

**Conduction System Pacing  
Summer Summit Berlin  
13./14.06.2025**

# **History of Physiologic Pacing**

P. Nagel

# Pacing through the decades

- 1925 – Effects of Ventricular Pacing

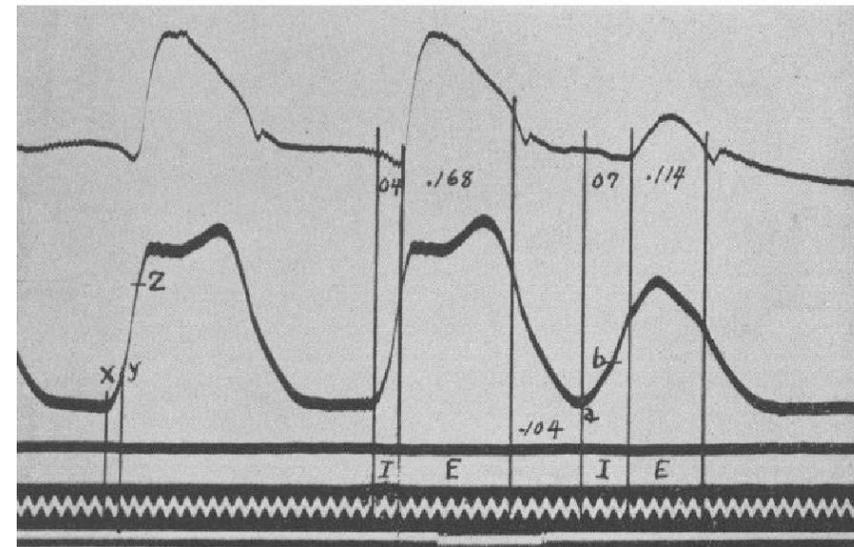
TABLE 2

EXPERIMENT	AFTER END OF SYSTOLE	REACTION	DIASTOLIC PRESSURE	EFFECTIVE VENOUS PRESSURE
C 217 VI	0.108	Ineffective	73	
	0.12	Just effective	73	
C 218 XII	0.105	Ineffective	64	
	0.18	Very effective	67	
C 265 VI	0.11	Ineffective	81	
C 268 IV	0.148	Almost effective	68	
	0.178	Very effective	68	
C 268 VII	0.09	Ineffective	60	
	0.14	Very effective	33	
	0.108	Ineffective	46	
C 270 XI	0.098	Just effective	73	
	0.069	Just effective	29	
C 320	0.098	Ineffective	55	
	0.131	Almost effective	?	
C 321 XI	0.094	Ineffective	48	
	0.098	Just effective	43	
	0.132	Very effective	43	
C 322 III	0.105	Almost effective		
	0.115	Almost effective		
	0.098	Ineffective		
C 323 V a	0.108	Barely effective	57	60
	0.112	Not effective	78	83
VI a	0.122	Just effective	81	83
	0.117	Just effective	59	75
C 324 II b	0.100	Not effective		80
	0.114	Quite effective		80
C 330 XVIII	0.12	Not effective		
	0.135	Quite effective	Same	Same

DOI: 10.1152/AJPLEGACY.1925.73.2.346 • Corpus ID: 14476149

## THE MUSCULAR REACTIONS OF THE MAMMALIAN VENTRICLES TO ARTIFICIAL SURFACE STIMULI

C. Wiggers • Published 1 July 1925 • Medicine • American Journal of Physiology



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# Pacing through the decades

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- 1960s – Ventricular Pacing ,on demand' (Berkovits / Davies)

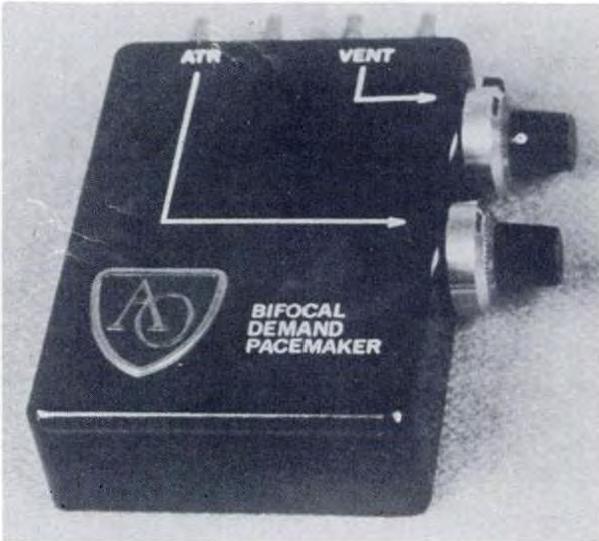
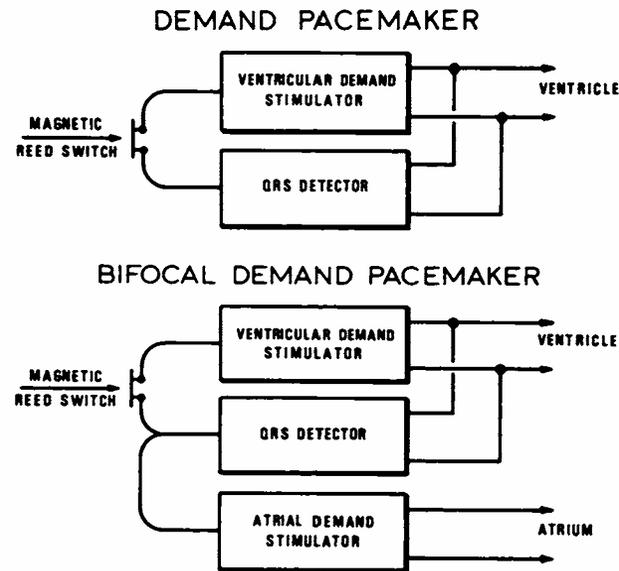
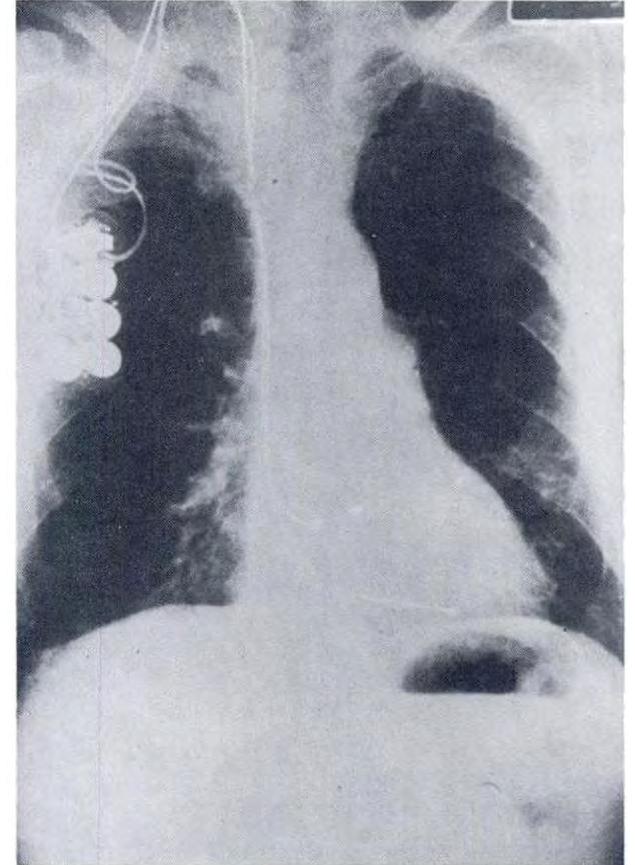


