



## Device 관련 연구 동향 및 부정맥학회 Statement 제안



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Sungkyunkwan University  
School of Medicine  
Seoul, Korea

# Korean Heart Rhythm Society

## COI Disclosure

Relationships with commercial interests:

- Grants/Research Support:  
*Boston Scientific, Biotronik, Abbott, Medtronic*
- Speakers Bureau/Honoraria:  
*Boston Scientific, Biotronik, Abbott, Medtronic, Phillips*



# Cardiac Resynchronization Therapy



cardiac resynchronization therapy



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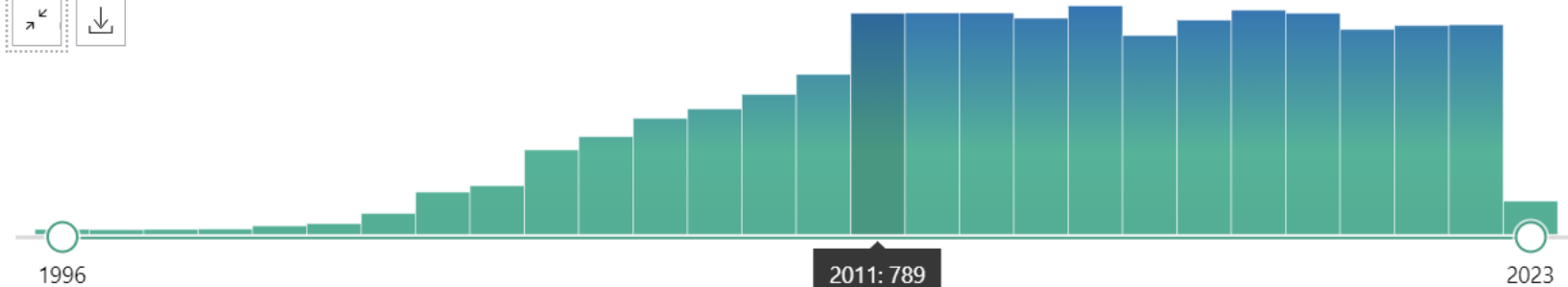
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10,670 results

Page 1 of 1,067



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TEXT AVAILABILITY

Abstract

[Effect of Digitalis on ICD or CRT-D Recipients: A Systematic Review and Meta-Analysis.](#)

1

Cite

Zhuo W, Liu H, Fu L, Fan W, Hong K.

J Clin Med. 2023 Feb 20;12(4):1686. doi: 10.3390/jcm12041686.

# Implantable Cardioverter-Defibrillator



implantable cardioverter defibrillator



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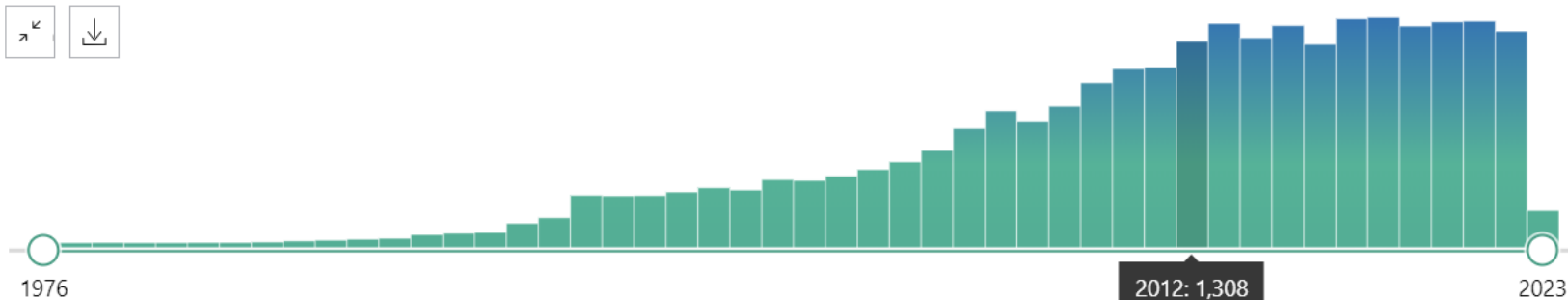
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RESULTS BY YEAR

24,554 results

Page 1 of 2,456



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TEXT AVAILABILITY

- Abstract
- Free full text
- Full text

1 [Prognostic role of three-dimensional speckle-tracking echocardiography-derived left ventricular global longitudinal strain in cardiac amyloidosis: Insights from the MAGYAR-Path Study.](#)

Cite Földeák D, Kormányos Á, Nemes A.  
Share J Clin Ultrasound. 2023 Feb 24. doi: 10.1002/jcu.23445. Online ahead of print.  
PMID: 36840337

Six patients were diagnosed with acute heart failure, two patients needed invasive interventions (percutaneous coronary intervention with stent-implantation, **implantable cardioverter defibrillator**



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# CIED infection



ciéd infection

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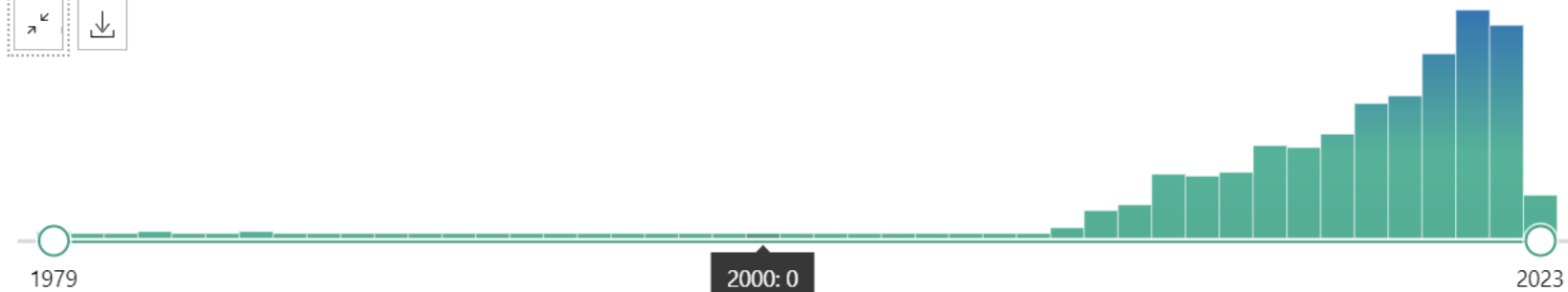
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RESULTS BY YEAR

634 results

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TEXT AVAILABILITY

Abstract

Long-term outcomes following transvenous lead extraction: Data from a tertiary referral center.

Cite Arabia G, Mitacchione G, Cersosimo A, Calvi E, Salghetti F, Bontempi L, Giacobelli D, Cerini M, Curnis A. Int J Cardiol. 2023 Feb 23:S0167-5273(23)00257-7. doi: 10.1016/j.ijcard.2023.02.040. Online ahead of print.

# Transvenous Lead Extraction



transvenous lead extraction



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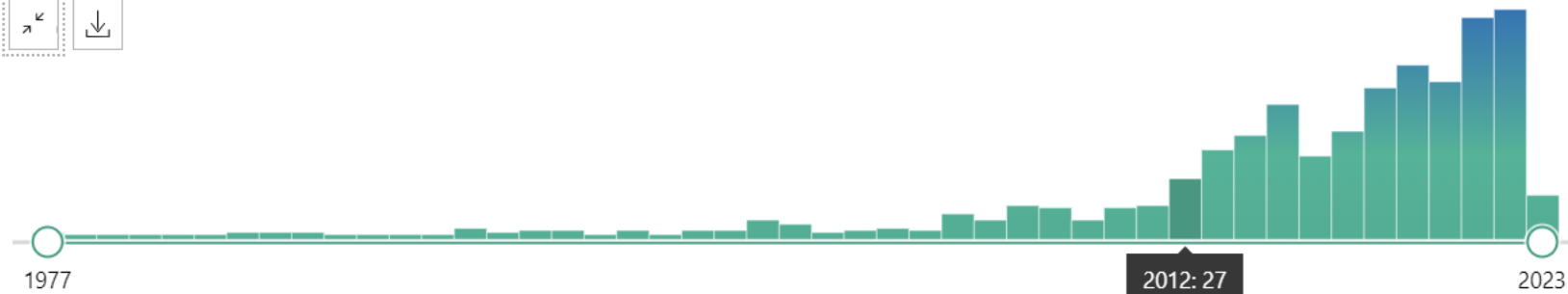
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RESULTS BY YEAR

728 results

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TEXT AVAILABILITY

Abstract

Long-term outcomes following **transvenous lead extraction**: Data from a tertiary referral center.

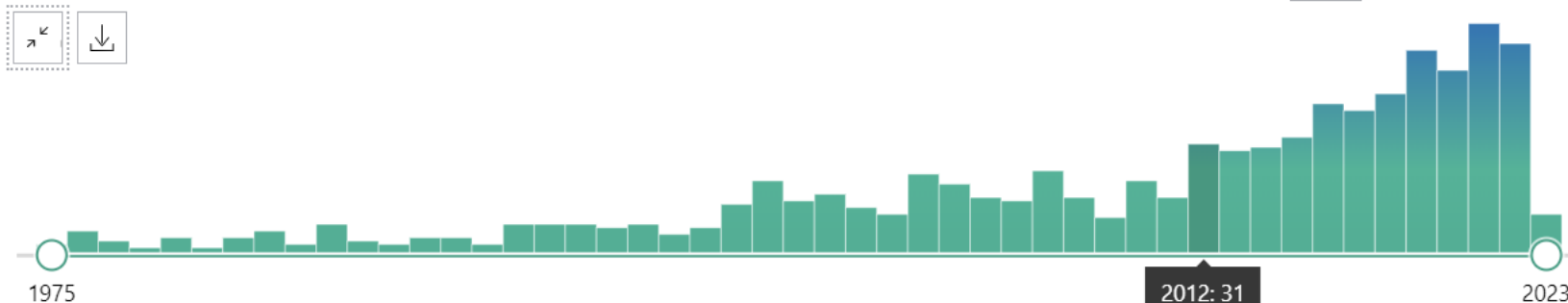
Cite Arabia G, Mitacchione G, Cersosimo A, Calvi E, Salghetti F, Bontempi L, Giacobelli D, Cerini M, Curnis A. Int J Cardiol. 2023 Feb 23:S0167-5273(23)00257-7. doi: 10.1016/j.ijcard.2023.02.040. Online ahead of print.

# Atrial High Rate Episodes

RESULTS BY YEAR

733 results

Page 1 of 74



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TEXT AVAILABILITY

Abstract

Value of baseline characteristics in the risk prediction of atrial fibrillation.

1 He J, Liu S, Yang C, Wei Y.

Cite Front Cardiovasc Med. 2023 Feb 1;10:1068562. doi: 10.3389/fcvm.2023.1068562. eCollection 2023.

PMID: 36818333 [Free PMC article.](#)

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INTRODUCTION: Atrial fibrillation (AF) is prone to heart failure and stroke. Early management can

# Cardiac Remote Monitoring



cardiac remote monitoring

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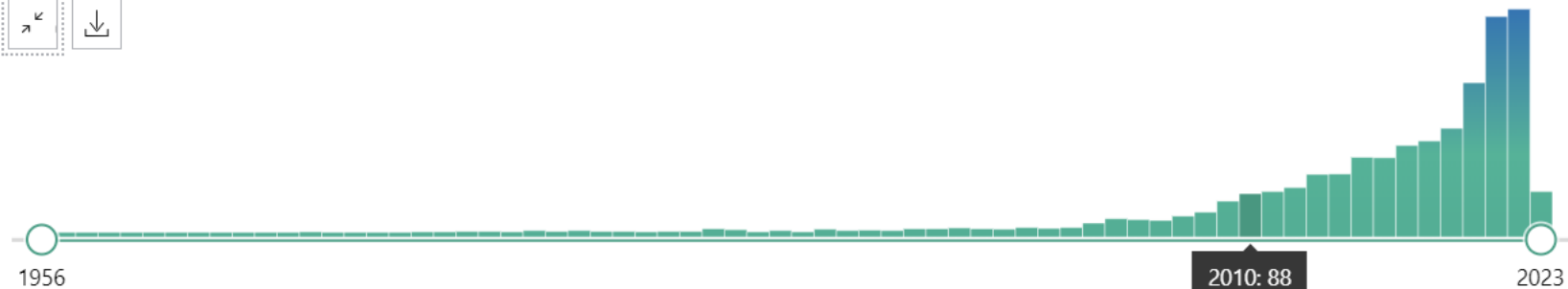
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RESULTS BY YEAR

3,027 results

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TEXT AVAILABILITY

Abstract

Prognostic Value of Cheyne-Stokes Respiration and Nutritional Status in Acute Decompensated **Heart** Failure.

Cite Abulimiti A, Naito R, Kasai T, Ishiwata S, Nishitani-Yokoyama M, Sato A, Suda S, Matsumoto H, Shitara J, Yatsu S, Murata A, Shimizu M, Kato T, Hiki M, Daida H, Minamino T.  
Share Nutrients. 2023 Feb 15;15(4):964. doi: 10.3390/nu15040964.



# Leadless Pacemaker

leadless pacemaker



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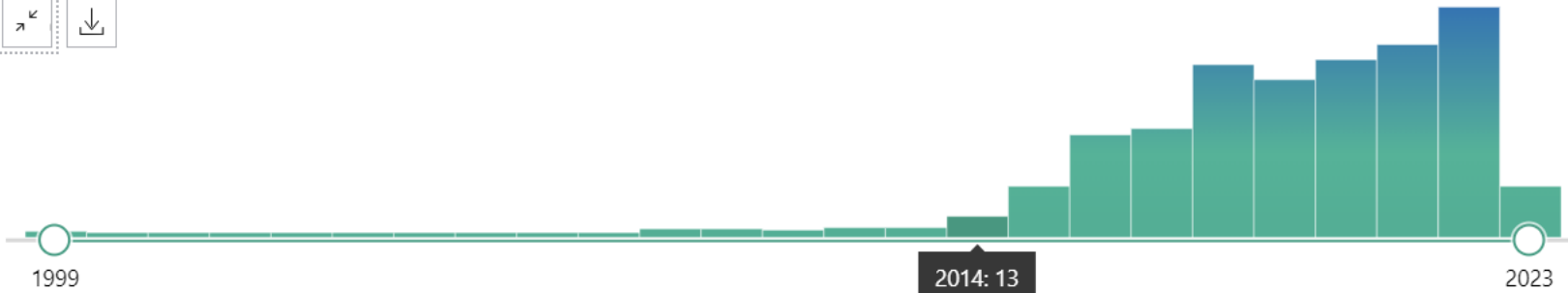
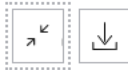
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RESULTS BY YEAR

844 results

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TEXT AVAILABILITY

Abstract

[Arrhythmias : Update on ablations and devices].

1 Johnson V, Schmitt J.

Cite Herz. 2023 Feb 23. doi: 10.1007/s00059-023-05165-7. Online ahead of print.

PMID: 36820853 Review. German.

Share There are also technical developments in the field of active rhythm implants. In cardiac **pacemaker**

# S-ICD

subcutaneous icd



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TEXT AVAILABILITY

Abstract

Intermuscular technique for implantation of the **subcutaneous** implantable defibrillator: a propensity-matched case-control study.

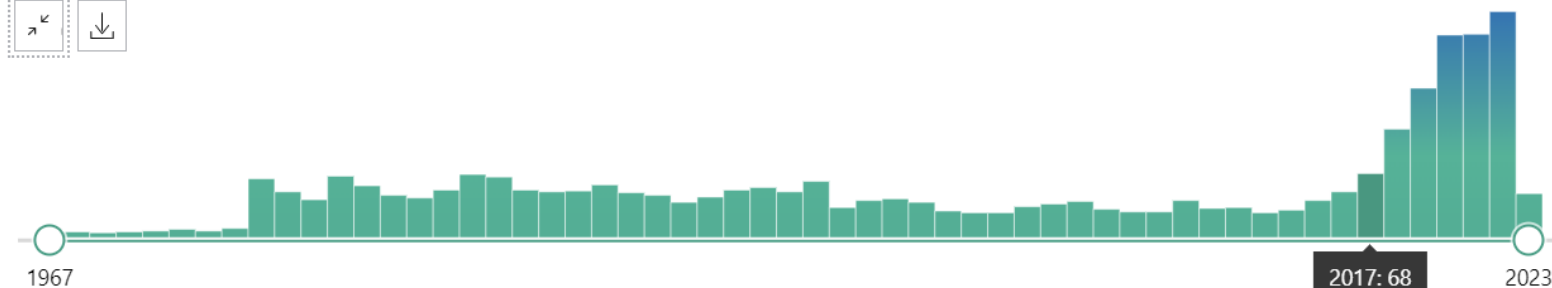
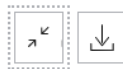
Cite Botto GL, Ziacchi M, Nigro G, D'Onofrio A, Dello Russo A, Francia P, Viani S, Pisanò E, Bisignani G, Caravati F, Migliore F, De Filippo P, Ottaviano L, Rordorf R, Manzo M, Canevese FL, Lovecchio M, Valsecchi S, Checchi L.

# His-Bundle Pacing

RESULTS BY YEAR

2,635 results

⏪ < Page 1 of 264 > ⏩



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Abstract

[\[Arrhythmias : Update on ablations and devices\].](#)

1 Johnson V, Schmitt J.

Cite Herz. 2023 Feb 23. doi: 10.1007/s00059-023-05165-7. Online ahead of print.

PMID: 36820853 Review. German.

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In cardiac pacemaker treatment and specifically for conduction system **pacing** (CSP) there is evidence for

# Left Bundle Branch Pacing



left bundle branch pacing



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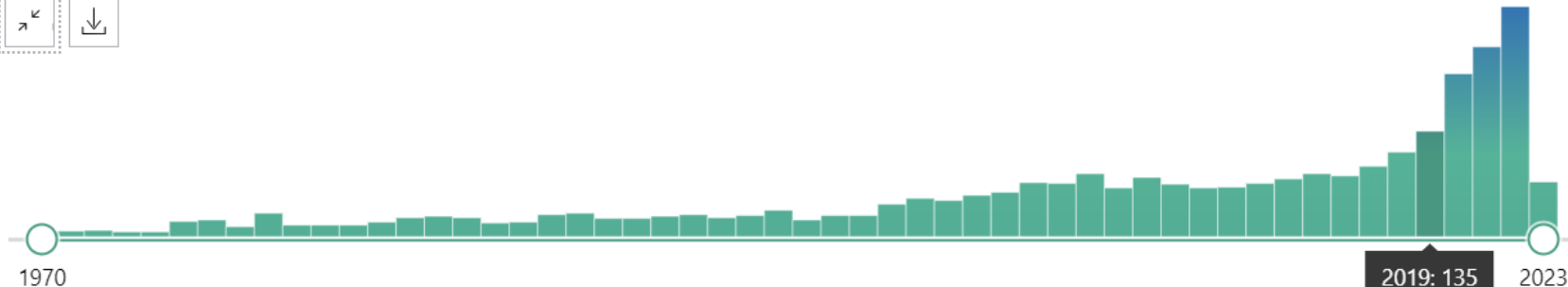
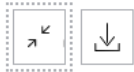
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RESULTS BY YEAR

2,383 results

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TEXT AVAILABILITY

Abstract

1 **A Study to Analyse the Feasibility and Effectiveness of Left Bundle Branch Area Pacing Used in Young Children.**

Cite Li J, Jiang H, Zhang Y, Cui J, Li M, Zhou H, Li X.

Pediatr Cardiol. 2023 Feb 25. doi: 10.1007/s00246-023-03119-8. Online ahead of print.

