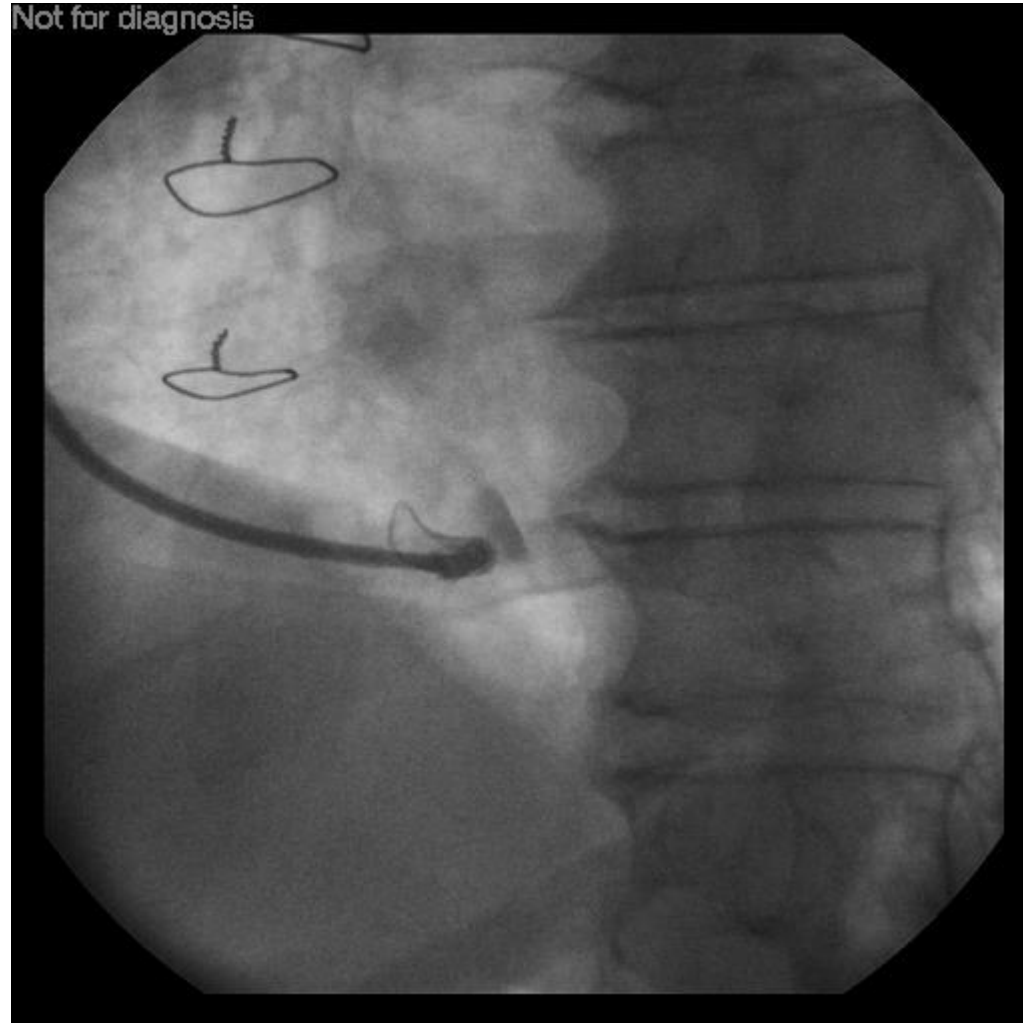


PA



LAO