FIGURE 3. External unit used for temporary bifocal demand pacing.



BIFOCAL DEMAND PACING



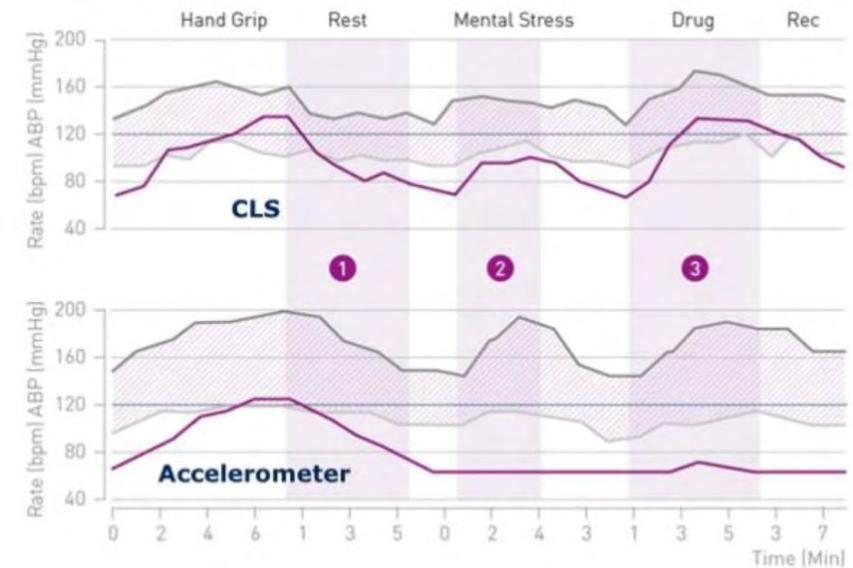
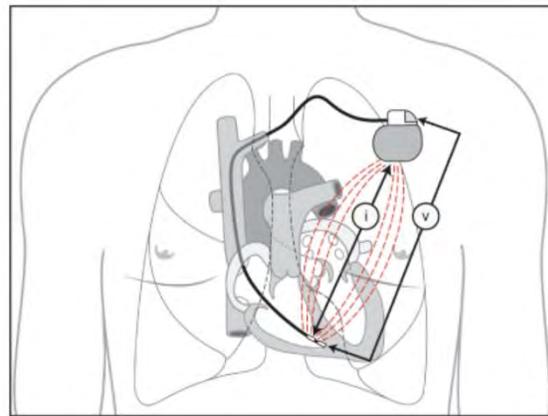
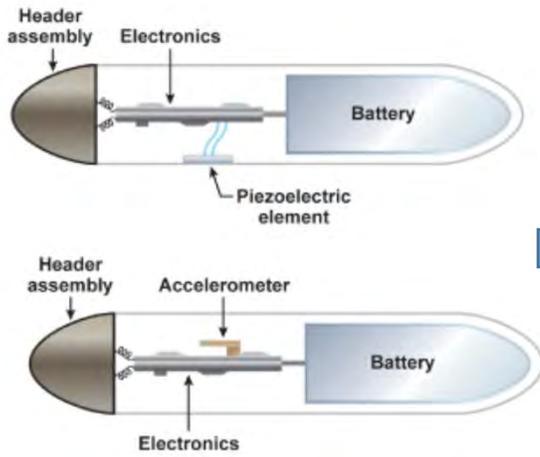
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- 1980s – Sensor triggered Rate Response



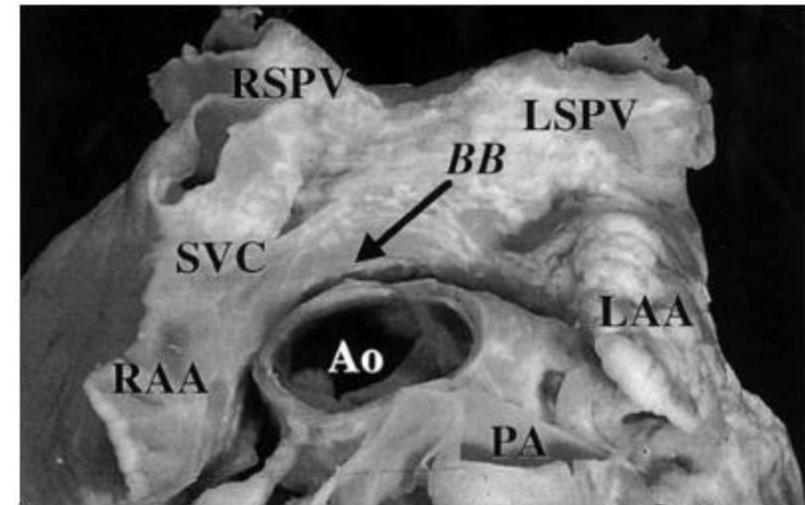
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- 2000 – Bachman-Bundle Pacing for Afib-Prevention