Share PMID: 36840807

# APHRS 2022

## Symposium 2: Conduction System Pacing 101

Friday, November 18, 2022 | 4:30 PM - 5:40 PM | Hall 405, Market Place, Level 4



**Giky Karwiky**  
Indonesia  
*Chairperson*



**Matthew Webber**  
New Zealand  
*Chairperson*



**Muhmmad Munawar**  
Indonesia  
*Pacing-Induced Cardiomyopathy:  
Predicting and Preventing*



**Ulhas Pandurangi**  
India  
*Conduction System Pacing: Is Conduction System  
Pacing for everyone who requires Pacing?*



**Swee-Chong Seow**  
Singapore  
*Tips and Tricks for His bundle  
pacing (HBP) / Left Bundle Branch  
Pacing (LBBP)*



**Justin Mariani**  
Australia  
*Conduction System Pacing for  
Heart Failure: Ready for Prime  
Time?*

## Oral Presentation - Cardiac Implantable Electronic Devices 2

Saturday, November 19, 2022 | 3:00 PM - 4:00 PM | Track 7, Room 329-322, Heart Rhythm Village, Level 3



Ying-Hsiang Lee  
Taiwan  
*Chairperson*



Kamal K Sethi  
India  
*Chairperson*



Rajeev Pathak  
Australia  
*Chairperson*

### Presentations

Paper Number	Paper Title	First Name	Last Name
OP-126-1-CIED (TRACK 7 - CIED 2)	Mid-term Feasibility of Left Bundle Branch Pacing With Standard Stylet-driven Leads and Predictors of Success	Ga-In	Yu
OP-127-1-CIED (TRACK 7 - CIED 2)	Pitfall of Left Bundle Branch Area Pacing in Complete Heart Block and ASD Primum Post-closure	Widuri Wita	Shariefuddin
OP-128-1-CIED (TRACK 7 - CIED 2)	Impact of Proposed Pacing Guidelines on Current Practice	Elizabeth	Woollard
OP-129-1-CIED (TRACK 7 - CIED 2)	Leadless Left Bundle Branch Area Pacing: a Feasibility Study	Mark	Elliott
OP-130-1-CIED (TRACK 7 - CIED 2)	Septal Fibrosis is Associated With Attenuated Left Ventricular Resynchronization During Left Bundle Branch Area Pacing	Mark	Elliott
OP-131-1-CIED (TRACK 7 - CIED 2)	The First Totally Leadless CRT System in the US	Dinesh	Sharma
OP-120-2-CIED (TRACK 6 - CIED 3)	Inappropriate Mode Switch Leading to Underpacing in Patient With Hbp, What is the Etiology?	Kurniawan	Prakoso
OP-125-1-CIED (TRACK 7 - CIED 6)	Allergic Contact Dermatitis Related to CIED Implantation Mimicking Infection Response: A Rare Case in Indonesia	Billy Aditya	Pratama

# Oral Presentation - Cardiac Implantable Electronic Devices 1

Saturday, November 19, 2022 | 3:00 PM - 4:00 PM | Track 6, Room 329-323, Heart Rhythm Village, Level 3



Jeremy Chow  
Singapore  
*Chairperson*



Leenhapong Navaravong  
United States  
*Chairperson*



Akira Mizukami  
Japan  
*Chairperson*

## Presentations

Paper Number	Paper Title	First Name	Last Name
OP-112-1-CIED (TRACK 6 - CIED 1)	Dual-Chamber Leadless Pacing Maintains Atrioventricular Synchrony Throughout Various Scenarios in a Preclinical Model	Vivek	Reddy
OP-114-1-CIED (TRACK 6 - CIED 1)	A RARE cause for Pacemaker Mediated Tachycardia	Wei Shen	Chee
OP-115-1-CIED (TRACK 6 - CIED 1)	Methodology of ventricular septal implantation using stylet-driven lead	Takatsugu	Kajiyama
OP-116-1-CIED (TRACK 6 - CIED 1)	Axillary Venous Spasm during Pacemaker Implantation: A Rare but Serious Phenomenon	Theovano	Oktavio
OP-111-1-CIED (TRACK 6 - CIED 1)	Electrical Considerations for Left Bundle Area Pacing	Yen-Nien	Lin
OP-125A-1-CIED (TRACK 6 - CIED 6)	Model 3830 Lead Performance for Left Bundle Branch Area Pacing: Results from a Multi-Center Registry	Pugazhendhi	Vijayaraman
OP-122-1-CIED (TRACK 6 - CIED 3)	Left Bundle Branch Area Pacing Using the 3830 Lumenless Lead: a Systematic Review and Meta-analysis	Pugazhendhi	Vijayaraman

# Korean CIED multicenter studies





# Korean Multicenter CIED study

## *Low voltage pacemaker studies*

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**NOVEL** study: *LBB area pacing* with extendable/retractable screw-in lead

**ACHIEVE -SYNC** study: *LBB area pacing* study

**LBBA pacing** for patients with **AF and HF**

**LEADER** study: algorithm to *minimize RV pacing* in dual chamber pacemaker

**Micra AV** study: *dual chamber leadless PPM study*

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# Korean Multicenter CIED study

## *High voltage CIED studies*

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**Korean AdaptivCRT** study: dynamic CRT optimization

**STEADIED Study:** *S-ICD* in patients with *CKD/ESRD*

**SPARK registry** study: *intrinsic ATP* for ventricular tachycardia

**RECOVER** Study: conduction time and *CRT response*

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# Korean Multicenter CIED study

## *CIED diagnostic function studies*

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**BENEFIT-RM study:** CIEDs with *remote monitoring*

**Multi-sensor for HF studies:** device-detected *HF events* (*HeartLogic*, ...)

**SMART-CONTROL study:** *VDD-ICD* lead with *atrial sensing* capability

**DEDICATES study:** device detected **sleep apnea**

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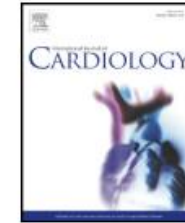
# DEDICATES



Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: [www.elsevier.com/locate/ijcard](http://www.elsevier.com/locate/ijcard)



## Rationale, design, and endpoints of the 'Device-Detected Cardiac Tachyarrhythmic Events and Sleep-disordered Breathing (DEDiCATES)' study: Prospective multicenter observational study of device-detected tachyarrhythmia and sleep-disordered breathing☆



Hye Bin Gwag<sup>a</sup>, Youngjun Park<sup>a</sup>, Seong Soo Lee<sup>a</sup>, June Soo Kim<sup>a</sup>, Kyoung-Min Park<sup>a</sup>, Young Keun On<sup>a</sup>, Dae In Lee<sup>b</sup>, Dong-Gu Shin<sup>c</sup>, Eue-Keun Choi<sup>d</sup>, Gu-Hyun Kang<sup>e</sup>, Hyoung-Seob Park<sup>f</sup>, Hyung Wook Park<sup>g</sup>, Jae-Min Shim<sup>h</sup>, Jae-Sun Uhm<sup>i</sup>, Jun Kim<sup>j</sup>, Jun-Hyung Kim<sup>k</sup>, Ki-Woon Kang<sup>l</sup>, Sang Weon Park<sup>m</sup>, Yong-Seog Oh<sup>n</sup>, Youngjin Cho<sup>o</sup>, Young Soo Lee<sup>p</sup>, Seung-Jung Park<sup>a,\*</sup>

<sup>a</sup> Division of Cardiology, Heart Vascular Stroke Institute, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea

<sup>b</sup> Division of Cardiology, Chungbuk National University Hospital, Cheongju, Republic of Korea

<sup>c</sup> Division of Cardiology, Yeungnam University Hospital, Daegu, Republic of Korea

<sup>d</sup> Division of Cardiology, Seoul National University College of Medicine, Seoul, Republic of Korea

<sup>e</sup> Division of Cardiology, Samsung Changwon Hospital, Sungkyunkwan University School of Medicine, Changwon, Republic of Korea

<sup>f</sup> Division of Cardiology, Keimyung University Dongsan Medical Center, Daegu, Republic of Korea

<sup>g</sup> Division of Cardiology, Chonnam National University of Hospital, Gwangju, Republic of Korea

<sup>h</sup> Division of Cardiology, Korea University College of Medicine and Korea University Medical Center, Seoul, Republic of Korea

<sup>i</sup> Division of Cardiology, Yonsei University College of Medicine, Seoul, Republic of Korea

<sup>j</sup> Division of Cardiology, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Republic of Korea

<sup>k</sup> Division of Cardiology, Chungnam National University Hospital, Daejeon, Republic of Korea

<sup>l</sup> Division of Cardiology, Eulji University Hospital, Daejeon, Republic of Korea

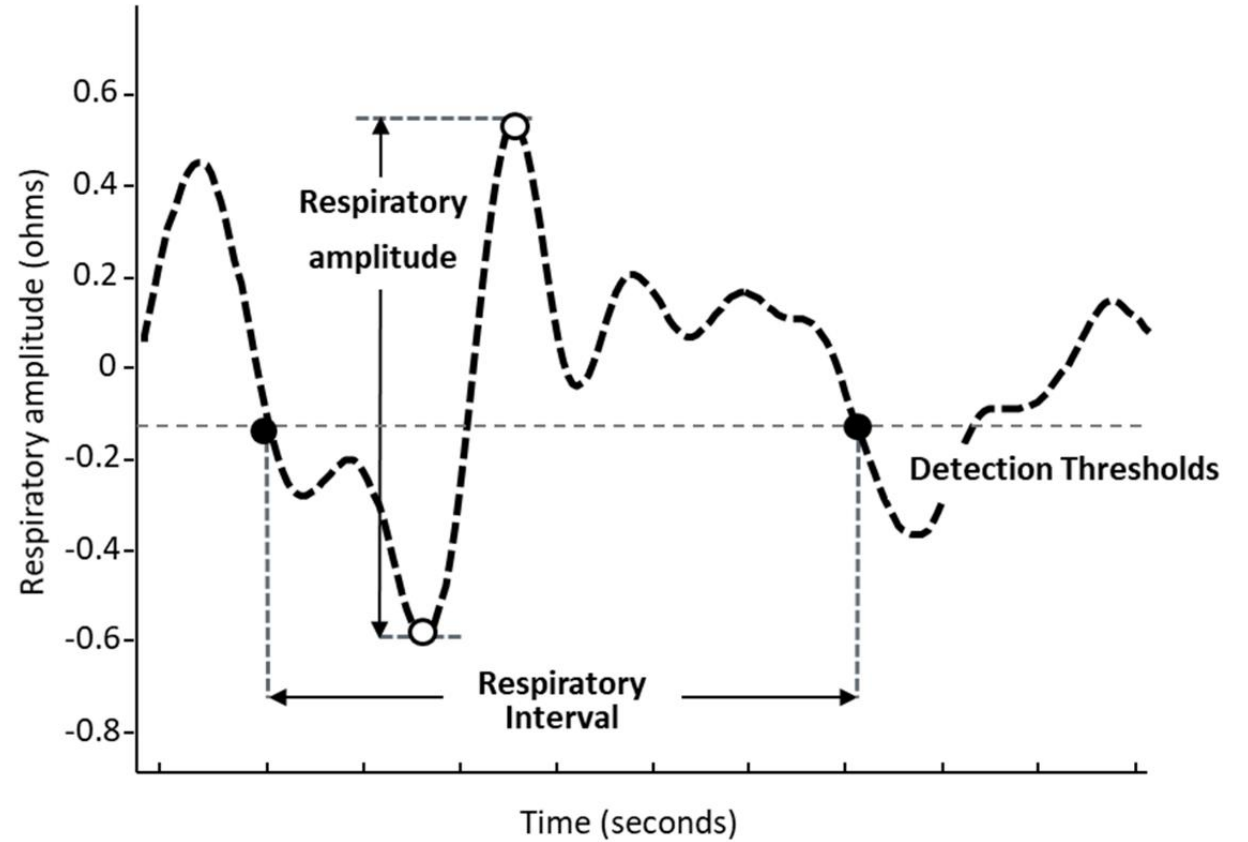
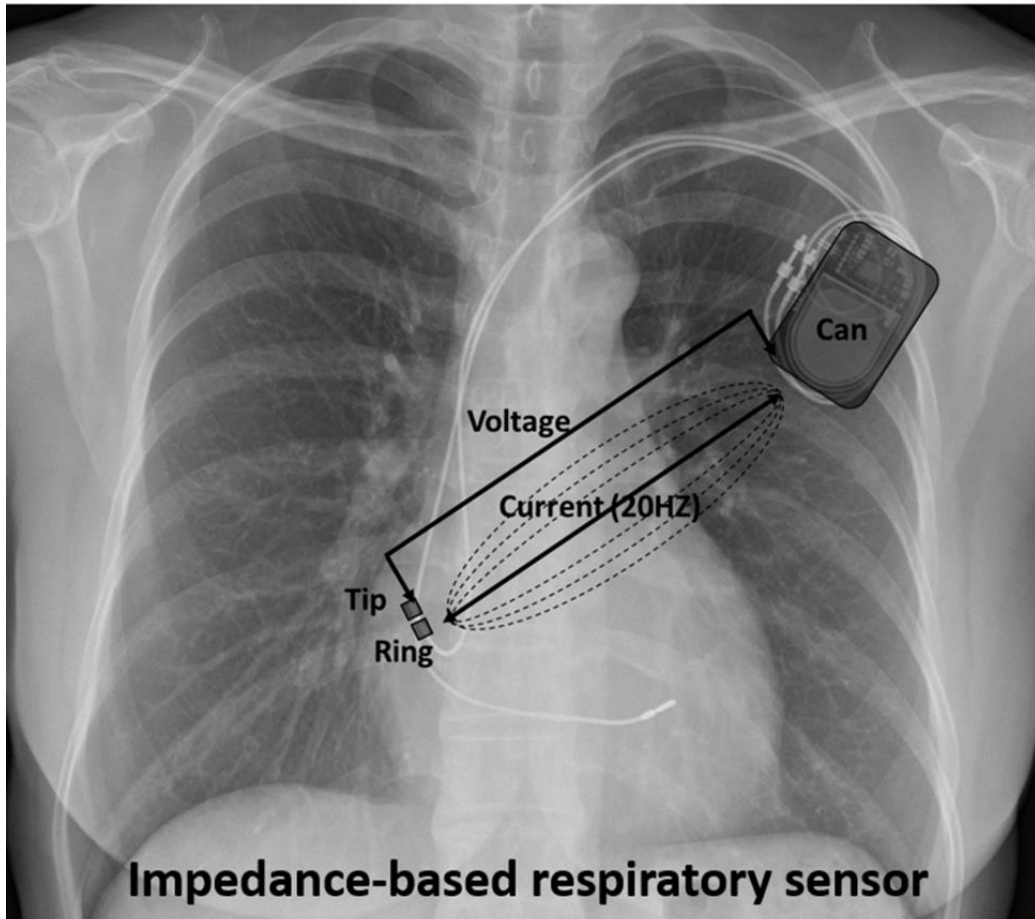
<sup>m</sup> Division of Cardiology, Sejong General Hospital, Bucheon, Republic of Korea

<sup>n</sup> Division of Cardiovascular Medicine, Seoul St. Mary's Hospital, Catholic University of Korea, Seoul, Republic of Korea

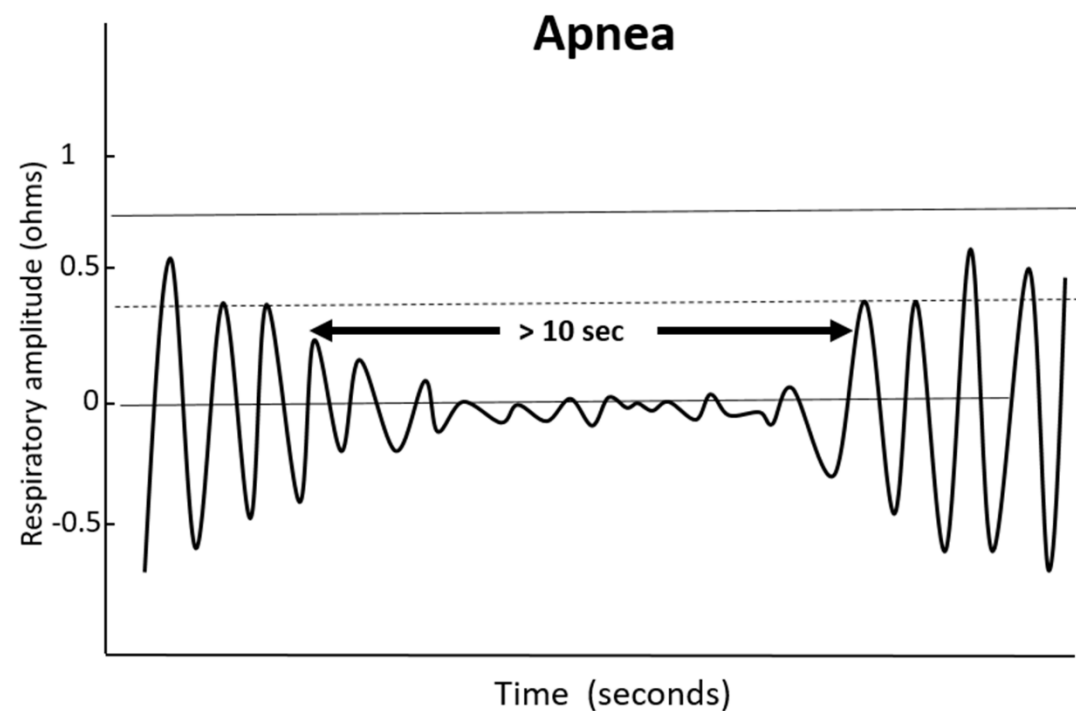
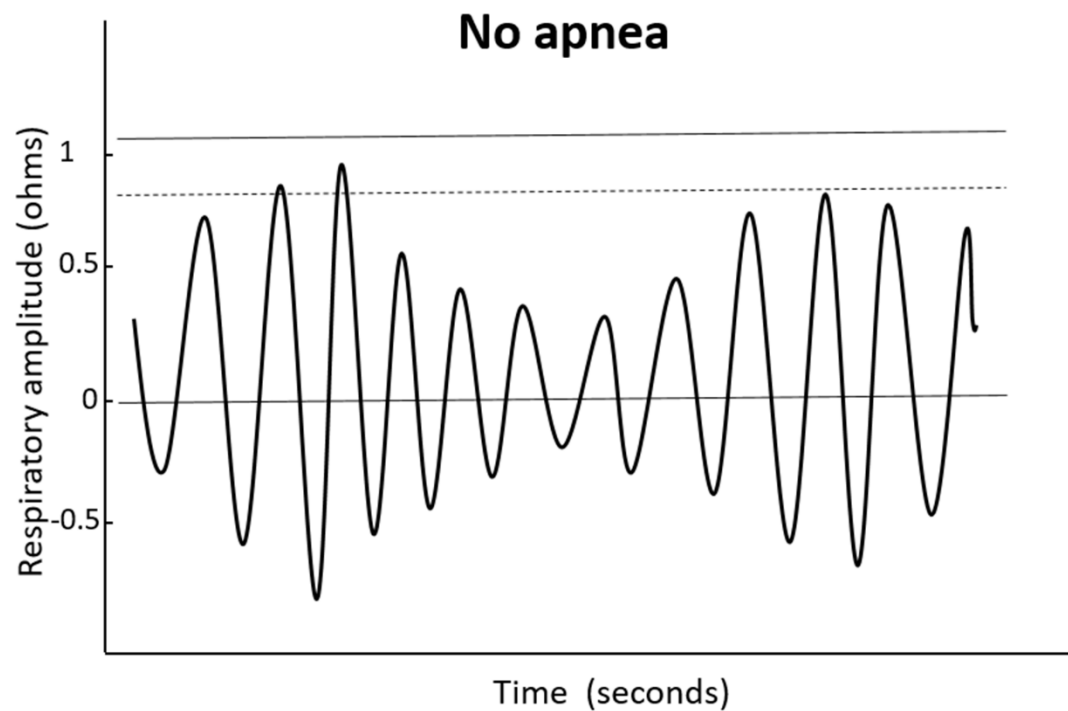
<sup>o</sup> Division of Cardiology, Seoul National University Bundang Hospital, Seongnam, Republic of Korea

<sup>p</sup> Division of Cardiology, Daegu Catholic University Medical Center, Daegu, Republic of Korea