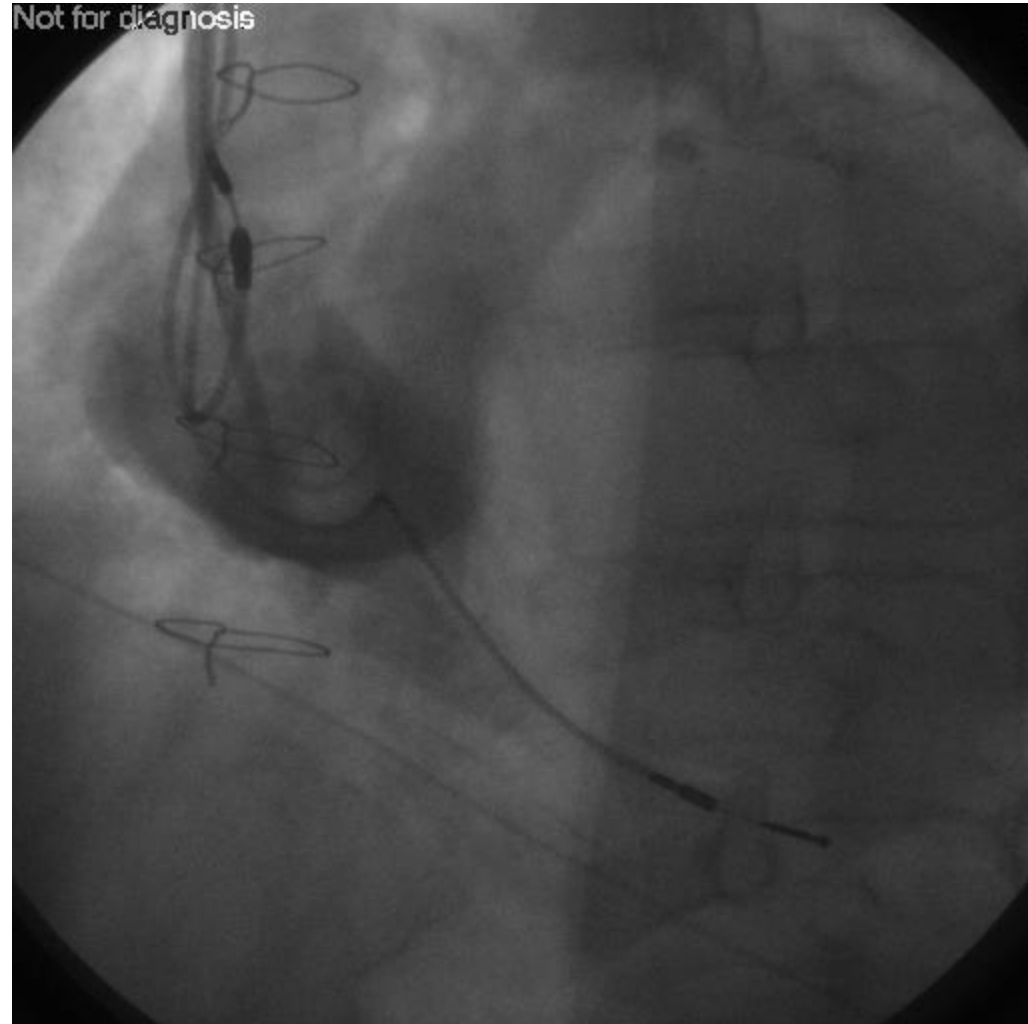
# *Use of Contrast Injection Near CS Ostium*