## Prevention of Chronic Atrial Fibrillation by Pacing in the Region of Bachmann’s Bundle: Results of a Multicenter Randomized Trial

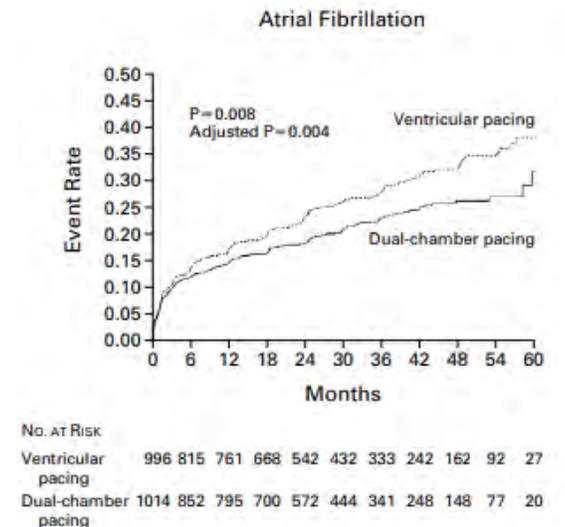
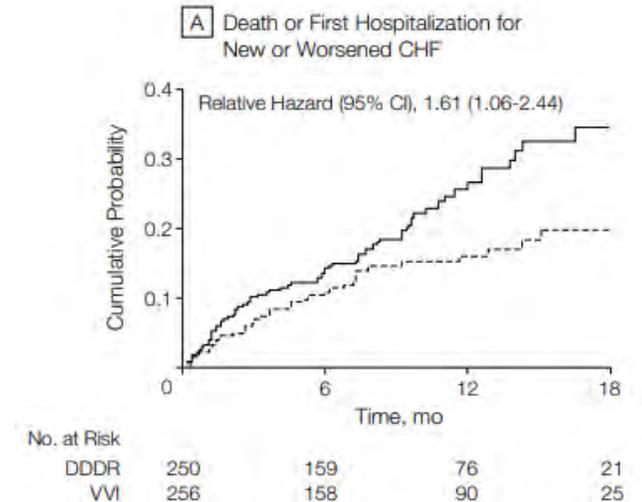
STEVEN J. BAILIN, M.D., STUART ADLER, M.D.,\* and MICHAEL GIUDICI, M.D.†

From the Iowa Heart Center, Des Moines, Iowa; the \*St. Paul Heart Institute, St. Paul, Minnesota; and the †Division of Cardiology, Genesis Medical Center, Davenport, Iowa



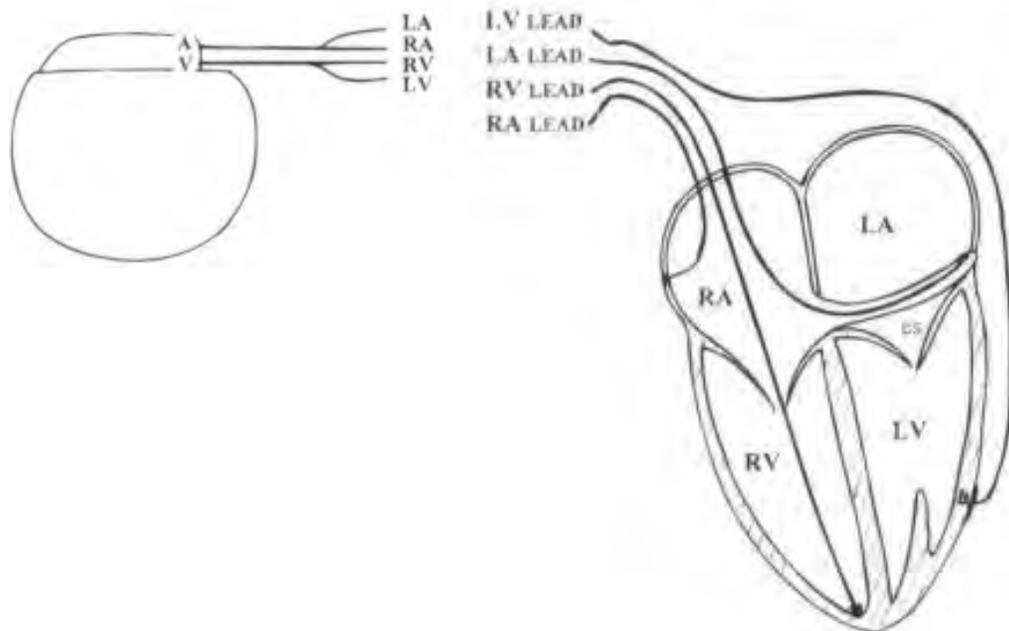
# Pacing through the decades

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- 1980s – Sensor triggered Rate Response
- 2000 – Bachman-Bundle Pacing for Afib-Prevention
- 2002 – Negative Effects of RV-Pacing (DAVID / MOST)



# Pacing for HF – Age of CRT

- 1994 – Bivent-Pacing in acute HF



## Four Chamber Pacing in Dilated Cardiomyopathy

S. CAZEAU, P. RITTER, S. BAKDACH, A. LAZARUS, M. LIMOUSIN,\*  
L. HENAO, O. MUNDLER,\*\* J.C. DAUBERT,† and J. MUGICA

*and disappearance of peripheral edema. His functional class was reduced to NYHA II. Four chamber pacing is technically feasible. In patients with evidence of interventricular dyssynchrony, this original pacing mode probably provides a mechanical activation sequence closer to the natural one. We doubt that this technique will have an impact on long-term survival, but it could be of major importance to improve the patient's well-being and control heart failure. (PACE 1994; 17(Pt. II):1974–1979)*