- AP scan



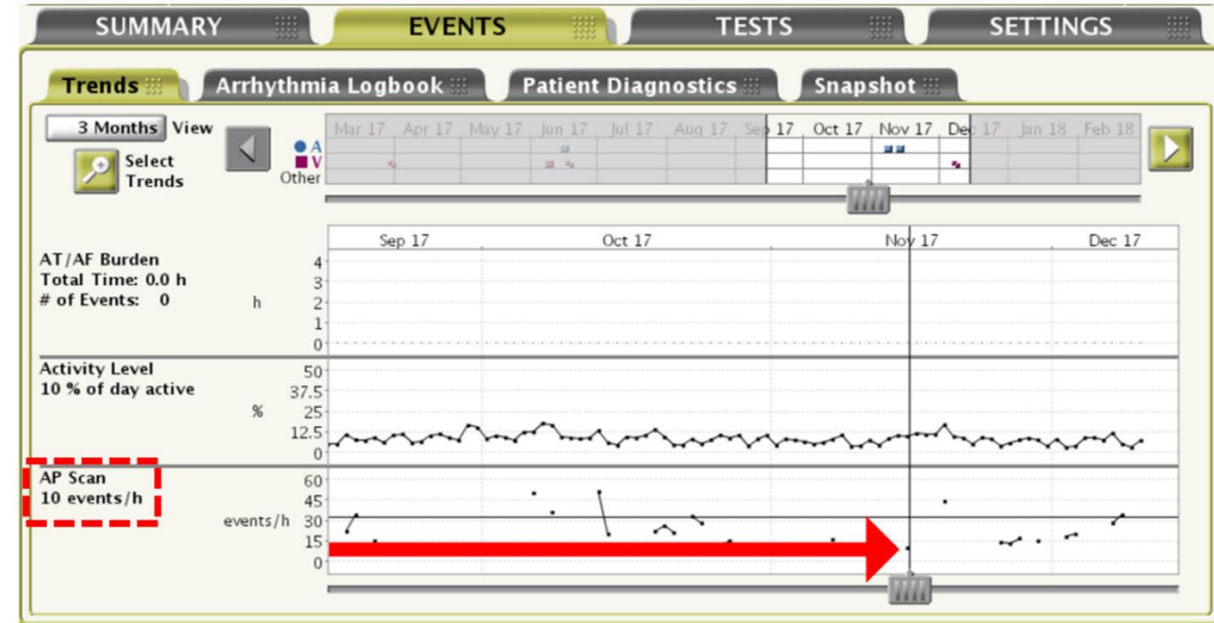
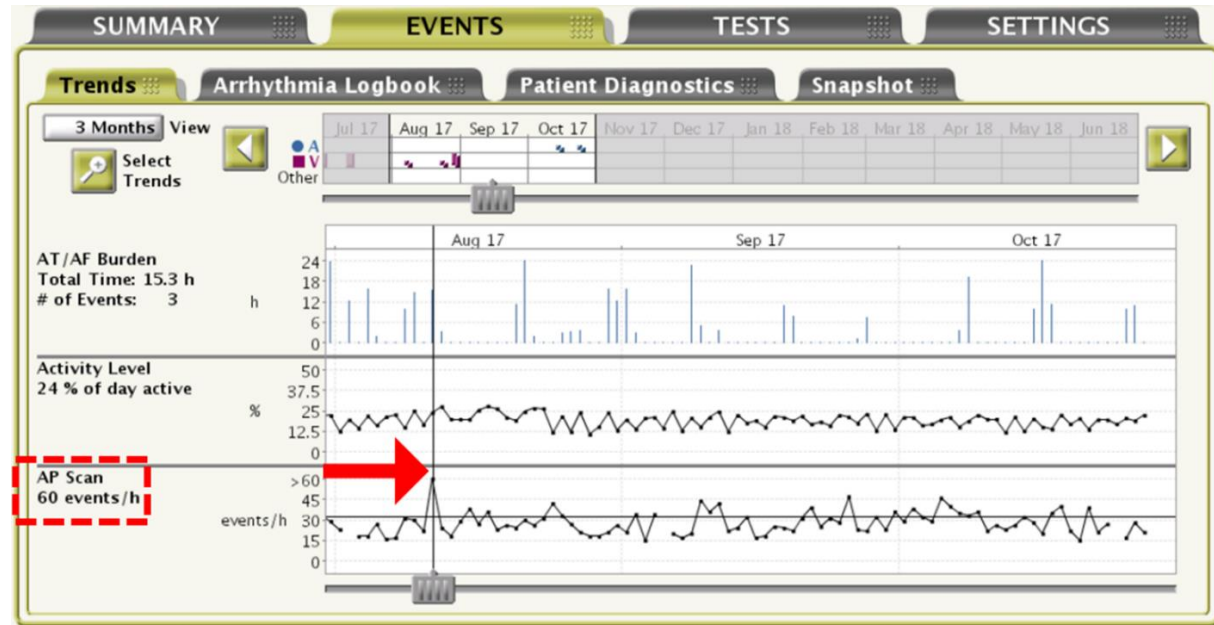
**Thoracic impedance changes during respiration**



—— Baseline smoothed respiratory amplitude  
- - - - Threshold amplitude (< 74% of baseline)



# Manual counting of Respiratory Disturbance Index (RDI)



# Clinical follow-up

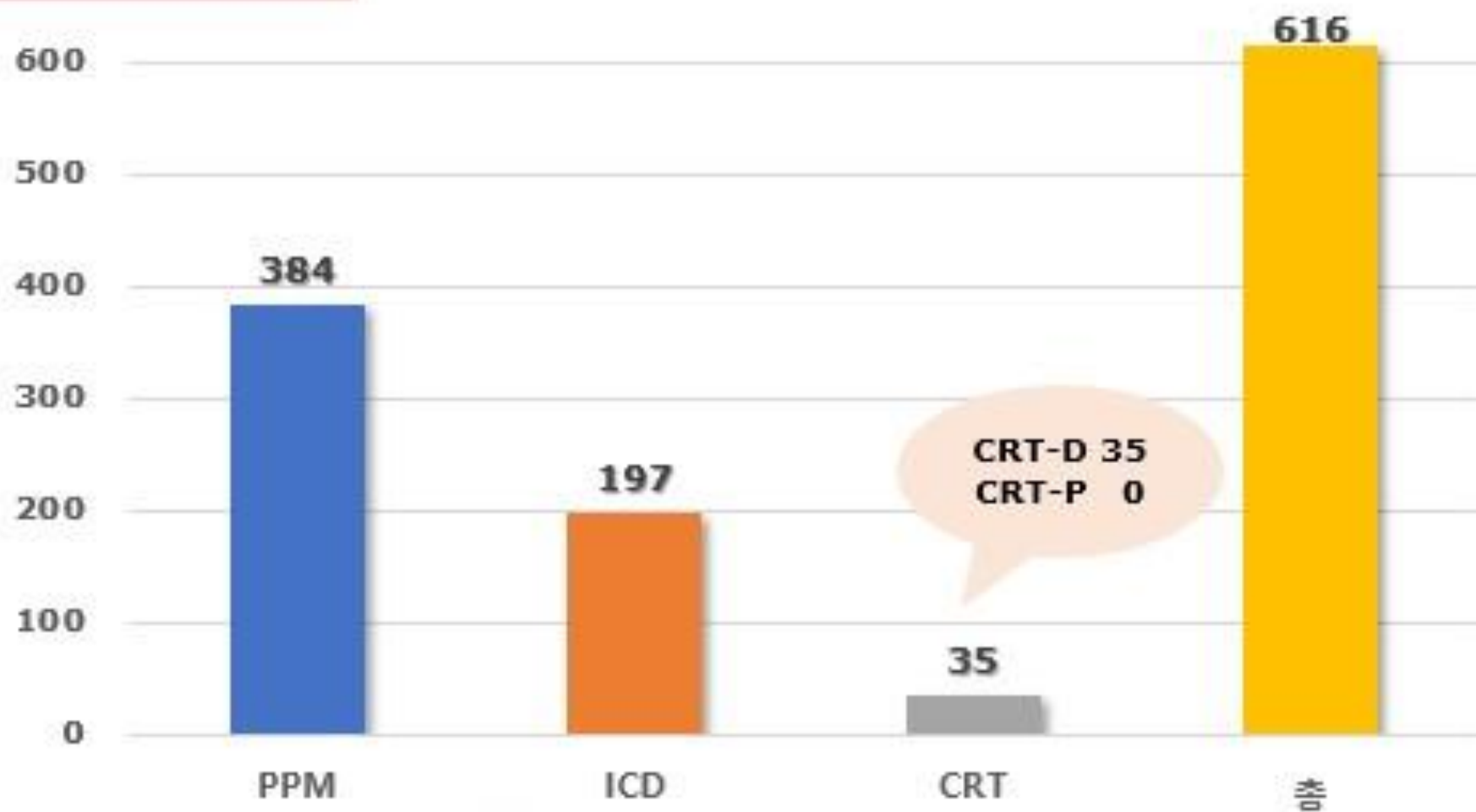
Details of follow-up outcomes.

CIED-detected and clinical outcomes	
<i>Primary outcomes</i>	
Atrial arrhythmia	CIED-detected atrial high rate episode Clinical atrial fibrillation or flutter
<i>Secondary outcomes</i>	
AF-related outcomes	Thromboembolic events, de novo heart failure or decompensation of chronic heart failure, AF progression to persistent/permanent form, ablation therapy of AF
MACE	Cardiac death, stroke, atrial fibrillation or flutter, ventricular tachyarrhythmia, and hospitalization for heart failure
Mortality	Overall and cardiovascular mortality
Ventricular arrhythmia	Clinical events and CIED-detected ventricular high rate episodes, defibrillation therapy (shock or anti-tachycardia pacing)
<i>At 1- and 2-year after CIED implantation</i>	
Quality of life	Assessment by EuroQol five dimensions questionnaire
Severity of SDB	Assessment by Berlin questionnaire

AF, atrial fibrillation; CIED, cardiac implantable electronic device; MACE, major adverse cardiovascular events; SDB, sleep-disordered breathing.



## 02. CIED 등록 현황



# 'DEvice-Detected CArdiac Tachyarrhythmic Events and Sleep-disordered Breathing (**DEDiCATES**)' study

2014 Study 가능성 논의

2016. 05 Study synopsis

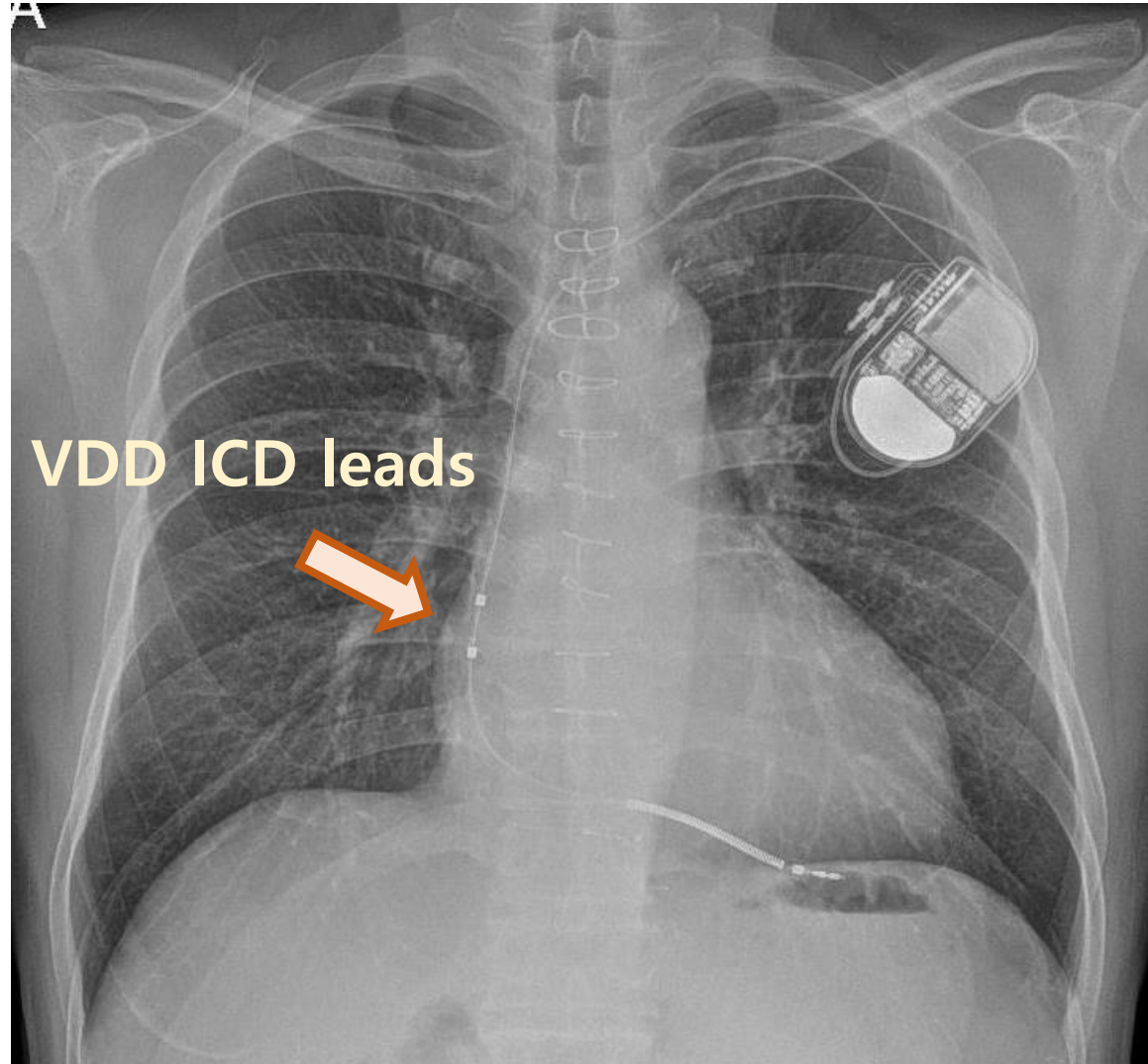
2017. 04 1<sup>st</sup> 연구자 미팅

2020. 07 등록완료

2022. 11 f/u (2년) 완료

2023. Event adjudication ~ Device data analysis

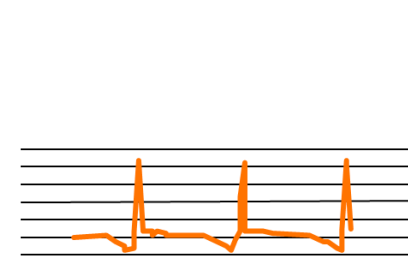
# SMART-CONTROL



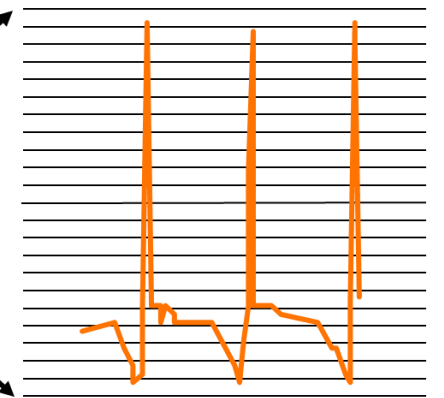
Single lead ICD  
with enhanced (?) DC-function

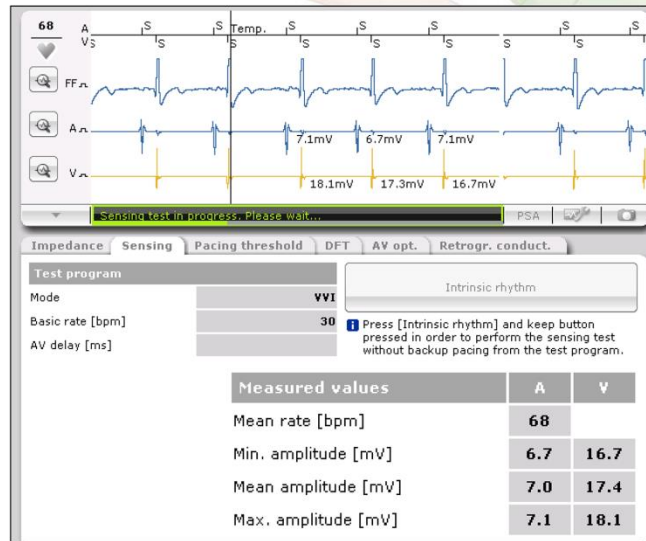
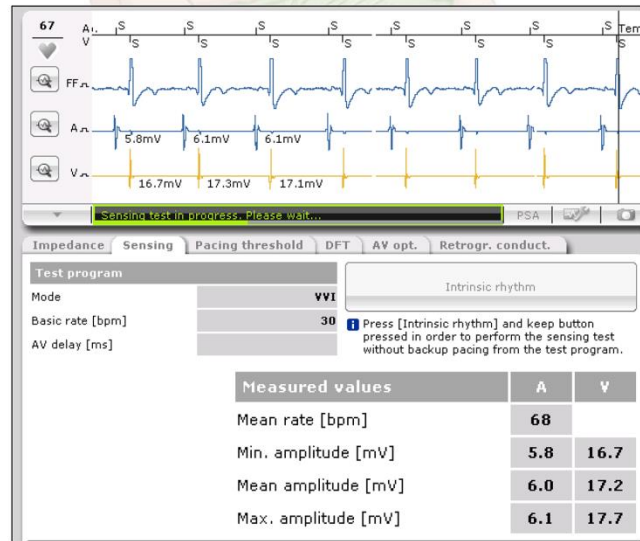
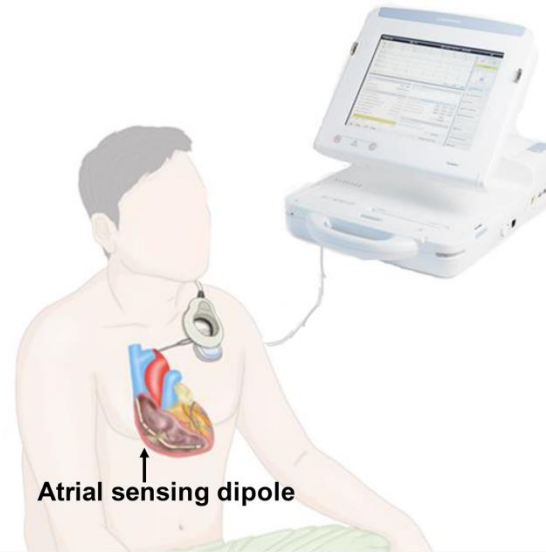
4 folds