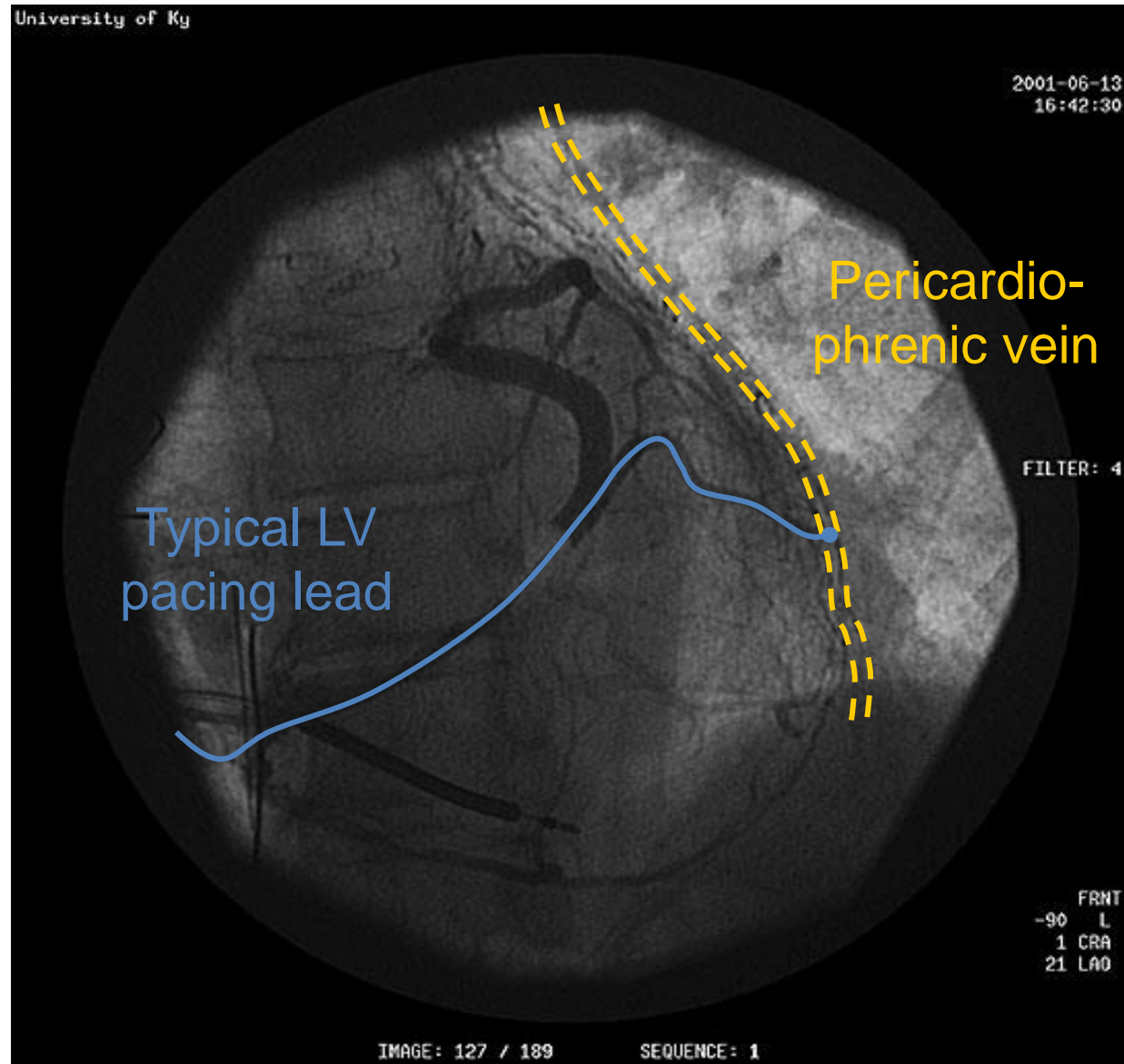
....but avoid « blasting away » with contrast !

# *Right Atriogram for CS os Visualization*

Power injection (40cc)  
via pigtail or guiding  
sheath (away from  
atrial wall)



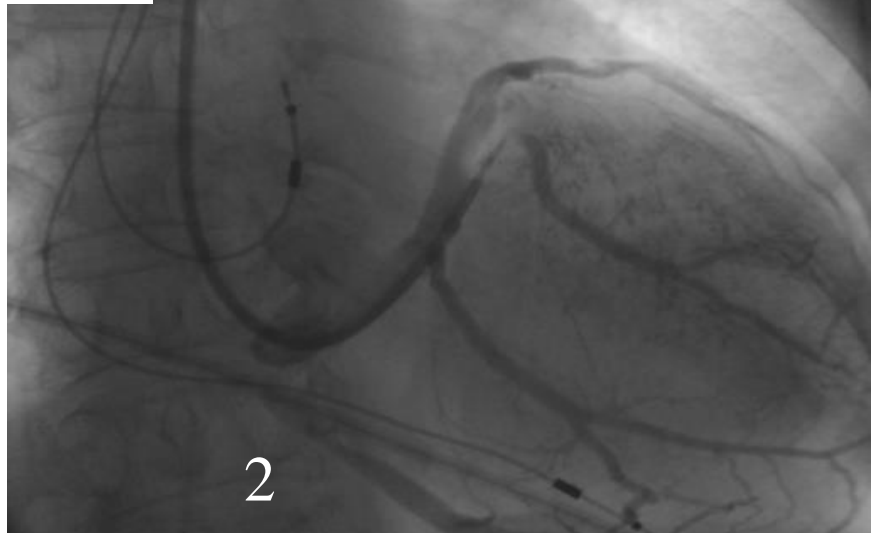
# Phrenic Nerve Stimulation



Not for diagnosis

Not for diagnosis

# ***CS dissection***



Not for diagnosis

Not for diagnosis