# Pacing for HF – Age of CRT

- 1994 – Bivent-Pacing in acute HF
- Late 1990ies – Bivent-Pacing as standardized therapy in HF with wide QRS

**BIVENTRICULAR PACING IN PATIENTS WITH HEART FAILURE AND INTRAVENTRICULAR CONDUCTION DELAY**

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**EFFECTS OF MULTISITE BIVENTRICULAR PACING IN PATIENTS WITH HEART FAILURE AND INTRAVENTRICULAR CONDUCTION DELAY**

SERGE CAZEAU, M.D., CHRISTOPHE LECLERCO, M.D., THOMAS LAVERGNE, M.D., STUART WALKER, M.D.,  
CHETAN VARMA, M.D., CECILIA LINDE, M.D., STÉPHANE GARRIGUE, M.D., LUKAS KAPPENBERGER, M.D.,  
GUY A. HAYWOOD, M.D., MASSIMO SANTINI, M.D., CHRISTOPHE BAILLEUL, PH.D., AND JEAN-CLAUDE DAUBERT, M.D.,  
FOR THE MULTISITE STIMULATION IN CARDIOMYOPATHIES (MUSTIC) STUDY INVESTIGATORS\*

Published March 22, 2001 | N Engl J Med 2001;344:873-880 | DOI: 10.1056/NEJM200103223441202

The New England  
Journal of Medicine

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VOLUME 346

JUNE 13, 2002

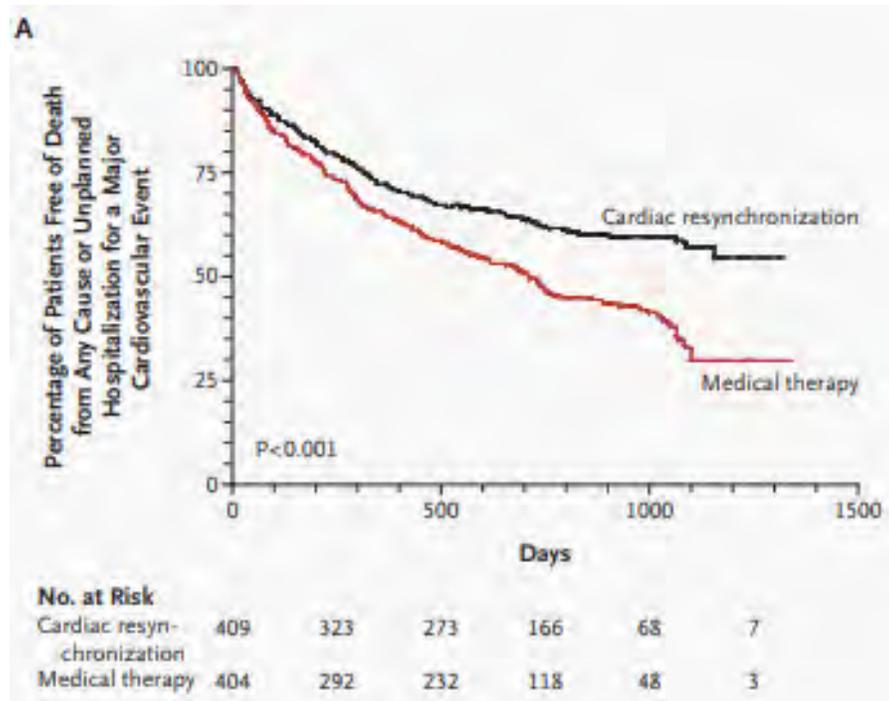
NUMBER 24

**CARDIAC RESYNCHRONIZATION IN CHRONIC HEART FAILURE**

WILLIAM T. ABRAHAM, M.D., WESTBY G. FISHER, M.D., ANDREW L. SMITH, M.D., DAVID B. DELURGIO, M.D.,  
ANGEL R. LEON, M.D., EVAN LOH, M.D., DUSAN Z. KOCOVIC, M.D., MILTON PACKER, M.D., ALFREDO L. CLAVELL, M.D.,  
DAVID L. HAYES, M.D., MYRVIN ELLESTAD, M.D., AND JOHN MESSENGER, M.D., FOR THE MIRACLE STUDY GROUP\*

# Pacing for HF – Age of CRT

- 1994 – Bivent-Pacing in acute HF
- Late 1990ies – Bivent-Pacing as standardized therapy in HF with wide QRS
- 2005 – Mortality Reduction with Bivent-Pacing