Iforia 7 DR  
- atrial channel

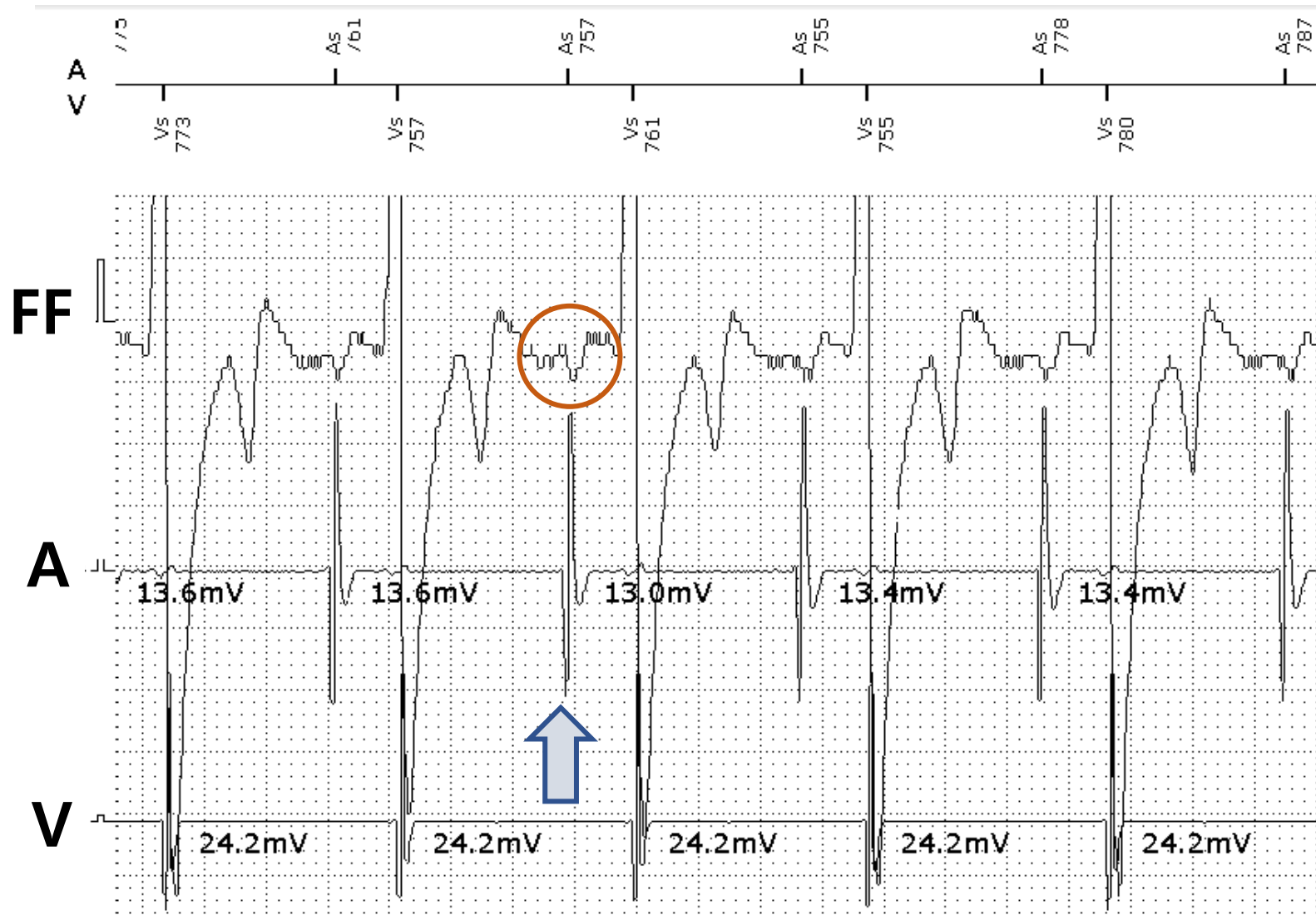


Iforia 7 VR-T DX  
- atrial channel

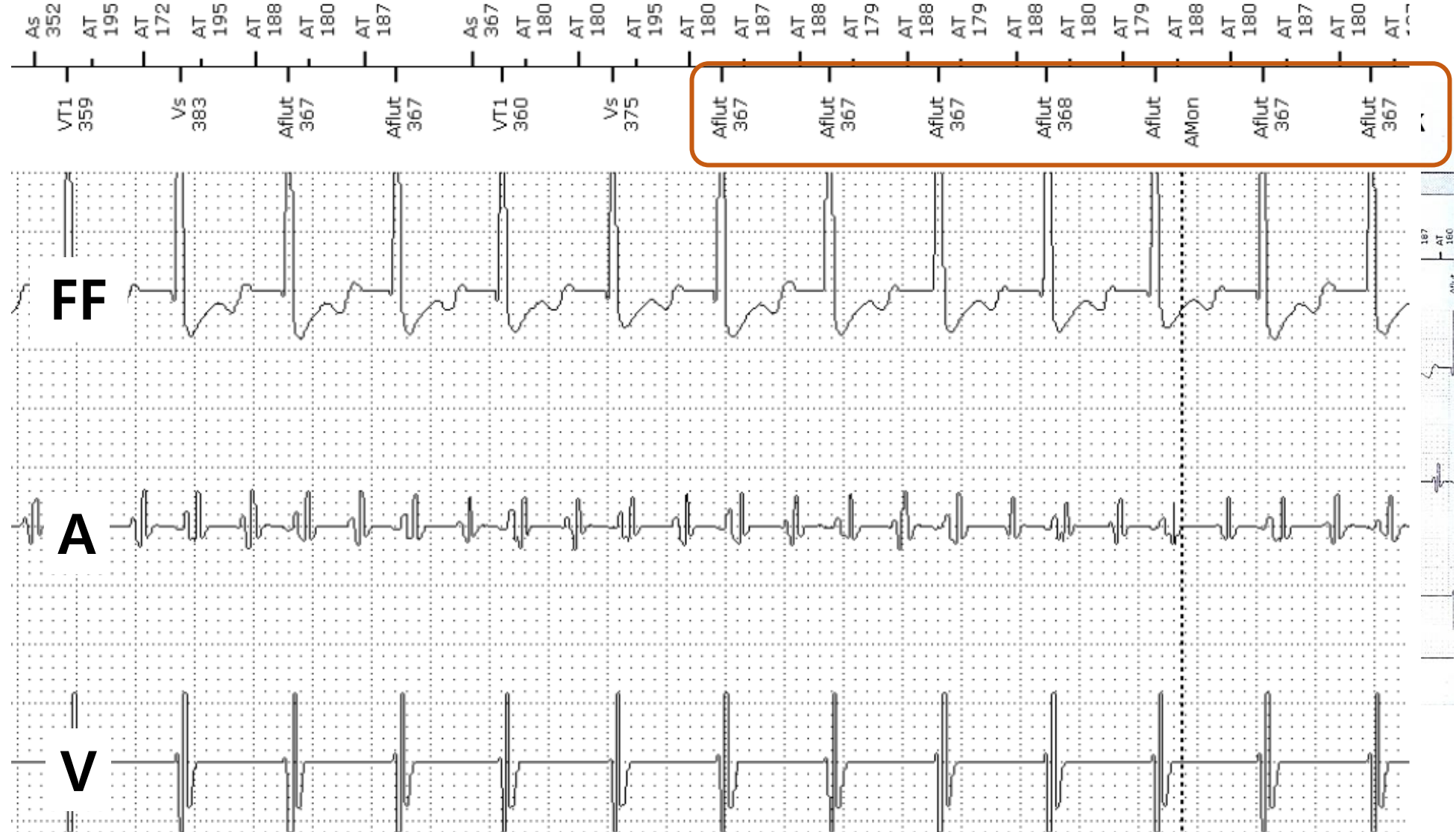


**A****B**

# Sinus Rhythm recorded by ICD

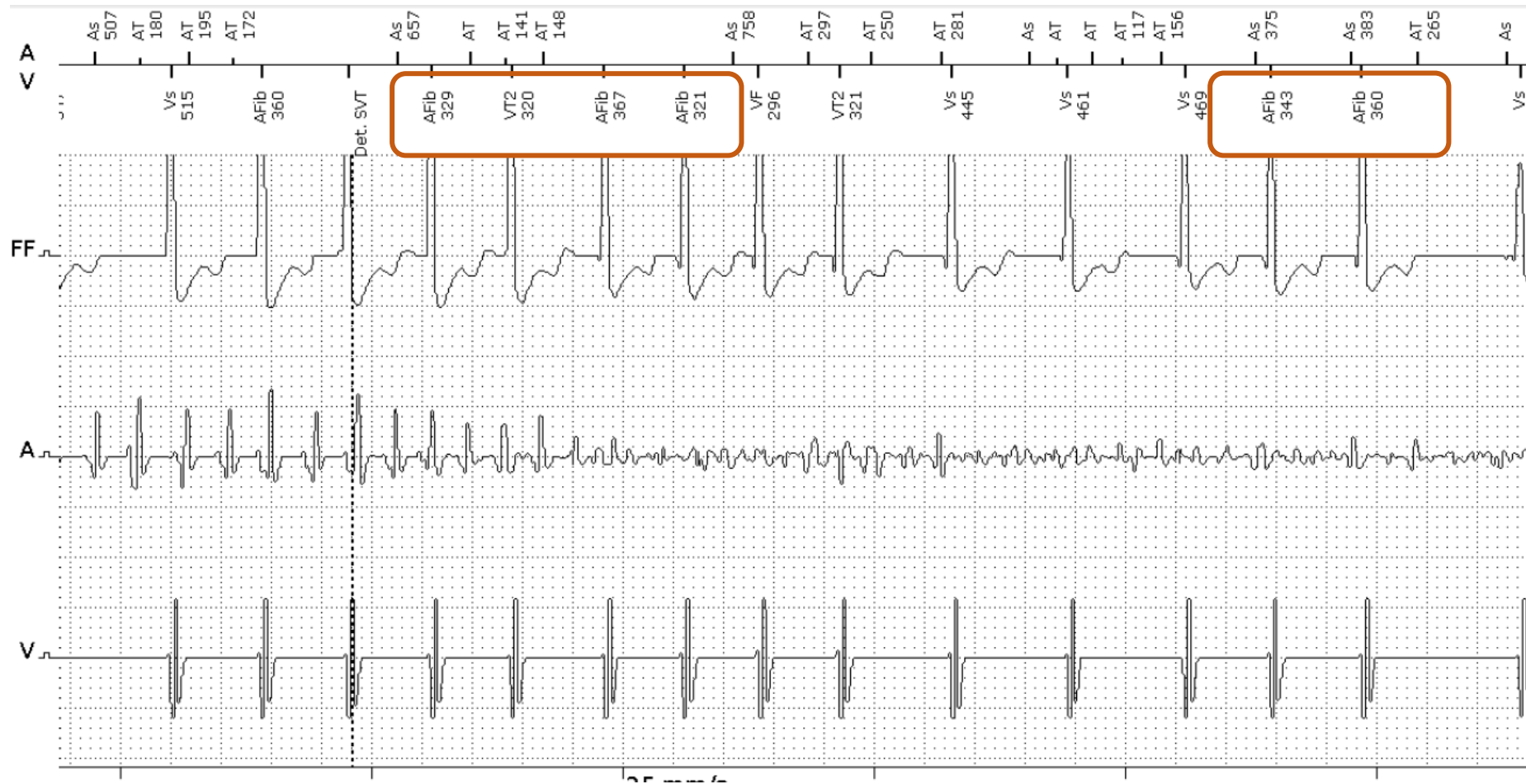


# Atrial flutter with 2:1 conduction





# AFL degenerated into AF

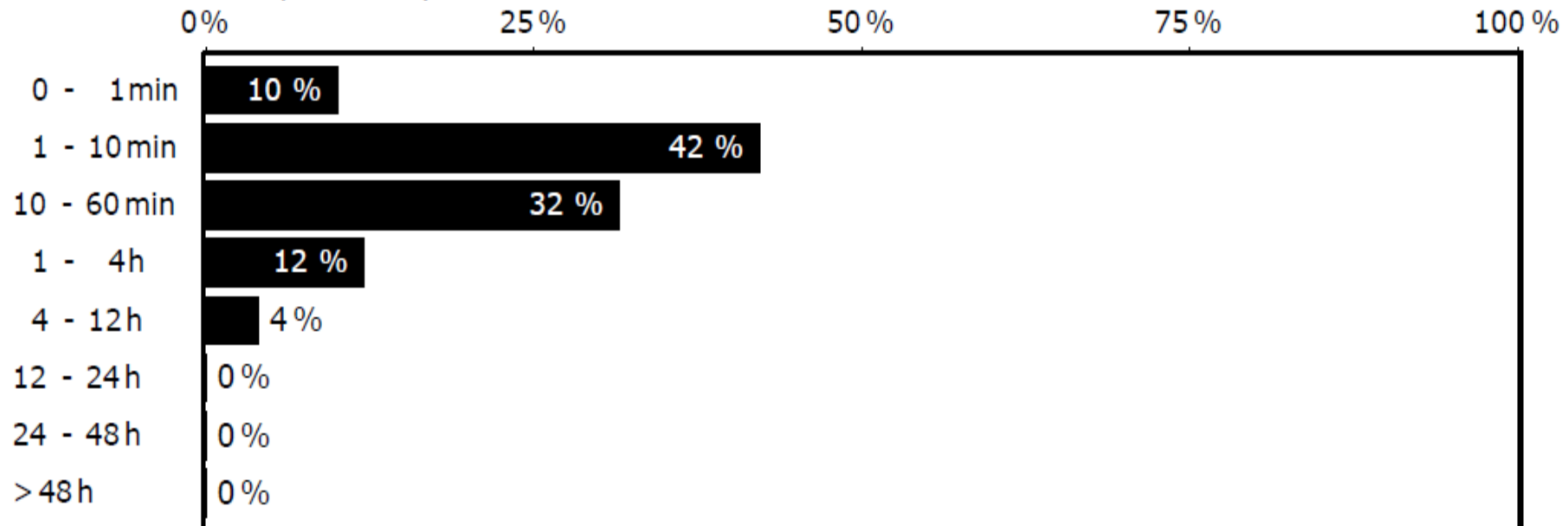


# Burden of Atrial tachyarrhythmia

## Atrial burden

Total number of episodes	149
Atrial arrhythmia burden [%]	4.9

## Duration of tachycardia episode





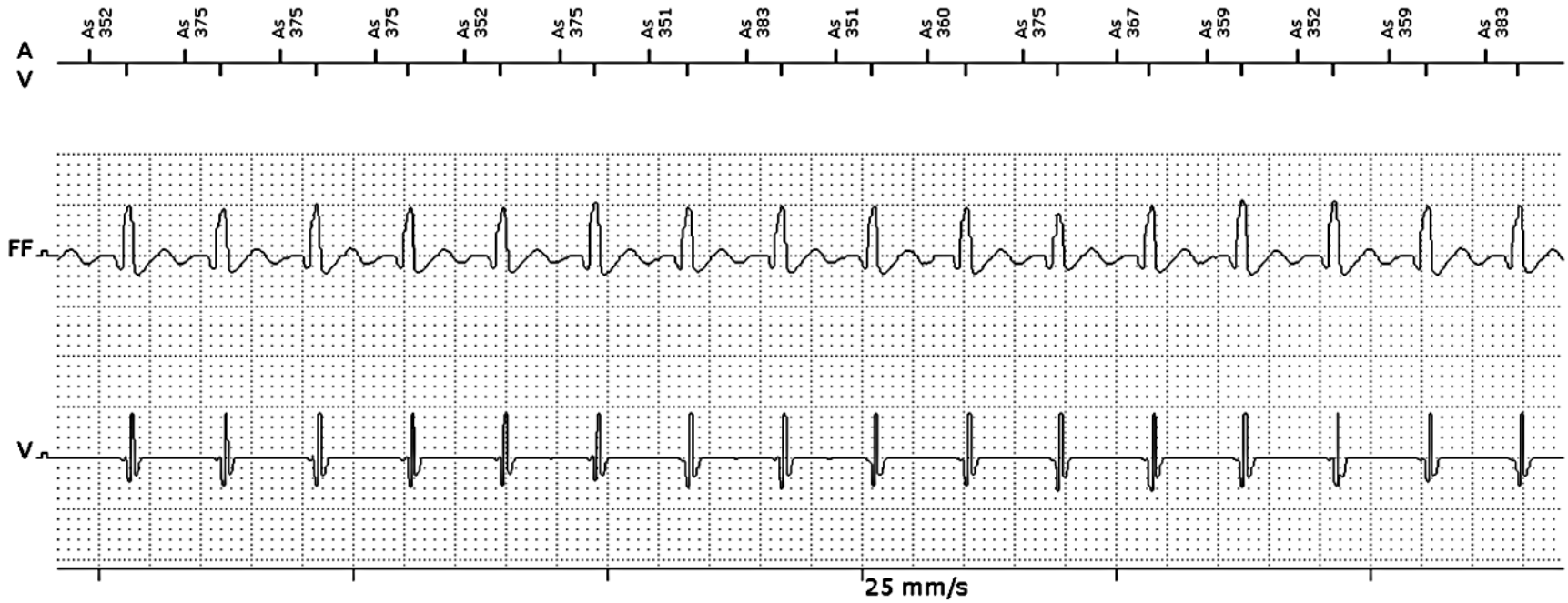
# Stroke in patients with AHREs



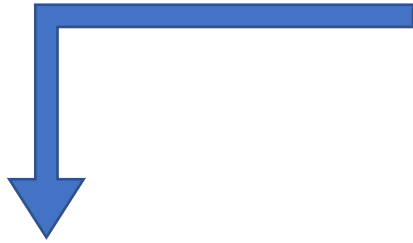
Rt. PCA  
infarction

# VT vs SVT ? (~167 bmp)

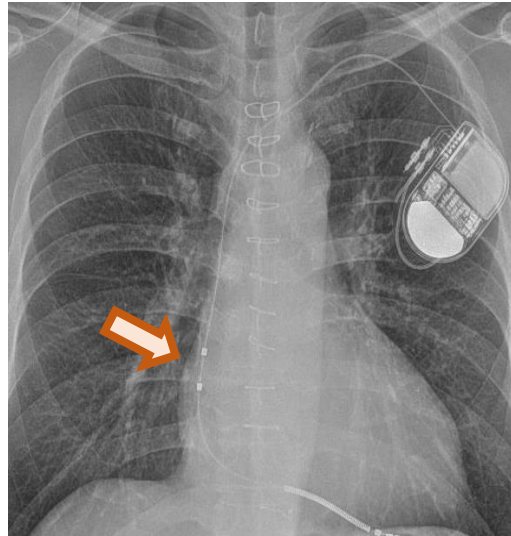
Recordings - IEGM Episode: 155



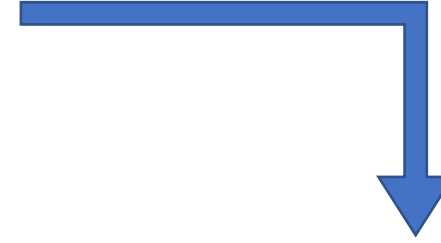
Atrial Sensing **ON**



*enhanced*  
**Dual-chamber  
ICD**



Atrial Sensing **OFF**



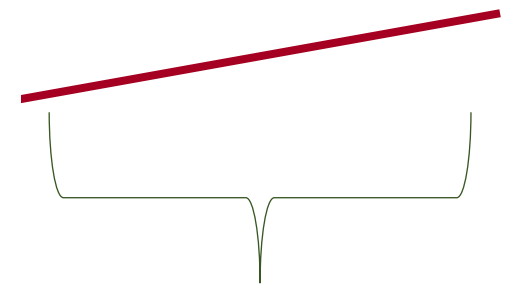
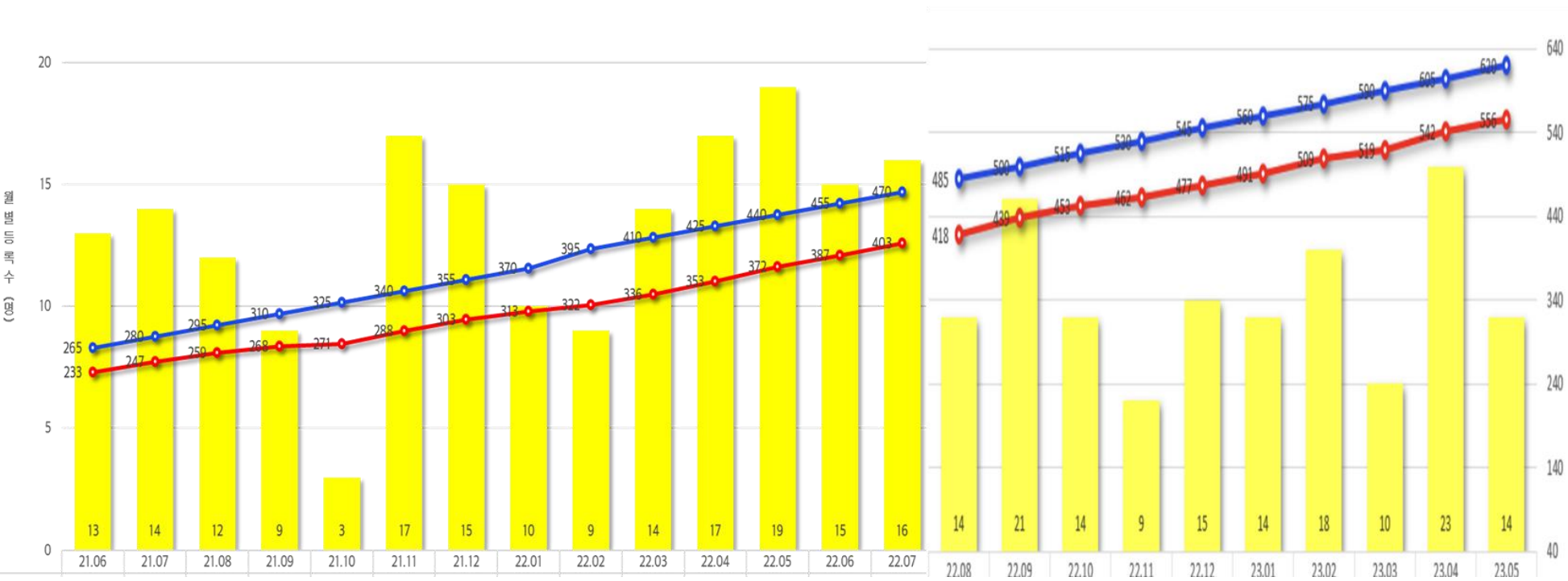
**Single-  
Chamber  
ICD**