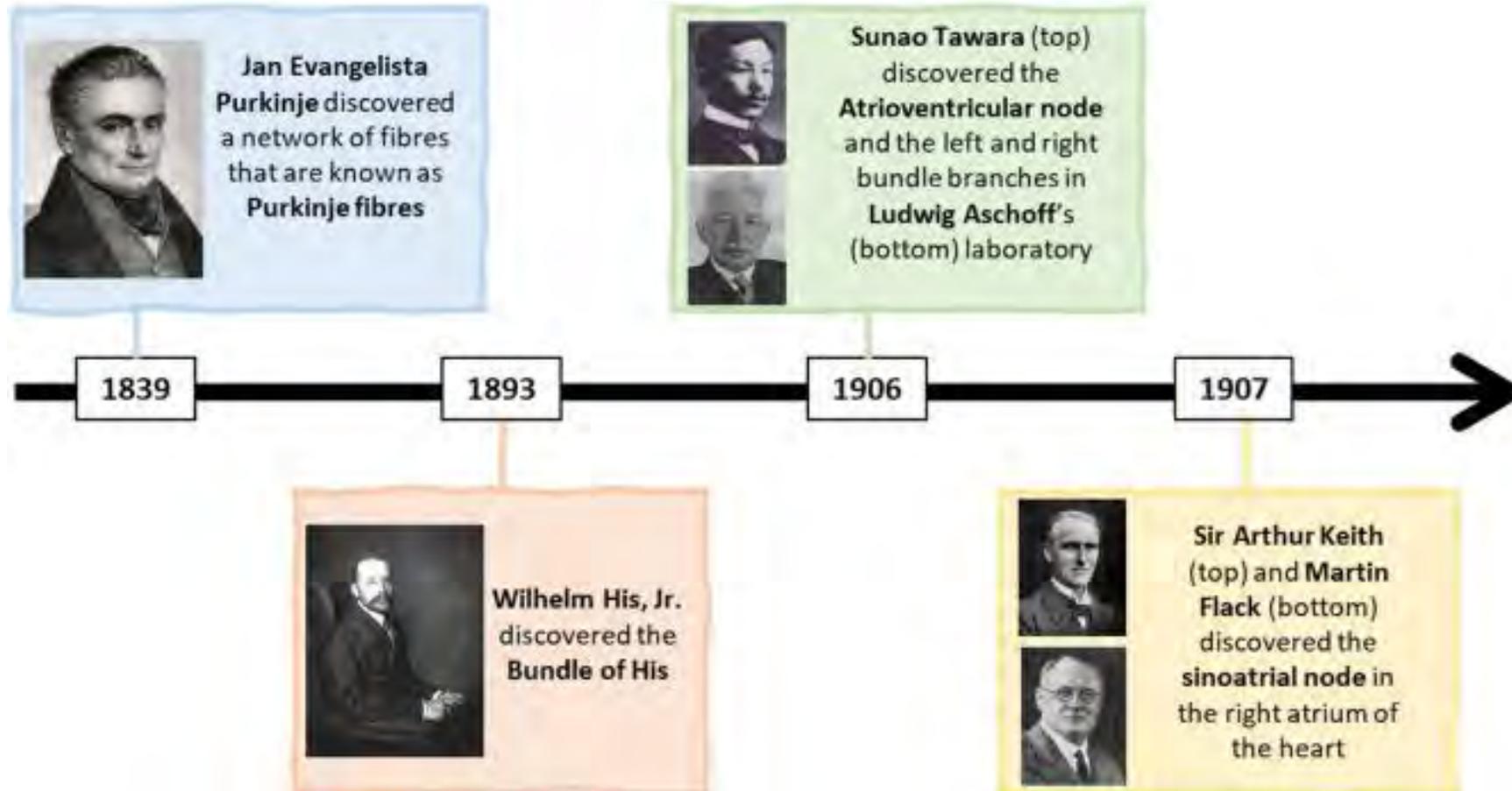
THE NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

## The Effect of Cardiac Resynchronization on Morbidity and Mortality in Heart Failure

John G.F. Cleland, M.D., Jean-Claude Daubert, M.D.,  
Erland Erdmann, M.D., Nick Freemantle, Ph.D., Daniel Gras, M.D.,  
Lukas Kappenberger, M.D., and Luigi Tavazzi, M.D.,  
for the Cardiac Resynchronization—Heart Failure (CARE-HF) Study Investigators\*

# Pacing the Conduction System



# Pacing the Conduction System

- 1967 – First attempts in Pacing the HIS-Bundle

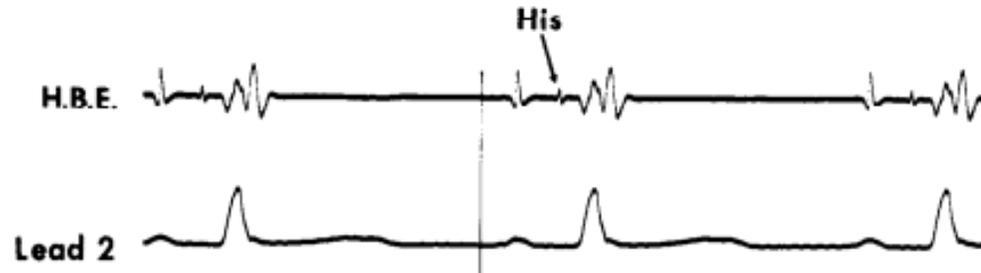


FIG. 1. Bipolar electrogram (above) recorded from wires placed in area of His bundle, recorded simultaneously with lead II (below). Note the sharp His spike occurring between the atrial and ventricular complexes. (Paper speed is 200 mm./sec.; entire strip is 1 sec.)



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## SPECIAL COMMUNICATIONS

### A technique for ventricular pacing from the His bundle of the intact heart<sup>1</sup>

BENJAMIN J. SCHERLAG, BERNARD D. KOSOWSKY,  
AND ANTHONY N. DAMATO  
*Cardiopulmonary Laboratory, US Public Health Service Hospital,  
Staten Island, New York*

SCHERLAG, BENJAMIN J., BERNARD D. KOSOWSKY, AND ANTHONY N. DAMATO. *A technique for ventricular pacing from the His bundle of the intact heart.* J. Appl. Physiol. 22(3): 584-587. 1967.—A technique for ventricular pacing by His bundle stimulation of the intact heart is described. After thoracotomy fine Teflon-coated stainless steel wires are inserted into the His bundle without cardiomy. Recording of His bundle activity can thus be accomplished as well as pacing of the ventricles from the same site. In contrast to direct stimulation of the ventricles, pacing of the His bundle produces no change in the amplitude, configuration, or duration of ventricular activity recorded in the peripheral electrocardiograms or in ventricular electrograms from random sites. Ventricular pacing of the intact heart can be performed acutely while maintaining normal sequential ventricular activation.

His bundle stimulation; ventricular depolarization; synchronous A-V pacing

SINCE THE INTRODUCTION of techniques for electrical pacing of the heart, a large part of the cardiovascular literature, both experimental and clinical, has involved

function, e.g., cardiac output and rate of development of left ventricular pressure (3, 8, 15). The present investigation describes a method whereby recording from the His bundle or pacing of the ventricles from this site can be performed, without cardiomy. This technique provides a means of pacing the ventricles while maintaining normal sequential ventricular activation. Only a standard thoracotomy and pericardial opening are required. Cardiomy, cardiopulmonary bypass, or inflow occlusion is avoided; thus, the animal can be studied acutely and the hemodynamic responses, although somewhat depressed, are usual for a thoracotomized preparation.

#### METHODS

Eleven mongrel dogs (15-25 kg) were anesthetized with sodium pentobarbital (30 mg/kg, iv). Under controlled ventilation a thoracotomy at the level of the fourth intercostal space was performed and the lateral surface of the right atrium and basal portions of the right ventricle were exposed. The heart was positioned by a pericardial cradle. Specific epicardial and endocardial landmarks were used to locate the His bundle (Fig. 1). The coronary sinus and posterior A-V border were pal-

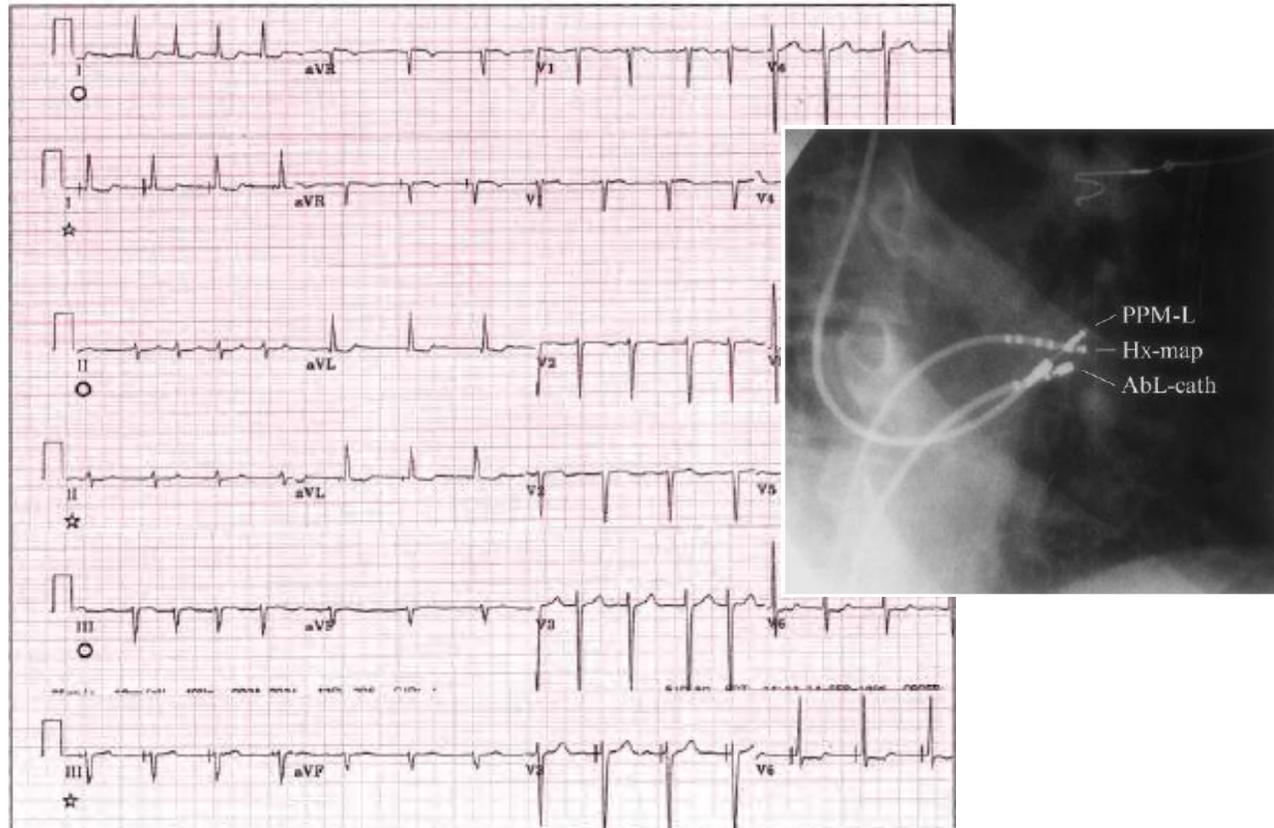
# Pacing the Conduction System

- 1967 – First attempts in Pacing the HIS-Bundle
- 2000 – Permanent direct HBP

*Circulation* February 29, 2000

## Permanent, Direct His-Bundle Pacing A Novel Approach to Cardiac Pacing in Patients With Normal His-Purkinje Activation

Pramod Deshmukh, MD; David A. Casavant, MS;  
Mary Romanyshyn, CRNP; Kathleen Anderson, BSN



### Future Directions

Although direct His bundle pacing was possible in a high number of patients, future studies with better lead designs are warranted to improve the pacing thresholds and success rate of this therapy. Possible improvements might include a longer helix with a steroid-eluting tip, modifications to the shape of permanent pacing leads for easier placement, or the development of lead delivery systems, such as specifically shaped (or multiplane steerable) guiding catheters that have distal mapping electrodes.

# Pacing the Conduction System

- 1967 – First attempts in Pacing the HIS-Bundle
- 2000 – Permanent direct HBP
- 2006 – HBP via steerable Catheter

## **A Feasible Approach for Direct His-Bundle Pacing Using a New Steerable Catheter to Facilitate Precise Lead Placement**

FRANCESCO ZANON, M.D., ENRICO BARACCA, M.D., SILVIO AGGIO, M.D., GIANNI PASTORE, M.D., GRAZIANO BOARETTO, B.S., PAOLA CARDANO, Ph.D.,\* TIZIANA MAROTTA, Ph.D.,\* GIANLUCA RIGATELLI, M.D., F.E.S.C., F.A.C.C., MARIAPAOLA GALASSO, M.D., MAURO CARRARO, M.D., and PIETRO ZONZIN, M.D.