1. Early detection of AF or SCAF
2. Inappropriate shock

2018. 04: VDD-ICD study 구상/논의  
 2019. 04: IRB 승인  
 2019. 06: 요양 급여 승인  
 2019. 07: first patient enrolled

**Target N  
 640 patients**

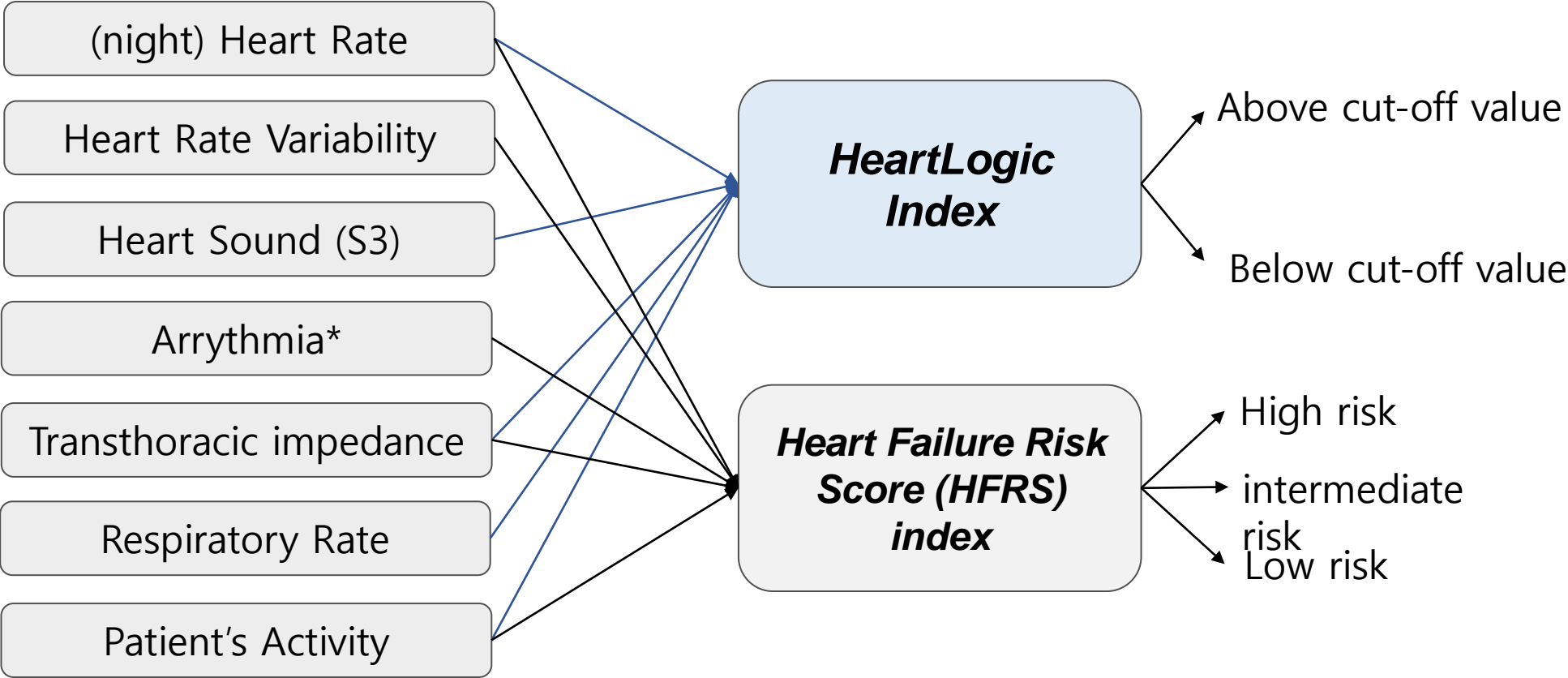


**(2023. 6~12월)**

**84명 / 7 m  
 = 12명/m**

2023.05:  
 목표: 620 vs. **달성556명**

# CIED Multisensors for HF

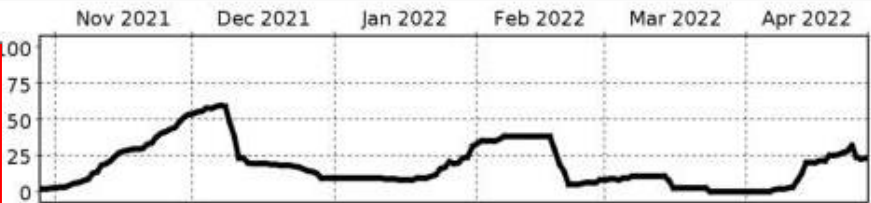


\*; AF burden, V rate during AF, % CRT pacing, VT episodes, and Shocks



Trends

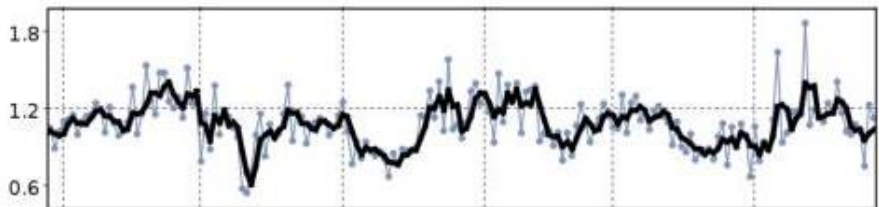
HeartLogic™ Heart Failure Index **23**



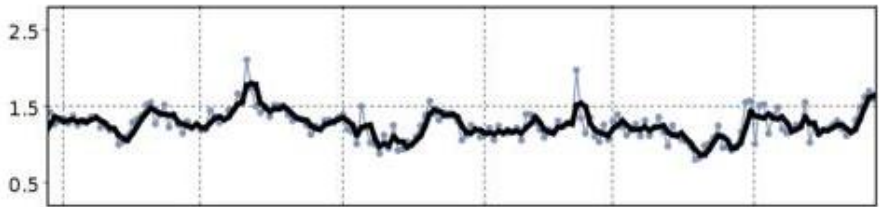
**i** The nominal HeartLogic™ Threshold is 16. This patient's HeartLogic™ Threshold can be confirmed in LATITUDE NXT™.

Most recent measurement:

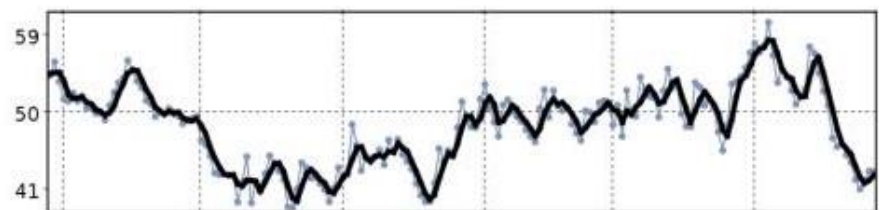
S3 **1.13**  
mG



S1 **1.59**  
mG



Thoracic Impedance **43**  
Ω

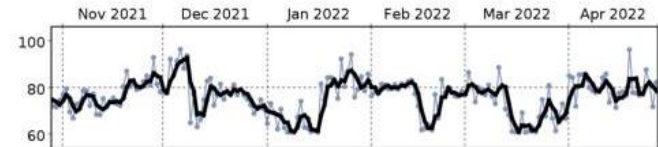


Respiratory Rate **Off**  
rpm



Most recent measurement:

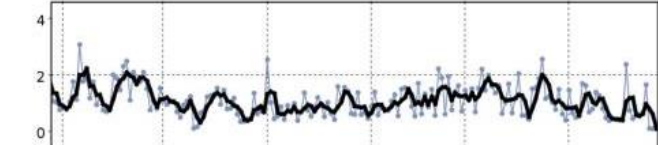
Night Heart Rate **82**  
min<sup>-1</sup>



Sleep Incline **Insufficient**  
degrees



Activity Level **0.0**  
h



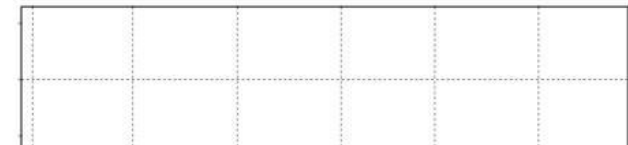
AP Scan **N/R**  
events/h



AT/AF Burden **Off**  
h

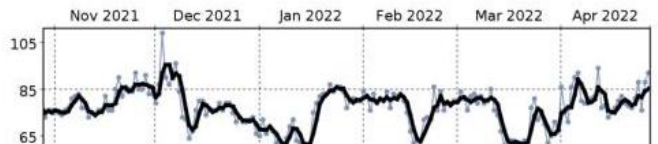


V Rate during AT/AF  
Max **N/R**  
Mean **N/R**  
min



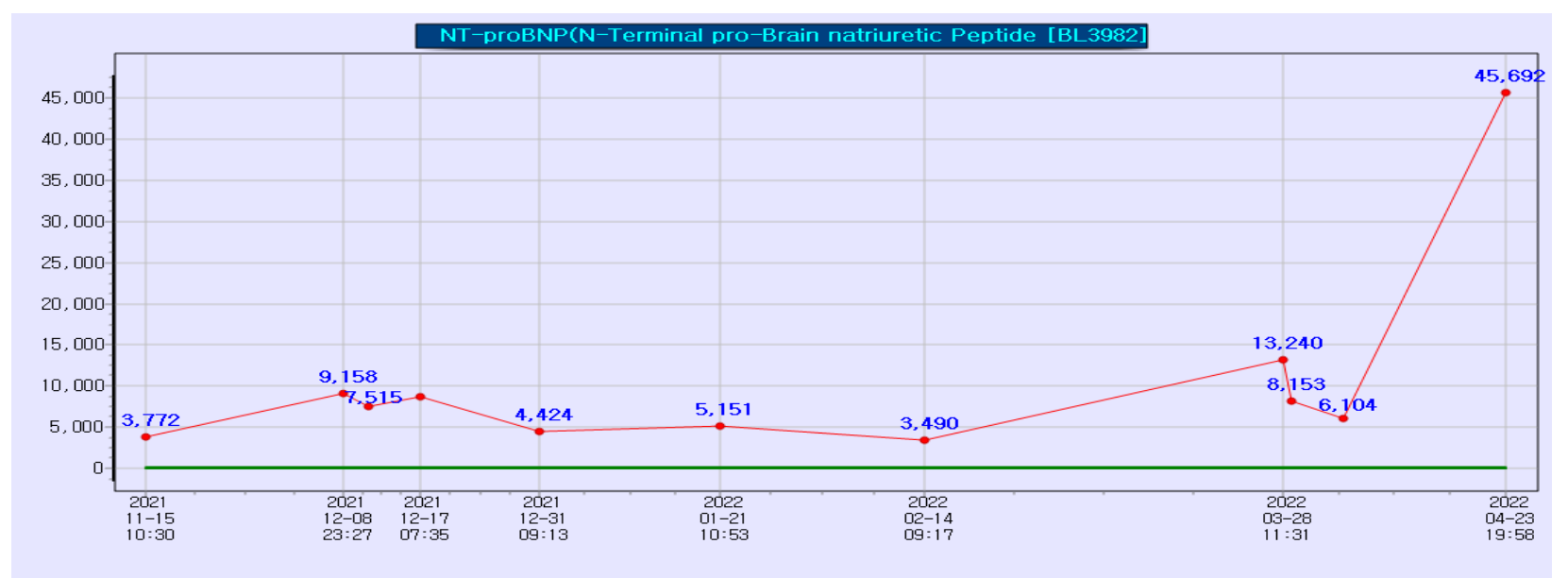
Most recent measurement:

Heart Rate **92**  
min<sup>-1</sup>



Heart Rate Variability (SDANN) **N/R**  
ms

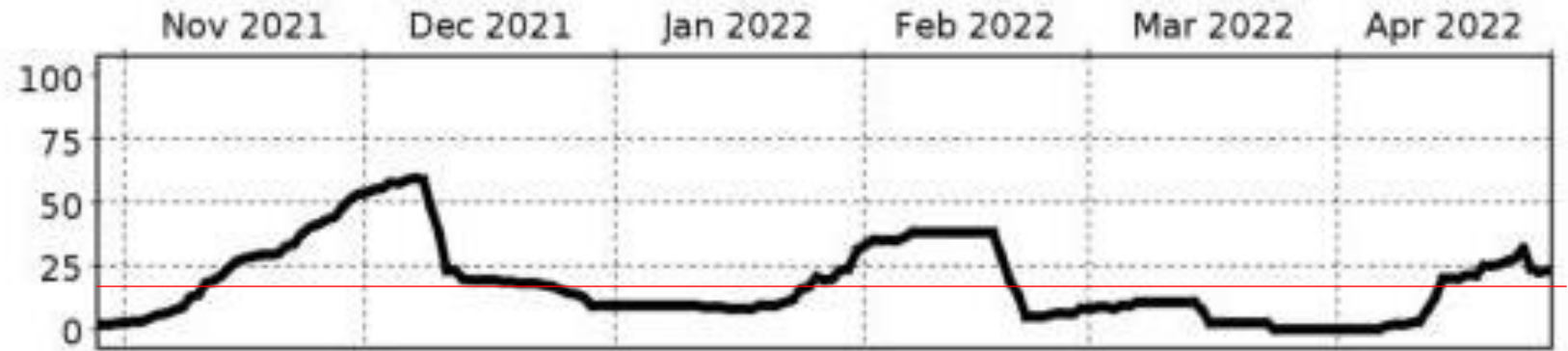




**Trends**

HeartLogic™ Heart Failure Index

23



The nominal HeartLogic™ Threshold is 16. This patient's HeartLogic™ Threshold can be confirmed in LATITUDE NXT™.

2021.10.13  
AF RFCA

2021.11.19  
OPD -  
dyspnea 로  
입원장

2021.12.8  
ADHF

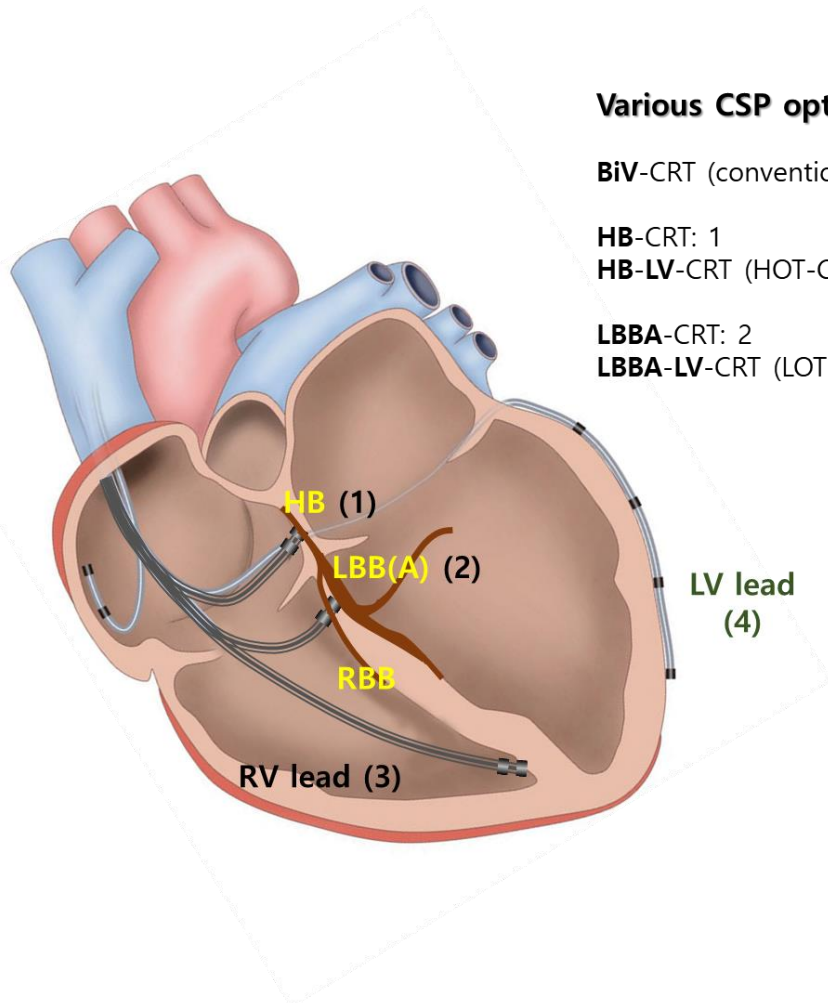
2022.2.14  
OPD -  
dyspnea 로  
이뇨제 증량

2022.3.28  
COVID

2022.4.26  
ADHF



# Conduction system pacing



## Various CSP options

BiV-CRT (conventional CRT): 3+4

HB-CRT: 1

HB-LV-CRT (HOT-CRT): 1+4

LBBA-CRT: 2

LBBA-LV-CRT (LOT-CRT): 2+4

## HBP

**LBB(A)P vs. Conv. PPM for brady**

**LBB(A)P vs. CRT for HF**

*Sinus rhythm, LBBB, QRSd > 150ms*

*Sinus rhythm, LBBB, midrange-QRSd 120~150ms*

*Sinus rhythm, non-LBBB, QRSd*

*CRT non-responder*

*AF with wide QRS*

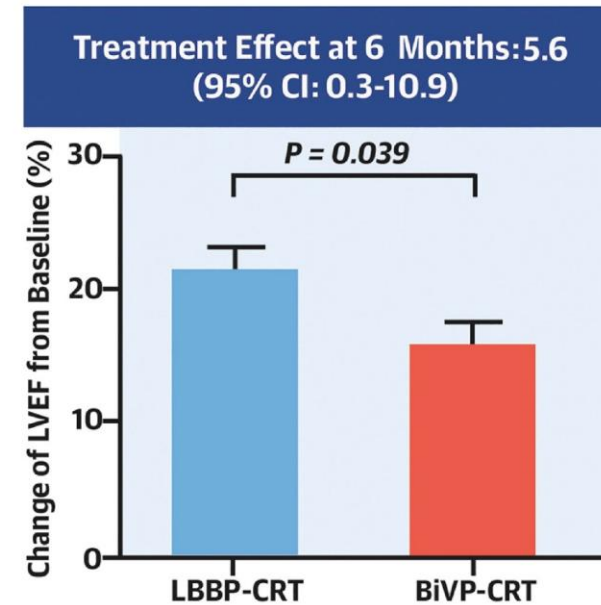
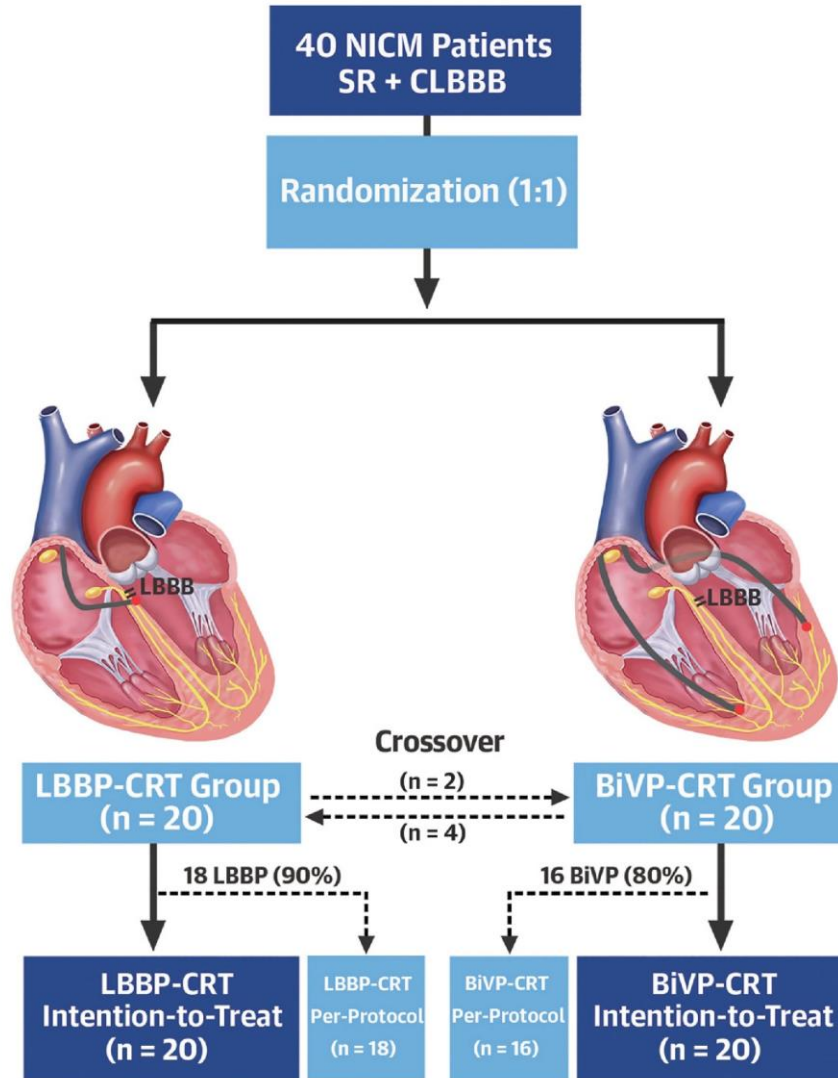
*AF with narrow QRS*

.....