*(J Cardiovasc Electrophysiol, Vol. 17, pp. 29-33, January 2006)*

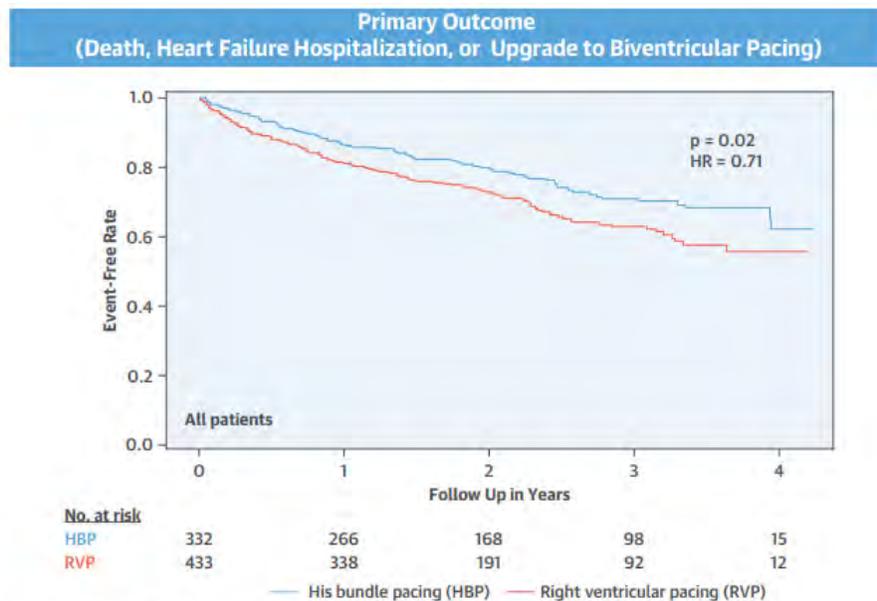
This study showed the reliability of this new lead-delivery system consisting of a steerable catheter for delivering a permanent His-bundle pacing screw-in lead. The implantation procedure is feasible and procedure and fluoroscopy times are satisfactory. Future controlled studies will be needed to evaluate whether this pacing technique can be more widely adopted.

# Pacing the Conduction System

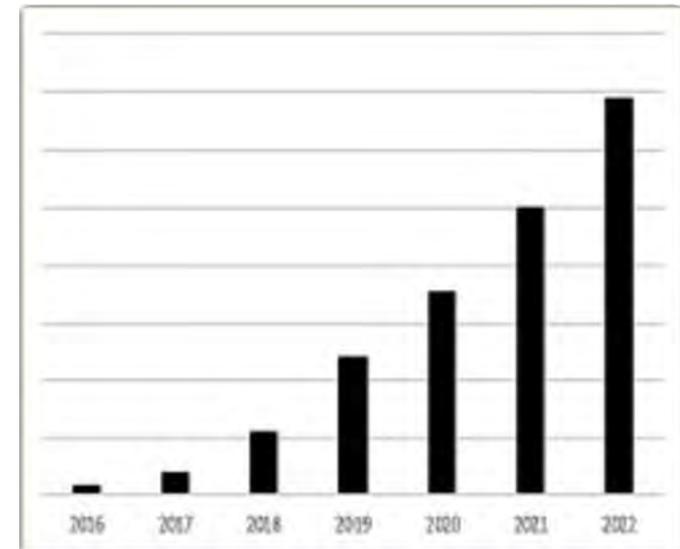
- 1967 – First attempts in Pacing the HIS-Bundle
- 2000 – Permanent direct HBP
- 2006 – HBP via steerable Catheter
- 2016 – Geisinger Registry

## Clinical Outcomes of His Bundle Pacing Compared to Right Ventricular Pacing

Mohamed Abdelrahman, MD,<sup>a</sup> Faiz A. Subzposh, MD,<sup>a</sup> Dominik Beer, DO,<sup>b</sup> Brendan Durr, DO,<sup>b</sup> Angela Naperkowski, RN, CEPS, CCDS,<sup>a</sup> Haiyan Sun, MS,<sup>c</sup> Jess W. Oren, MD,<sup>b</sup> Gopi Dandamudi, MD,<sup>d</sup> Pugazhendhi Vijayaraman, MD<sup>a</sup>



Abdelrahman, M. et al. J Am Coll Cardiol. 2018;71(20):2319-30.



Sales of Medtronic 3830 Lead in Western Europe

# Pacing the Conduction System

- 1967 – First attempts in Pacing the HIS-Bundle
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- 2016 – Geisinger Registry
- 2017 – LBBP Case Study

Canadian Journal of Cardiology 33 (2017) 1736.e1–1736.e3 www.onlinecjc.ca

## Case Report

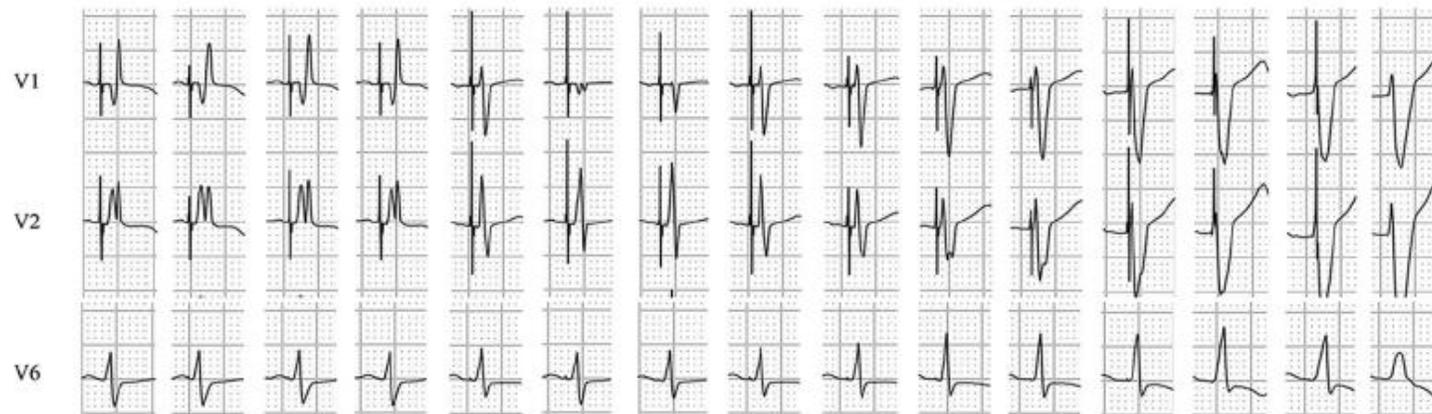
### **A Novel Pacing Strategy With Low and Stable Output: Pacing the Left Bundle Branch Immediately Beyond the Conduction Block**