**CENTRAL ILLUSTRATION: Left Bundle Branch Pacing vs Biventricular Pacing for cardiac Resynchronization Therapy**

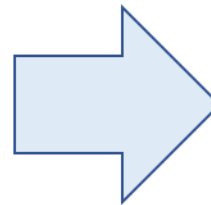
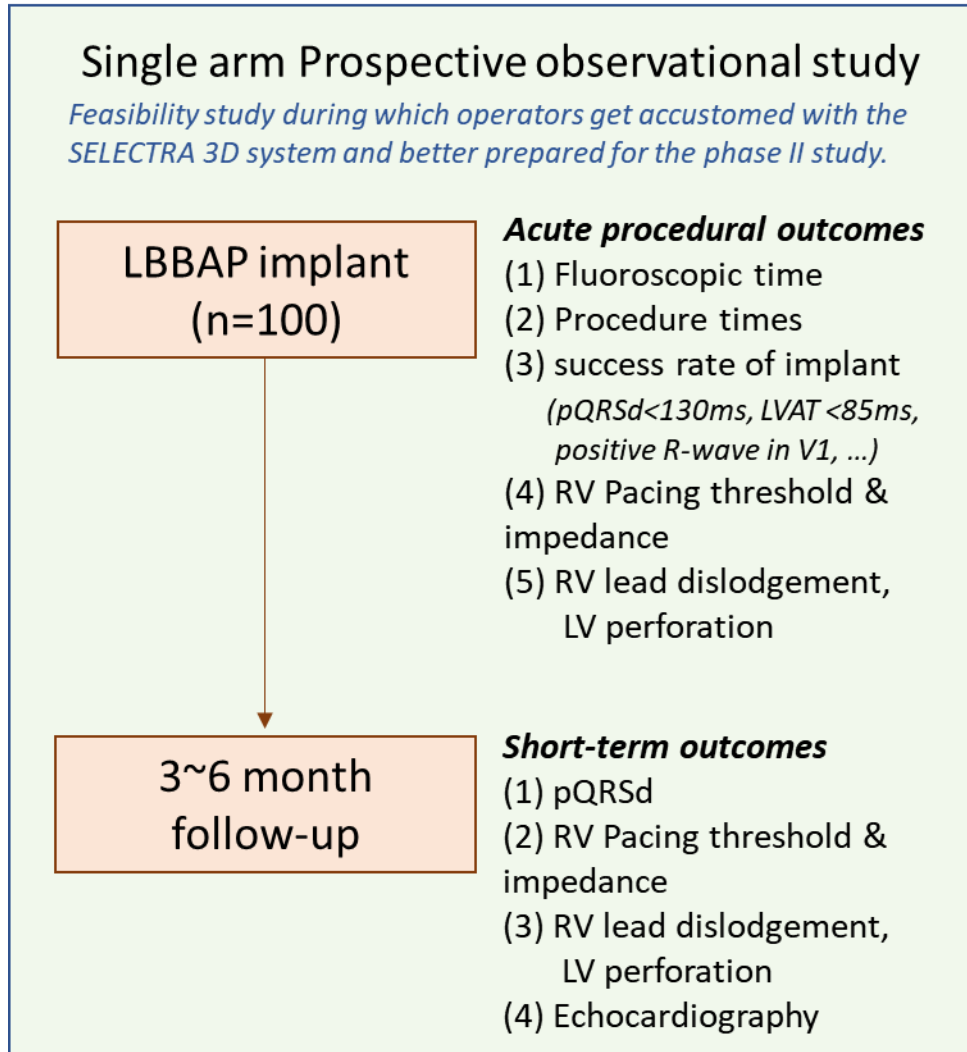


Wang Y, et al. J Am Coll Cardiol. 2022;80(13):1205-1216.

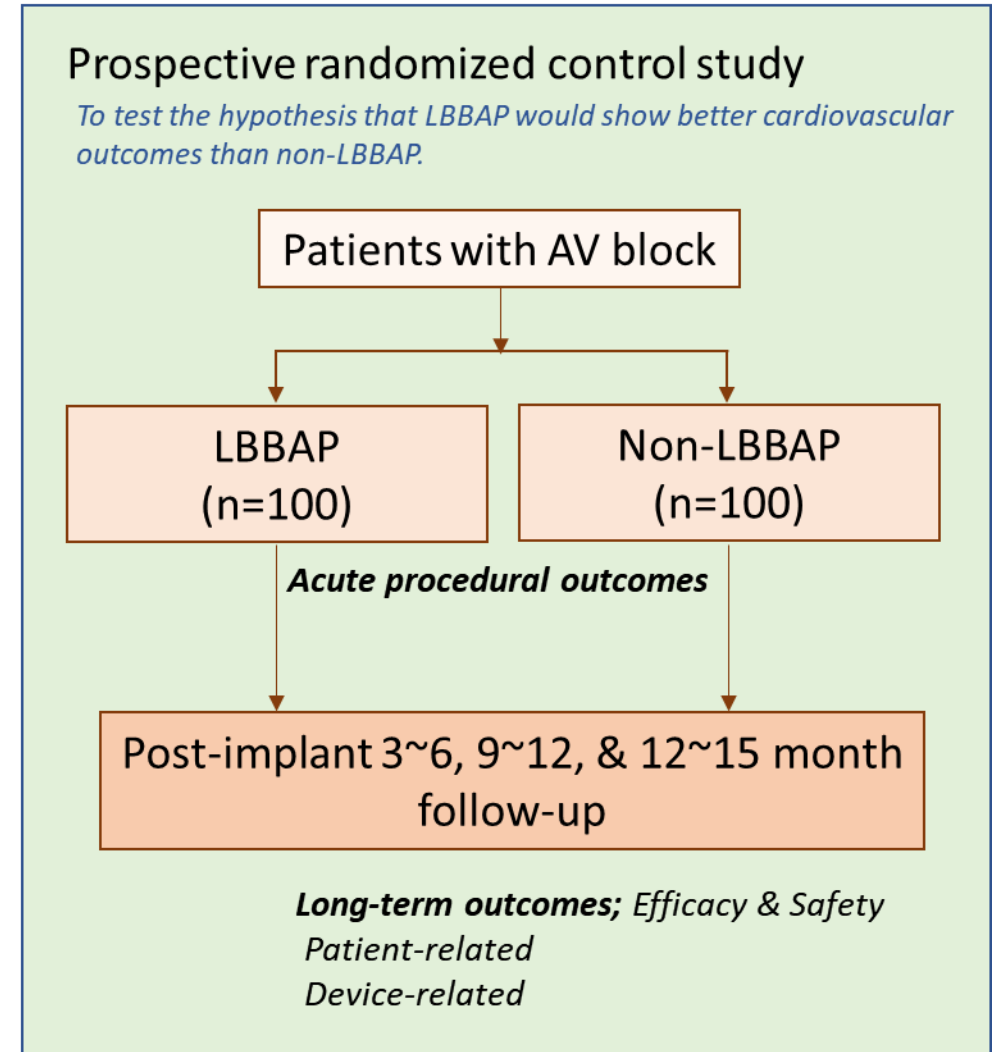


# Overall scheme of *LBBAP (NOVEL) study*

## Phase I study



## Phase II study



# LBBAP for AF with HF (narrow QRS)

## Graphical Abstract

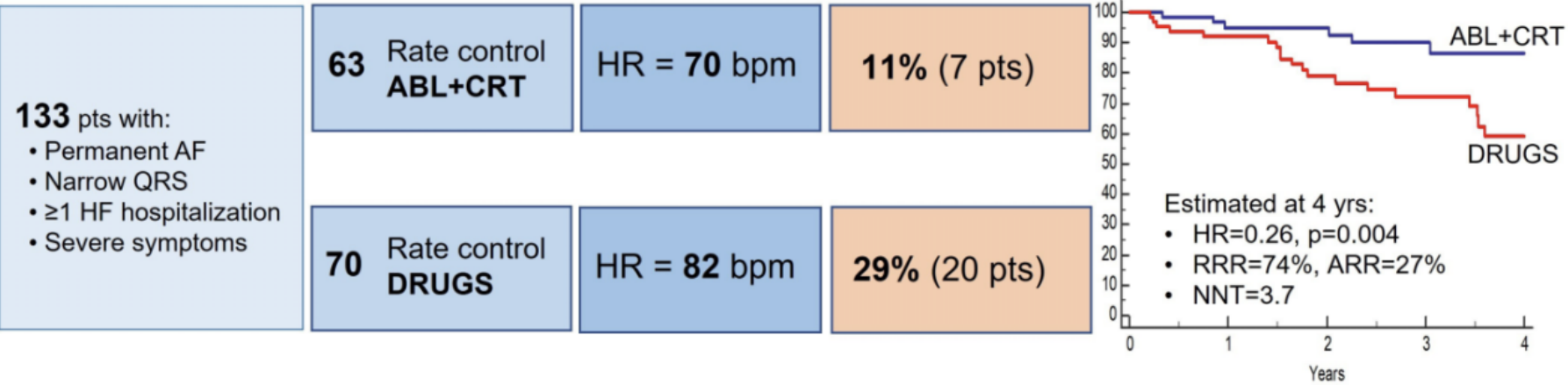
AV junction ablation and cardiac resynchronization for patients with permanent atrial fibrillation and narrow QRS: The APAF-CRT Mortality Trial. *Brignole M et al.*

Trial population

Randomization

Optimization

Death from any cause (ITT analysis)



Permanent AF with QRS duration <130msec  
HF with LVEF ≤35% refractory to optimal medical therapy at least 3 months

Randomization

LBBAP with<sup>\*</sup>  
AVJ ablation

BiV pacing with<sup>†</sup>  
AVJ ablation

Medical therapy with  
ICD for primary  
prevention

# Changes in recommendation

## *in 2022 ESC guidelines of VT management & SCD prevention*

**Table 5** Changes in recommendations since 2015

	Class	
	2015	2022
<b>Coronary artery disease</b>		
In patients with syncope and previous STEMI, PES is indicated when syncope remains unexplained after non-invasive evaluation.	IIa	I
Intravenous amiodarone treatment should be considered for patients with recurrent PVT/VF during the acute phase of ACS.	I	IIa
In patients with CAD eligible for ICD implantation, catheter ablation may be considered just before (or immediately after) ICD implantation to decrease subsequent VT burden and ICD shocks.	IIa	IIb
<b>PVC-induced cardiomyopathy</b>		
In patients with a cardiomyopathy suspected to be caused by frequent and predominately monomorphic PVCs, catheter ablation is recommended.	IIa	I

### CHD

In patients after repair of TOF without arrhythmia symptoms, but with a combination of other risk factors,<sup>a</sup> electrophysiologic evaluation, including PES, may be considered.

IIa

IIb

In patients with CHD and recurrent, symptomatic SMVT, or ICD shocks for SMVT not manageable by medical therapy or ICD reprogramming, catheter ablation performed in specialized centres should be considered.

I

IIa

### Primary electrical disease and selected populations

ICD implantation is recommended in patients with LQTS who are symptomatic<sup>b</sup> while receiving beta-blockers and genotype-specific therapies.

IIa

I

ICD implantation should be considered in patients with CPVT who experience arrhythmic syncope and/or documented bidirectional/PVT while on the highest tolerated beta-blocker dose and on flecainide.

I

IIa

Pre-participation cardiovascular evaluation of competitive athletes should be considered.

I

IIa

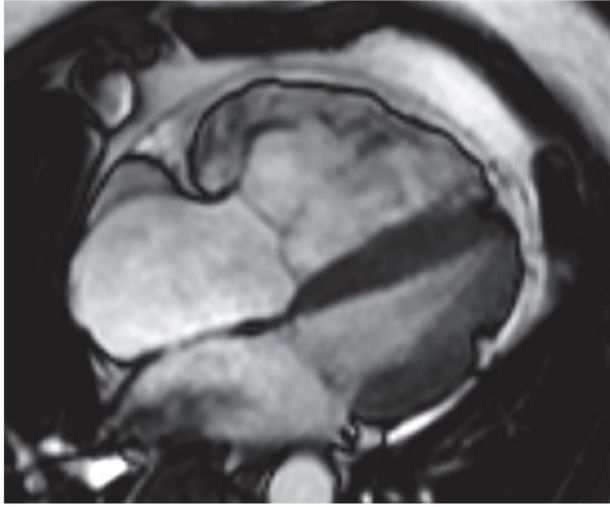
Catheter ablation of triggering PVCs and/or PVOT

IIa

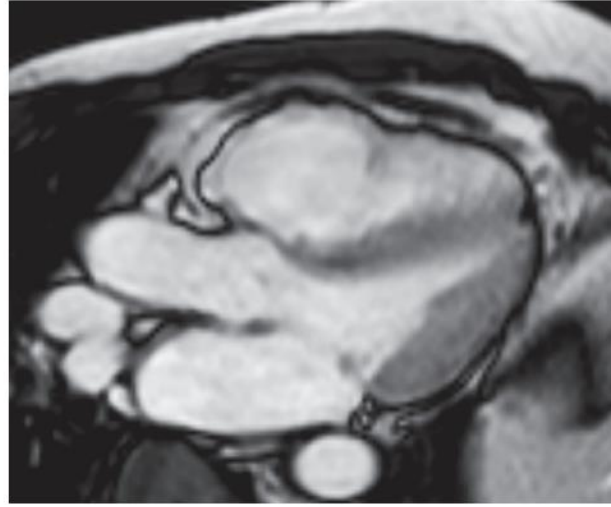
IIa



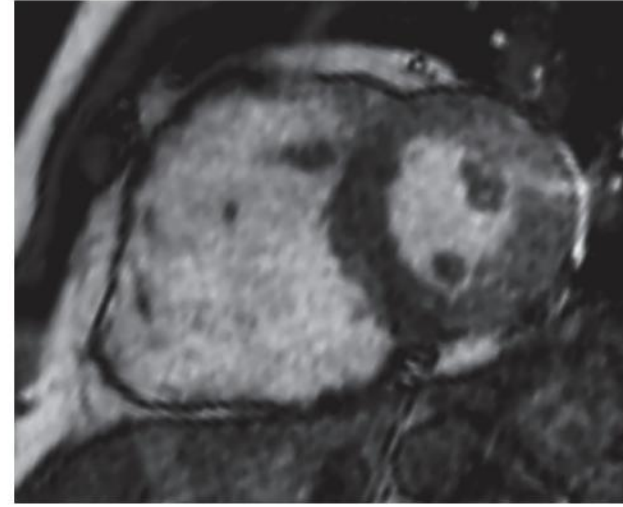
# ARVC



4-chamber

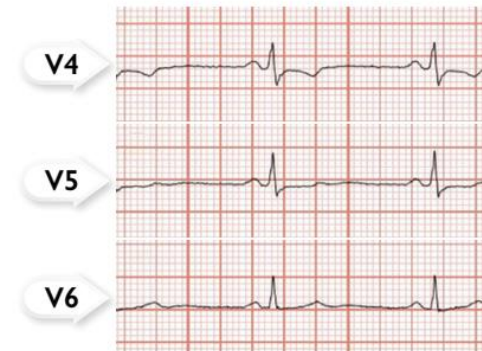
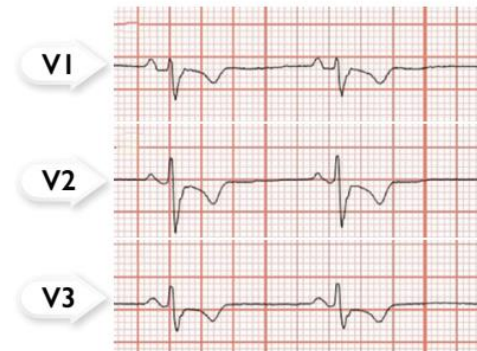
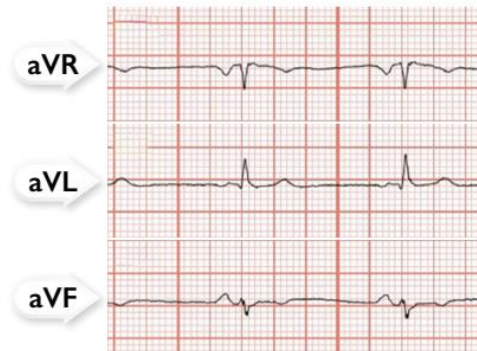


3-chamber



Short axis

ECG sinus rhythm – Negative T waves VI-V4, terminal QRS duration >55 ms



# ARVC

	2015	2022
<b>ARVC</b>		
ICD implantation should be considered in patients with definite ARVC and an arrhythmic syncope.	<b>IIb</b>	<b>IIa</b>
ICD implantation should be considered in patients with definite ARVC and severe RV or LV systolic dysfunction.	<b>IIb</b>	<b>IIa</b>

## Risk stratification and primary prevention of SCD

ICD implantation should be considered in patients with definite ARVC and an arrhythmic syncope.<sup>696,701,711–713</sup>

**IIa**

**B**

ICD implantation should be considered in patients with definite ARVC and severe RV or LV systolic dysfunction.<sup>675,691</sup>

**IIa**

**C**

ICD implantation should be considered in symptomatic<sup>d</sup> patients with definite ARVC, moderate right or left ventricular dysfunction, and either NSVT or inducibility of SMVT at PES.<sup>695,696,701,703,705</sup>

**IIa**

**C**

In patients with ARVC and symptoms highly suspicious for VA, PES may be considered for risk stratification.<sup>695,705</sup>

**IIb**

**C**



# Arrhythmogenic Right Ventricular Cardiomyopathy

## Clinical Course and Predictors of Arrhythmic Risk



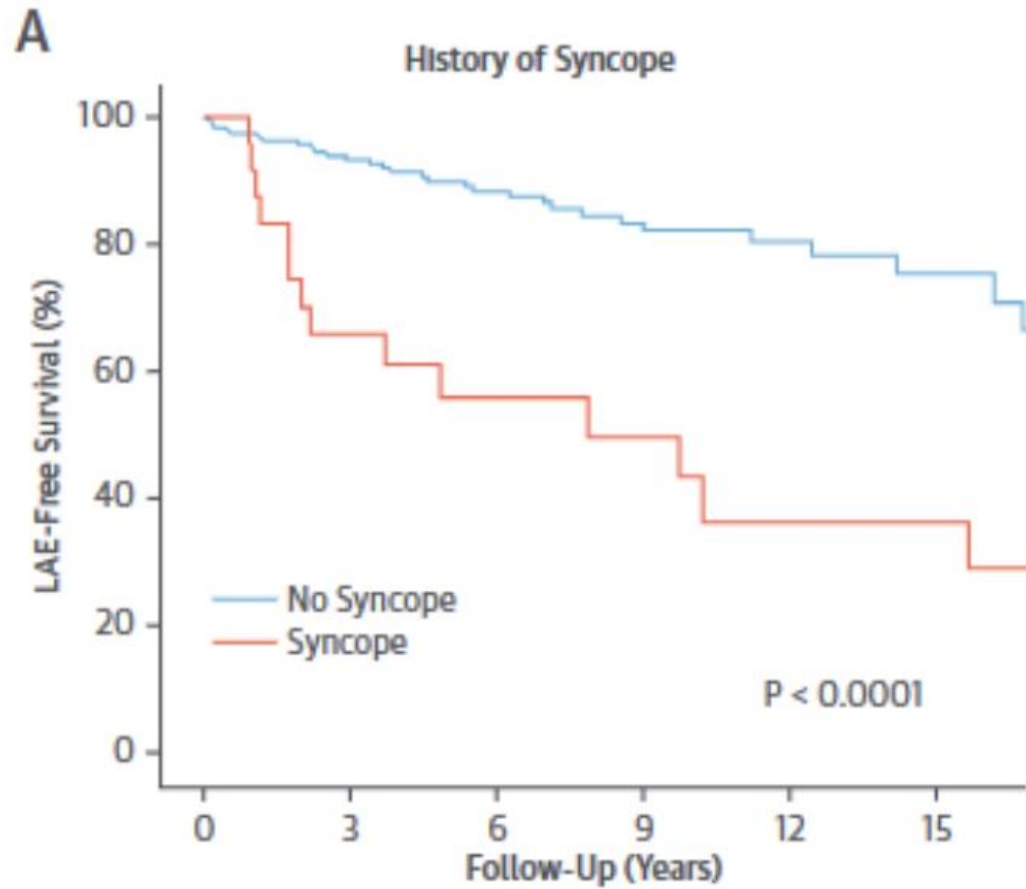
Andrea Mazzanti, MD,<sup>a</sup> Kevin Ng, MD,<sup>a</sup> Alessandro Faragli, MD,<sup>a</sup> Riccardo Maragna, MD,<sup>a</sup> Elena Chiodaroli, MD,<sup>a</sup> Nicoletta Orphanou, MD,<sup>a</sup> Nicola Monteforte, MD,<sup>a</sup> Mirella Memmi, PhD,<sup>a</sup> Patrick Gambelli, MS,<sup>a</sup> Valeria Novelli, PhD,<sup>a</sup> Raffaella Bloise, MD,<sup>a</sup> Oronzo Catalano, MD,<sup>a</sup> Guido Moro, MD,<sup>a</sup> Valentina Tibollo, MS,<sup>a</sup> Massimo Morini, MS,<sup>a</sup> Riccardo Bellazzi, MS, PhD,<sup>b</sup> Carlo Napolitano, MD, PhD,<sup>a</sup> Vincenzo Bagnardi, PhD,<sup>c</sup> Silvia G. Priori, MD, PhD<sup>a,d</sup>

### ABSTRACT

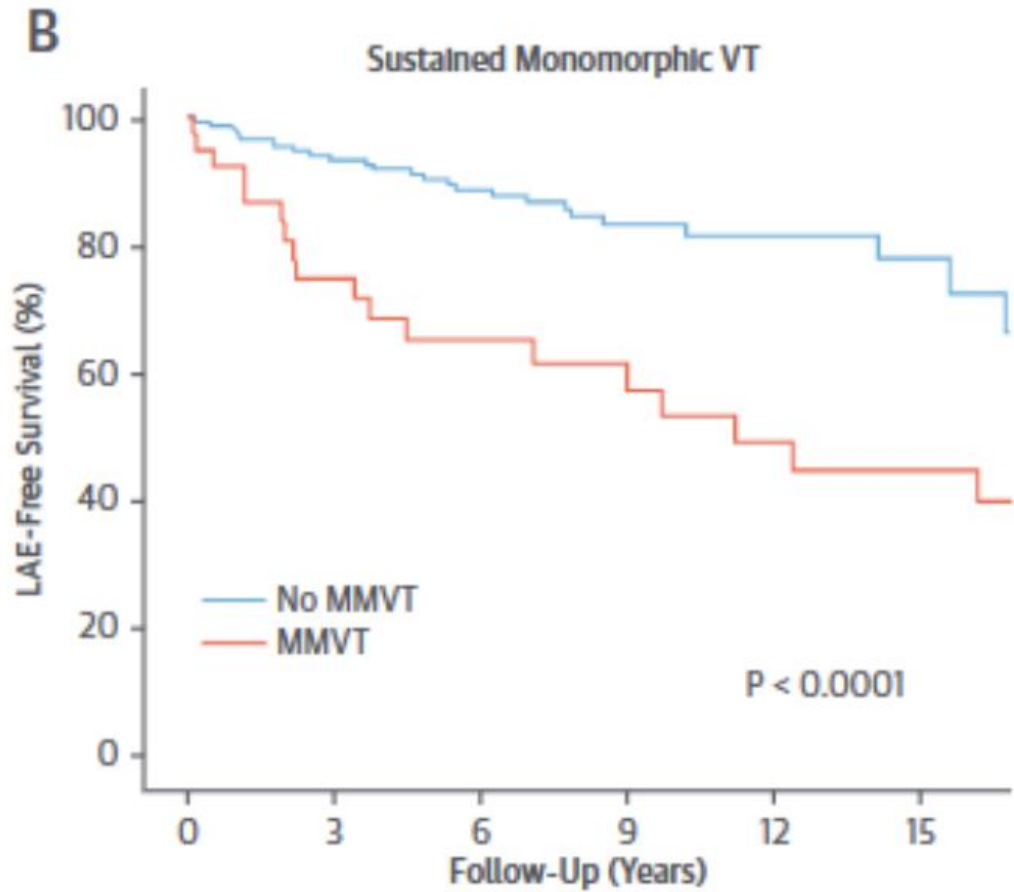
**BACKGROUND** Arrhythmogenic right ventricular cardiomyopathy (ARVC) is a leading cause of sudden cardiac death, but its progression over time and predictors of arrhythmias are still being defined.

**OBJECTIVES** This study sought to describe the clinical course of ARVC and occurrence of life-threatening arrhythmic events (LAE) and cardiovascular mortality; identify risk factors associated with increased LAE risk; and define the response to therapy.

**METHODS** We determined the clinical course of 301 consecutive patients with ARVC using the Kaplan-Meier method adjusted to avoid the bias of delayed entry. Predictors of LAE over 5.8 years of follow-up were determined with Cox multivariable analysis. Treatment efficacy was assessed comparing LAE rates during matched time intervals.



No Syncope	240	144	109	65	40	19
Syncope	27	14	9	8	5	5



No MMVT	228	134	100	59	34	15
MMVT	39	24	18	14	11	9

**TABLE 3 Predictors of Arrhythmic Risk at Follow-Up**

Risk Factor	Univariable Analysis*			Multivariable Analysis*		
	$\beta$ (SE)	HR (95% CI)	p Value†	$\beta$ (SE)	HR (95% CI)	p Value
Male	1.01 (0.36)	2.76 (1.37-5.56)	0.005	0.91 (0.36)	2.49 (1.22-5.07)	0.012
Family history of unexplained sudden death	-0.05 (0.30)	0.95 (0.52-1.73)	0.872	—	—	—
Atrial fibrillation	1.26 (0.48)	3.51 (1.38-8.93)	0.008	1.48 (0.48)	4.38 (1.70-11.29)	0.002
History of syncope	1.51 (0.31)	4.54 (2.48-8.34)	<0.001	1.21 (0.34)	3.36 (1.71-6.60)	<0.001
History of HT-MMVT	1.21 (0.30)	3.37 (1.87-6.07)	<0.001	0.79 (0.35)	2.19 (1.12-4.32)	0.023
Participation in strenuous exercise	1.06 (0.48)	2.90 (1.14-7.38)	0.026	1.09 (0.50)	2.98 (1.12-7.90)	0.028
Age at presentation $\leq 20$ yrs vs. $>40$ yrs	-0.36 (0.57)	0.70 (0.23-2.14)	0.530	—	—	—
Age at presentation 21-40 yrs vs. $>40$ yrs	1.07 (0.33)	2.91 (1.51-5.58)	0.001	—	—	—
Proband status‡	1.26 (0.39)	3.54 (1.65-7.59)	0.001	—	—	—
Negative T waves in leads V <sub>1</sub> -V <sub>3</sub>	0.48 (0.31)	1.62 (0.88-2.99)	0.121	—	—	—
Nonsustained VT	0.34 (0.30)	1.40 (0.78-2.51)	0.256	—	—	—
PVC count $>1,000$ /day	0.01 (0.39)	1.01 (0.47-2.18)	0.984	—	—	—

HT-MMVT ; hemodynamically tolerated sustained monomorphic ventricular tachycardia



CONTEMPORARY REVIEW

# Predicting arrhythmic risk in arrhythmogenic right ventricular cardiomyopathy: A systematic review and meta-analysis



Heart Rhythm 2018;15:1097–1107

Laurens P. Bosman, MD,<sup>\*†</sup> Arjan Sammani, BSc,<sup>†</sup> Cynthia **45 studies (median cohort size of 70 patients)**  
Julia Cadrin-Tourigny, MD,<sup>‡||</sup> Hugh Calkins, MD, FHRS,<sup>‡</sup> **median follow-up of 5.0 years**  
J. Peter van Tintelen, MD, PhD,<sup>\*§</sup> Richard N.W. Hauer, M.D.,<sup>||</sup>  
Folkert W. Asselbergs, MD, PhD,<sup>\*†¶</sup> Anneline S.J.M. te Riele, MD, PhD<sup>\*†¶</sup>

*From the <sup>\*</sup>Netherlands Heart Institute, Utrecht, The Netherlands, <sup>†</sup>Division Heart and Lungs, Department of Cardiology, University Medical Center Utrecht, University of Utrecht, Utrecht, The Netherlands, <sup>‡</sup>Division of Cardiology, Department of Medicine, Johns Hopkins University, Baltimore, Maryland, <sup>§</sup>Department of Clinical Genetics, Academic Medical Center, University of Amsterdam, Amsterdam, The Netherlands, <sup>||</sup>Montreal Heart Institute, University of Montreal, Montreal, Quebec, Canada, and <sup>¶</sup>Institute of Cardiovascular Science, Faculty of Population Health Sciences, University College London, London, United Kingdom.*

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While many studies evaluate predictors of ventricular arrhythmias in arrhythmogenic right ventricular cardiomyopathy (ARVC), a systematic review consolidating this evidence is currently lacking. There-

predictors—inducibility during electrophysiology study and strenuous exercise—were identified; and with mutation carriers, all aforementioned predictors as well as ventricular ectopy, multiple

● = cohort with definite ARVC patients only (TFC ≥4)    ○ = cohort with at least borderline ARVC patients (TFC ≥3)

Risk factor	Size / events	Studies	Pooled Hazard Ratio, random-effects, 95%CI	p-value	I <sup>2</sup>	References
Demographics	Age, 5 yrs increase	180 / 89	3	1.12 [0.94-1.33]	0.196	15.5 <sup>S6, S19, S38</sup>
		133 / 56	2	0.95 [0.87-1.03]	0.239	0.0 <sup>S11, S37</sup>
	Age <35 yrs	170 / 58	3	0.99 [0.96-1.02]	0.550	0.0 <sup>S11, S22, S23</sup>
	Male sex	617 / 194	7	1.83 [1.41-2.37]	<0.001	0.0 <sup>S6, S11, S19, S22, S23, S24, S38</sup>
342 / 154		4	1.42 [0.91-2.23]	0.124	18.5 <sup>S3, S8, S9, S37</sup>	
Symptoms	Unexplained syncope	509 / 136	5	3.67 [2.75-4.9]	<0.001	0.0 <sup>S6, S11, S22, S24, S38</sup>
		147 / 59	2	2.04 [0.39-10.74]	0.401	85.8 <sup>S3, S9</sup>
Family history	Proband status	293 / 60	2	2.01 [0.76-5.33]	0.159	82.4 <sup>S24, S25</sup>
	Family SCD <35 yrs	483 / 123	4	1.25 [0.86-1.8]	0.237	0.0 <sup>S6, S11, S24, S39</sup>
		147 / 59	2	1.21 [0.39-3.8]	0.741	65.0 <sup>S3, S9</sup>
Arrhythmia	>1000 PVC/24h	299 / 59	2	0.86 [0.45-1.64]	0.640	0.0 <sup>S24, S38</sup>
	Prior non-sustained VT	405 / 84	3	1.54 [1.10-2.15]	0.011	0.0 <sup>S11, S24, S38</sup>
	Prior sustained VT/VF	406 / 104	3	2.05 [1.08-3.88]	0.027	54.5 <sup>S19, S24, S25</sup>



ESC


European Society  
of Cardiology

European Heart Journal (2020) **41**, 1401–1410  
doi:10.1093/eurheartj/ehz570

**FASTTRACK CLINICAL RESEARCH**

*Heart failure/cardiomyopathy*

# High penetrance and similar disease progression in probands and in family members with arrhythmogenic cardiomyopathy

**Monica Chivulescu<sup>1,2</sup>, Øyvind H. Lie<sup>1,2</sup>, Bogdan A. Popescu<sup>3,4</sup>, Helge Skulstad<sup>1,2</sup>, Thor Edvardsen <sup>1,2</sup>, Ruxandra O. Jurcut <sup>3,4</sup>, and Kristina H. Haugaa<sup>1,2\*</sup>**

<sup>1</sup>Faculty of Medicine, Institute of Clinical Medicine, University of Oslo, PO Box 1171 Blindern, 0318 Oslo, Norway; <sup>2</sup>Department of Cardiology, Center for Cardiological Innovation, Oslo University Hospital, Rikshospitalet, PO Box 4950 Nydalen, 0424 Oslo, Norway; <sup>3</sup>Institute for Cardiovascular Diseases C.C. Iliescu, 258, Fundeni street, District 2, 022322 Bucharest Romania; and <sup>4</sup>Carol Davila University of Medicine and Pharmacy, 37, Dionisie Lupu street, District 2, 020021 Bucharest, Romania

Received 13 February 2019; revised 24 May 2019; editorial decision 3 July 2019; accepted 26 July 2019; online publish-ahead-of-print 1 September 2019

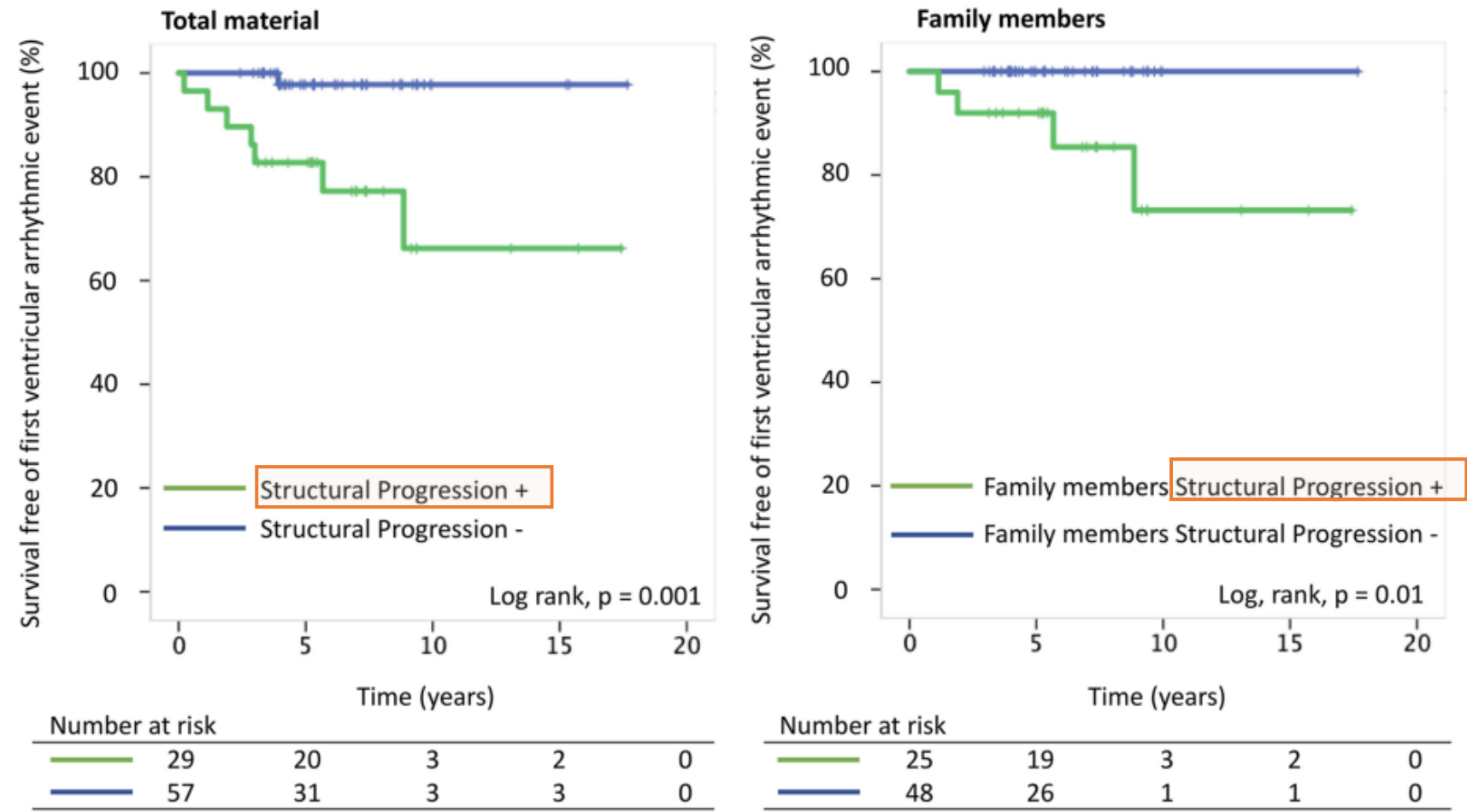
**See page 1411 for the editorial comment on this article (doi: 10.1093/eurheartj/ehz705)**

## **Aims**

We aimed to assess structural progression in arrhythmogenic cardiomyopathy (AC) patients and mutation-positive family members and its impact on arrhythmic outcome in a longitudinal cohort study.