Weijian Huang, MD, FHRS,<sup>a</sup> Lan Su, MD,<sup>a</sup> Shengjie Wu, MD,<sup>a</sup> Lei Xu, MD,<sup>a</sup> Fangyi Xiao, MD,<sup>a</sup>  
Xiaohong Zhou, MD,<sup>b</sup> and Kenneth A. Ellenbogen, MD, FHRS<sup>c</sup>

<sup>a</sup>Department of Cardiology, First Affiliated Hospital of Wenzhou Medical University, Key Lab of Cardiovascular Disease of Wenzhou, Wenzhou, China

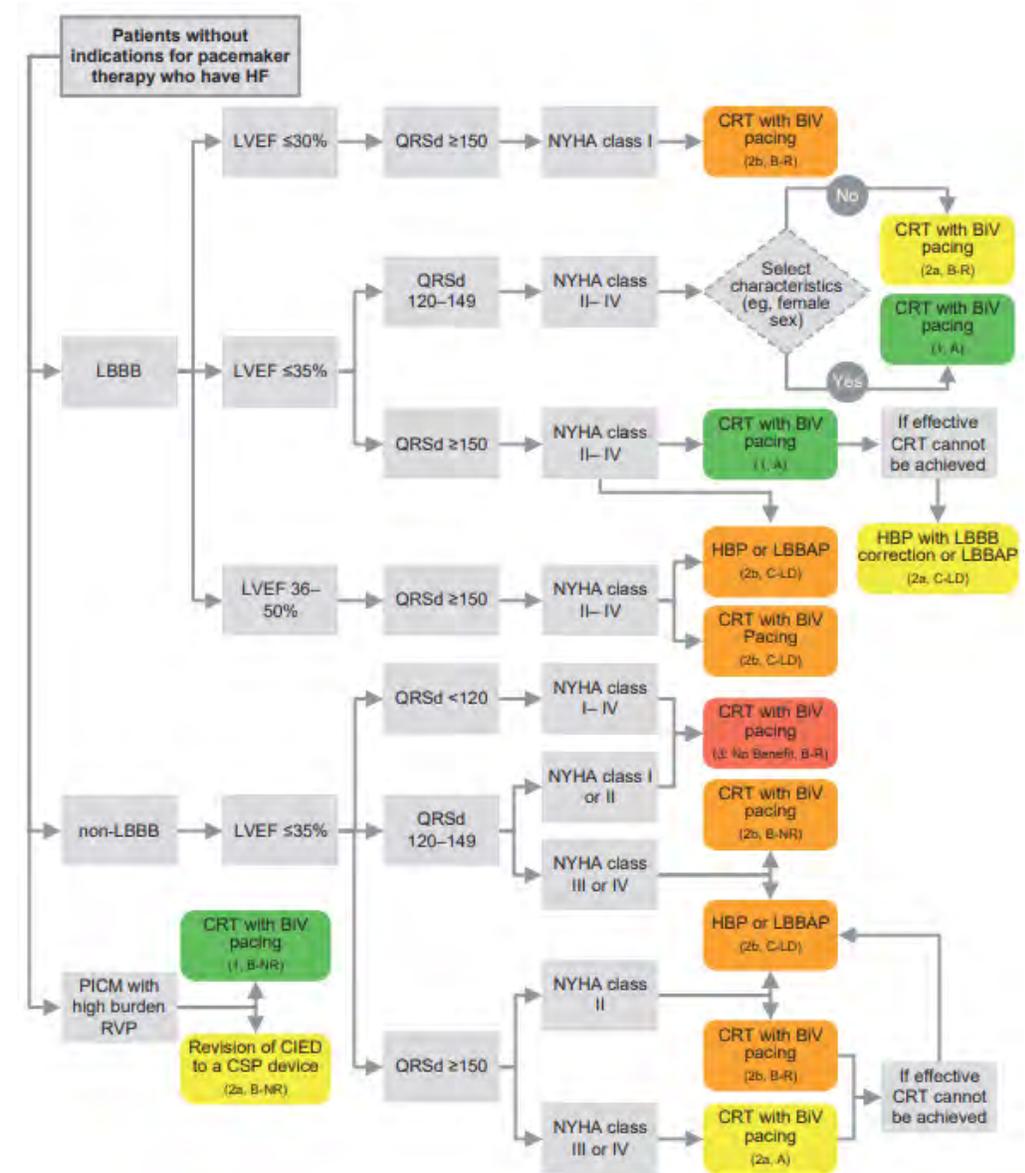
<sup>b</sup>CRHF Division, Medtronic PLC, Mounds View, Minnesota, USA

<sup>c</sup>Department of Cardiology, Virginia Commonwealth University Health System, Richmond, Virginia, USA



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- 2025 – EHRA Consensus Statement on Indications of CSP

# Conclusion

- 1925 – Effects of Ventricular Pacing

100 years of ,physiologic Pacing‘

- 2025 – EHRA Consensus Statement on Indications of CSP

..and we are only getting closer



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DER CHARITÉ

Thank you for your attention!



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