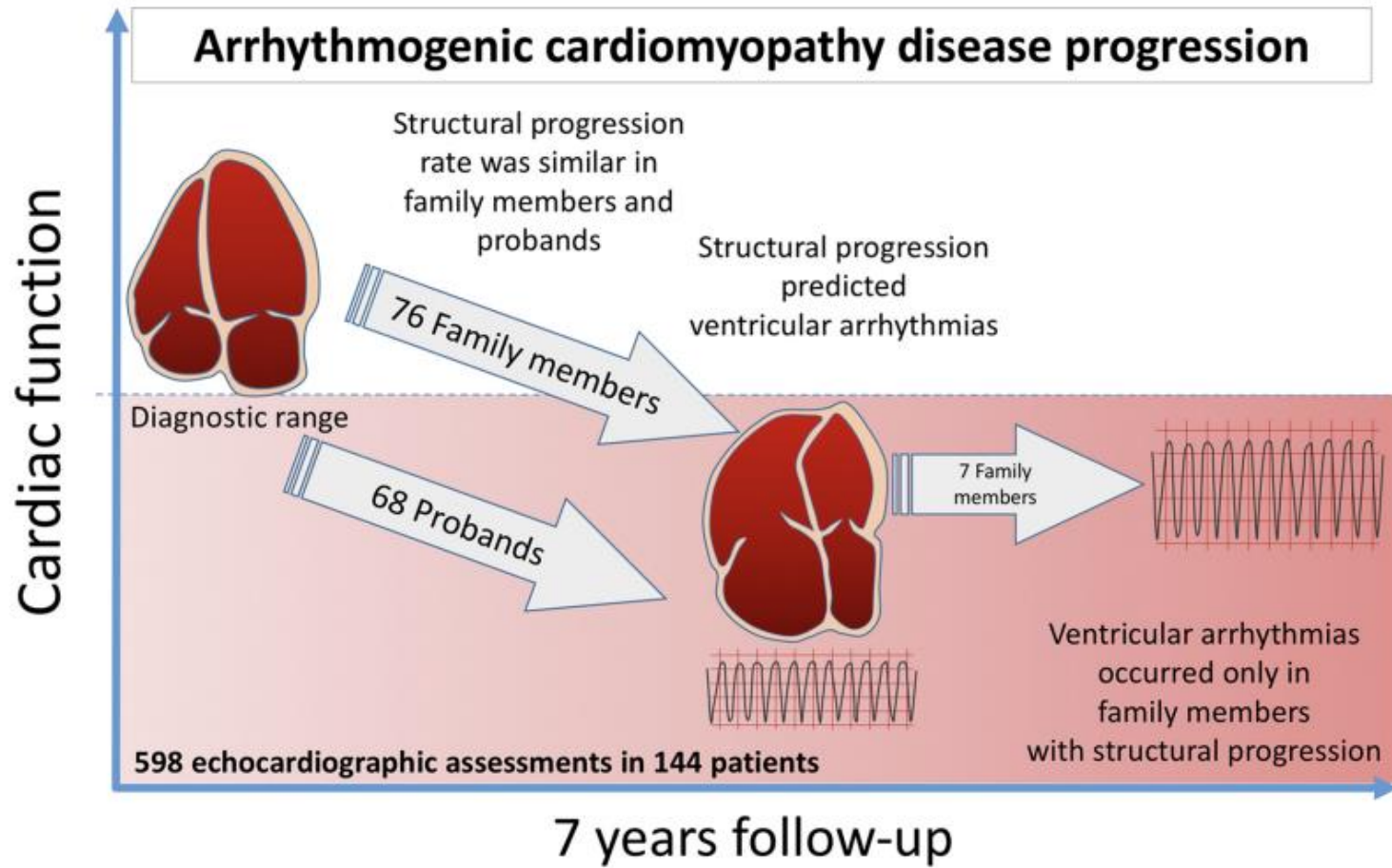
## **Methods and results**

Structural progression was defined as the development of new Task Force imaging criteria from inclusion to follow-up and progression rates as annual changes in imaging parameters. We included 144 AC patients and family members (48% female, 47% probands, 40 ± 16 years old). At genetic diagnosis and inclusion, 58% of family mem-



**Figure 3** Kaplan–Meier curves of survival free from first severe ventricular arrhythmic event in 86 AC patients and in mutation-positive family members only without history of arrhythmia at inclusion. Green curves represent presence and blue curves absence of structural progression during follow-up. First severe arrhythmic event was more frequent in patients with structural progression during follow-up in the total material (left panel) and in family members only (right panel).

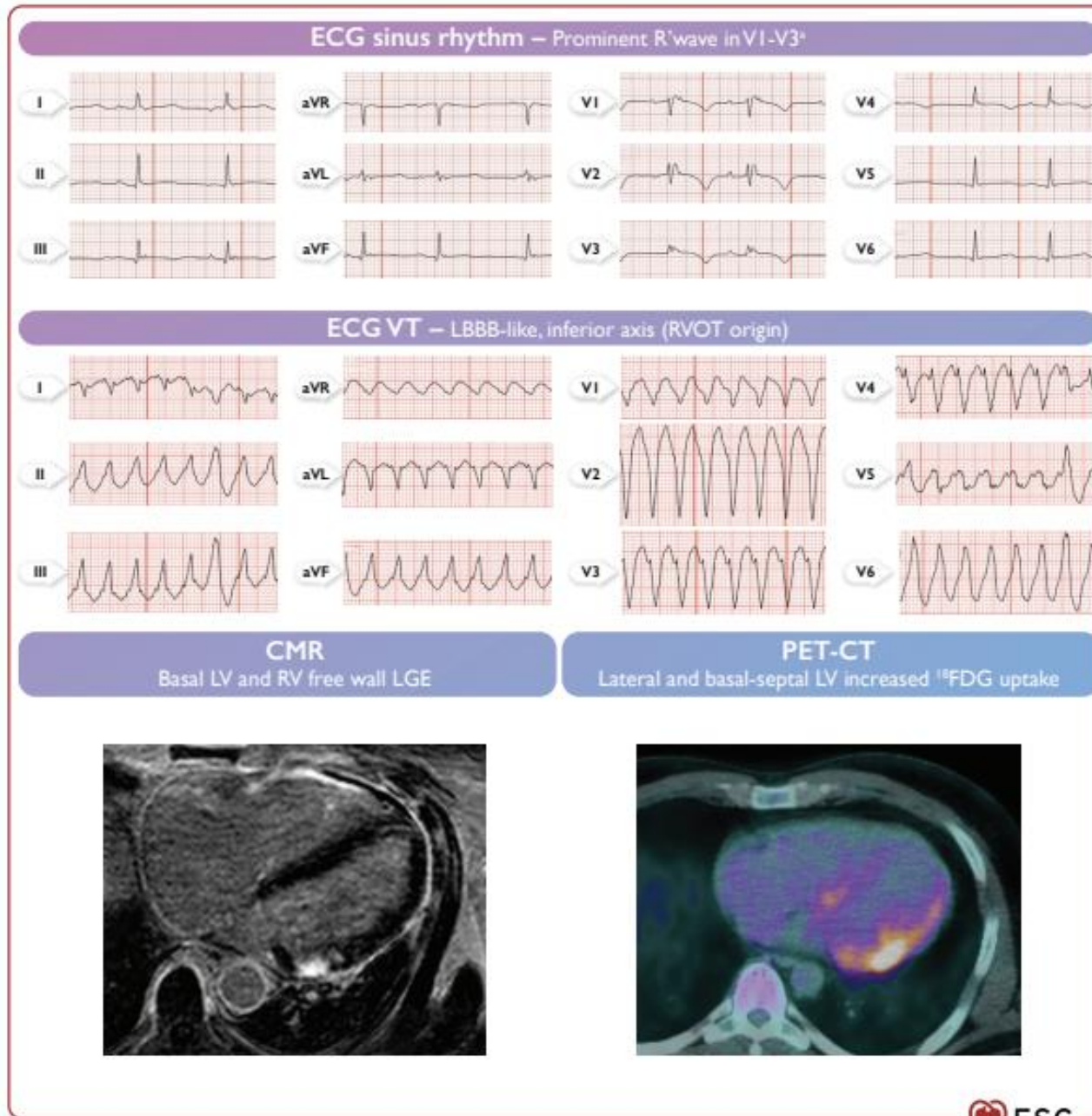




**Take home figure** Arrhythmogenic cardiomyopathy disease progression. Proband and family members with arrhythmogenic cardiomyopathy had similar structural progression rates by linear mixed model statistical analysis of 598 repeated echocardiographic assessments in 144 individuals over 7 years follow-up. Structural progression was associated with higher incidence of first severe arrhythmic events.

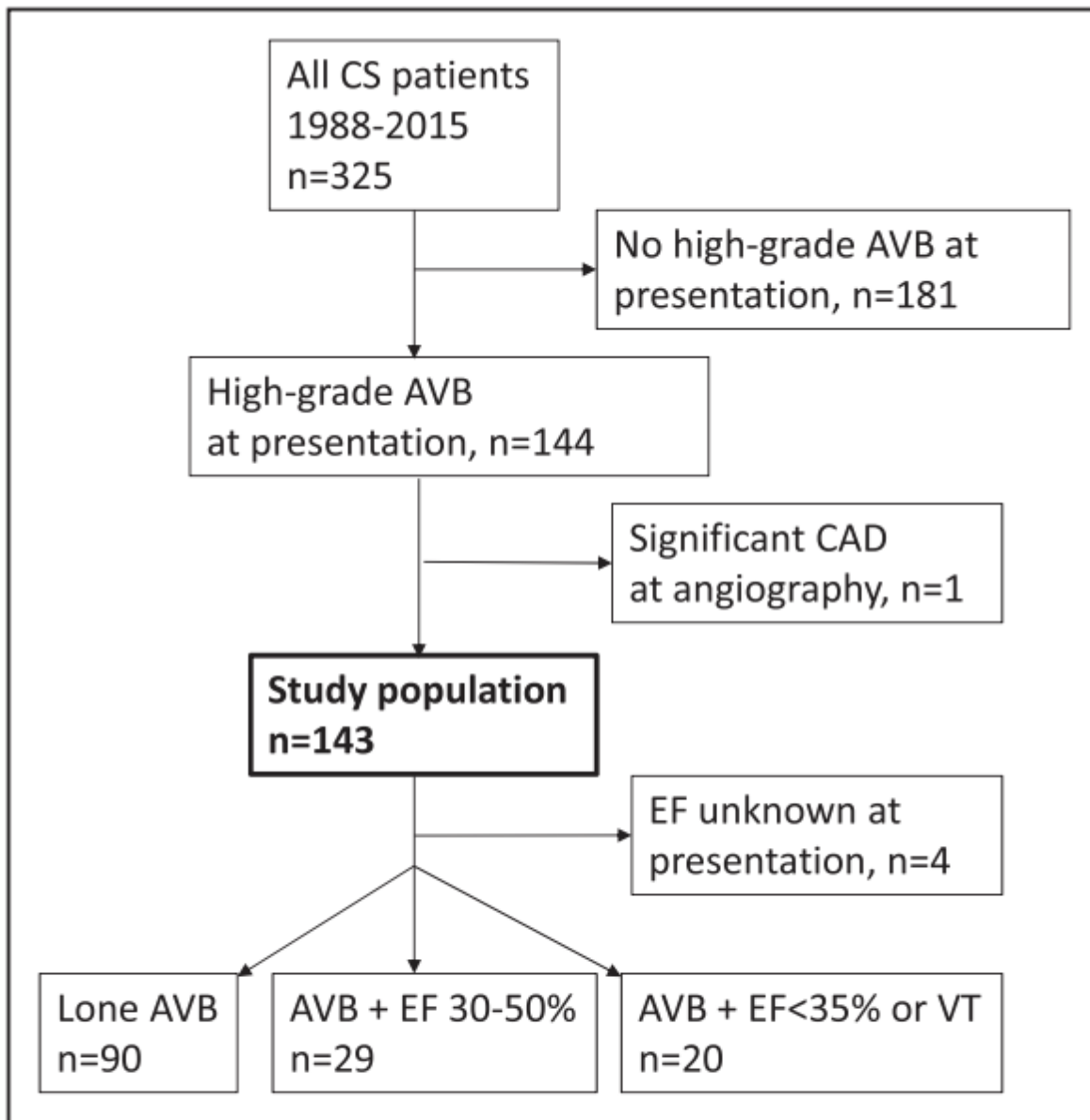


# Cardiac Sarcoidosis



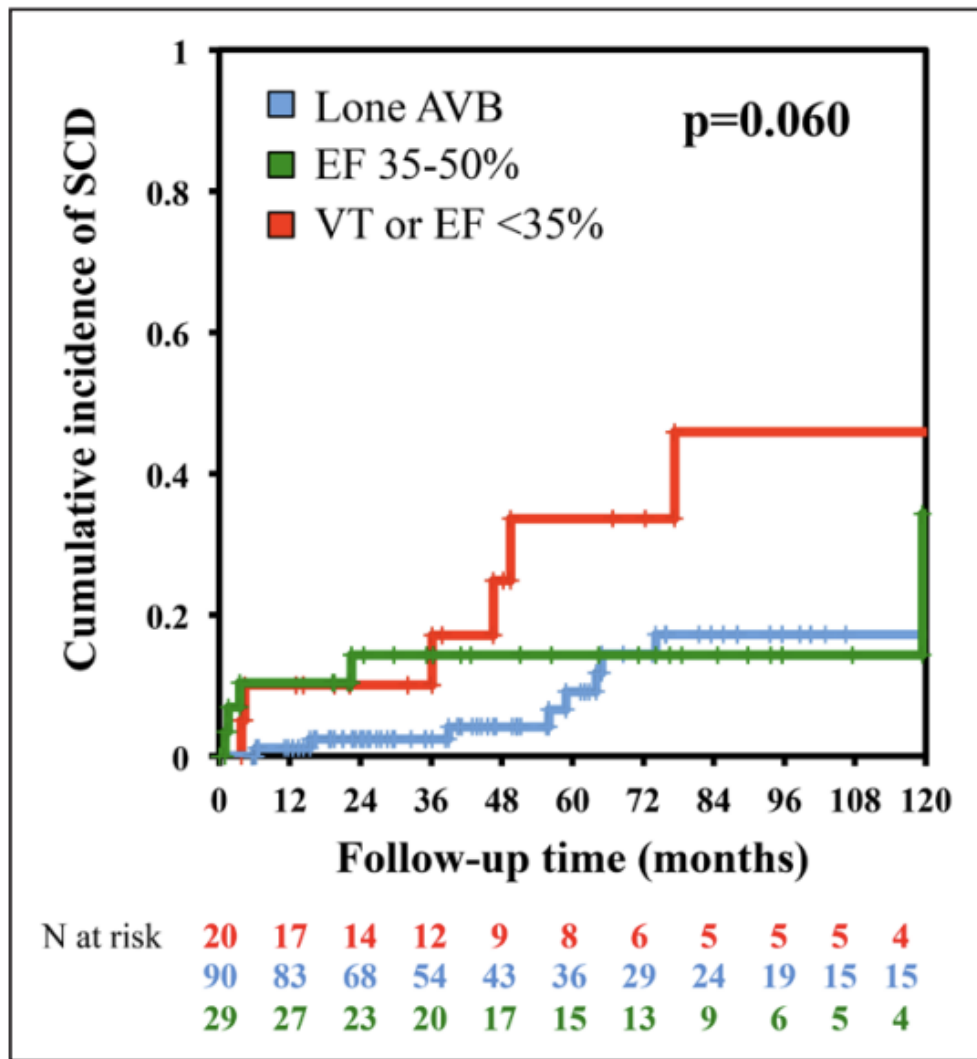
## Inflammatory diseases

In patients with haemodynamically not-tolerated SMVT occurring in the chronic phase of myocarditis, ICD implantation is recommended.	<b>IIa</b>	<b>I</b>
ICD implantation is recommended in patients with cardiac sarcoidosis who have an LVEF $\leq 35\%$ .	<b>IIb</b>	<b>I</b>
ICD implantation is recommended in patients with cardiac sarcoidosis who (1) have documented sustained VT, or (2) aborted CA.	<b>IIb</b>	<b>I</b>
In patients with cardiac sarcoidosis who have an indication for permanent cardiac pacing related to high-degree AV block, ICD implantation should be considered, regardless of LVEF.	<b>IIb</b>	<b>IIa</b>
In patients with Chagas' cardiomyopathy and symptomatic VT in whom AADs (amiodarone and beta-blockers) are ineffective or not tolerated, ICD implantation may be considered.	<b>IIa</b>	<b>IIb</b>

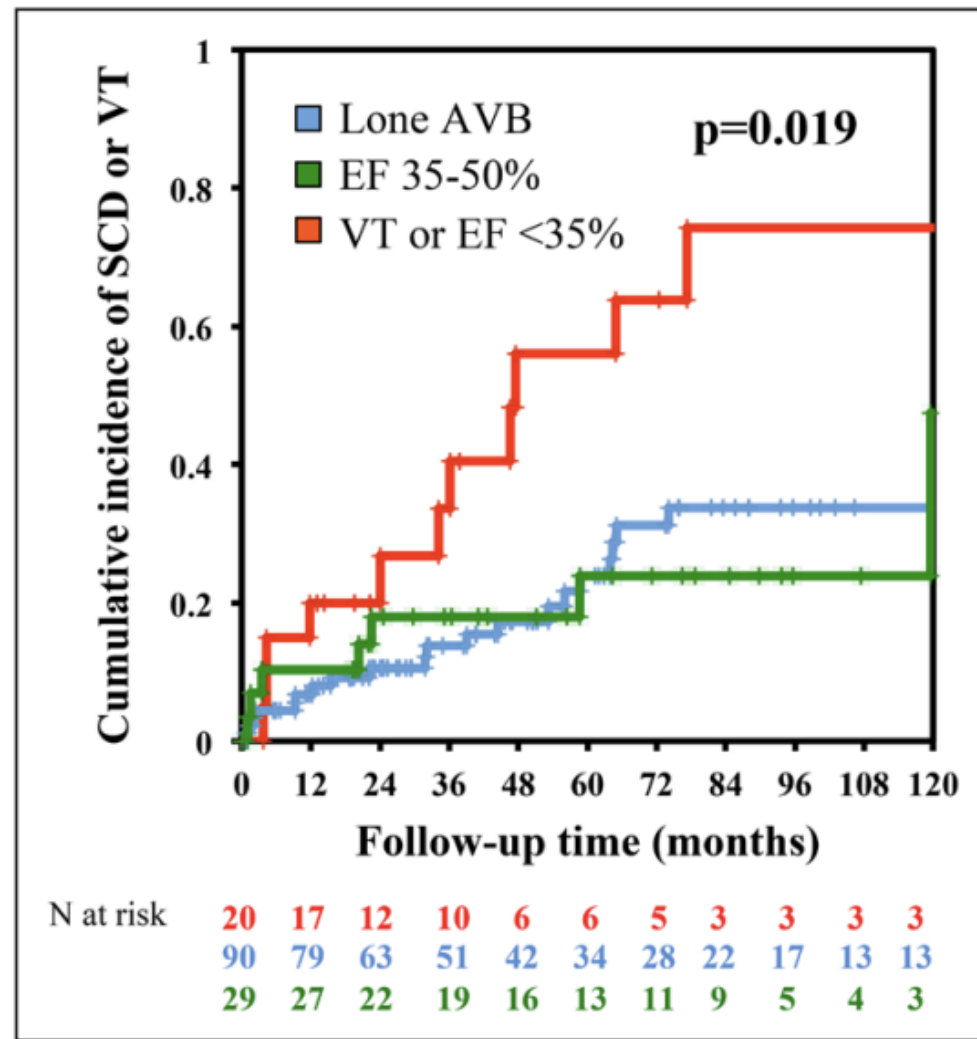


**Figure 1.** Flow diagram showing the selection of the study population and its division into subgroups by cardiac manifestations and left ventricular ejection fraction (EF) at presentation.

Circ Arrhythm Electrophysiol  
2018;11(8):e006145.



**Figure 4.** Cumulative incidence of the composite of fatal or aborted sudden cardiac death (SCD) in cardiac sarcoidosis patients presenting with high-grade atrioventricular block (AVB) without other cardiac manifestations (lone AVB), with AVB and nonsevere left ventricular (LV) dysfunction (ejection fraction [EF], 35%–50%), and with AVB and severe LV dysfunction (EF <35%) or ventricular tachycardia (VT).



**Figure 5.** Cumulative incidence of the composite of sudden cardiac death (SCD, fatal or aborted) or ventricular tachycardia (VT) in cardiac sarcoidosis patients with high-grade atrioventricular block (AVB) presenting without other cardiac manifestations (lone AVB), with nonsevere left ventricular (LV) dysfunction (ejection fraction [EF], 35%–50%), and with severe LV dysfunction (EF <35%) or VT.

Part of Study Population	Incidence (95% CI) of SCD		Incidence (95% CI) of SCD or VT	
	1 Year, %	5 Years, %	1 Year, %	5 Years, %
All patients (n=143)	4 (2–9)	17 (11–27)	9 (6–16)	31 (23–42)
AVB+VT and EF <35% (n=20)	10 (3–37)	34 (16–71)	20 (8–48)	56 (36–88)
AVB+EF 35%–50% (n=29)	10 (4–30)	14 (6–35)	10 (4–30)	24 (12–49)
Lone AVB (n=90)	1 (0–8)	9 (4–22)	7 (3–15)	24 (15–38)

# Summary

- More interest and affection for Korean Multicenter CIED studies.
- **ARVC: syncope, RV or LV systolic dysfunction → ICD**
- **Cardiac Sarcoidosis: advanced AVB → ICD regardless of EF**



경청해 주셔서 감사합니다.

2023

춘계심혈관  
통합학술대회

4.21(Fri.) ~ 22(Sat.)  
김대중컨벤션센터, 광주