DEUTSCHES HERZZENTRUM
DER CHARITÉ

Florian Blaschke

CSP in Bradycardia Indication

20. May 2023

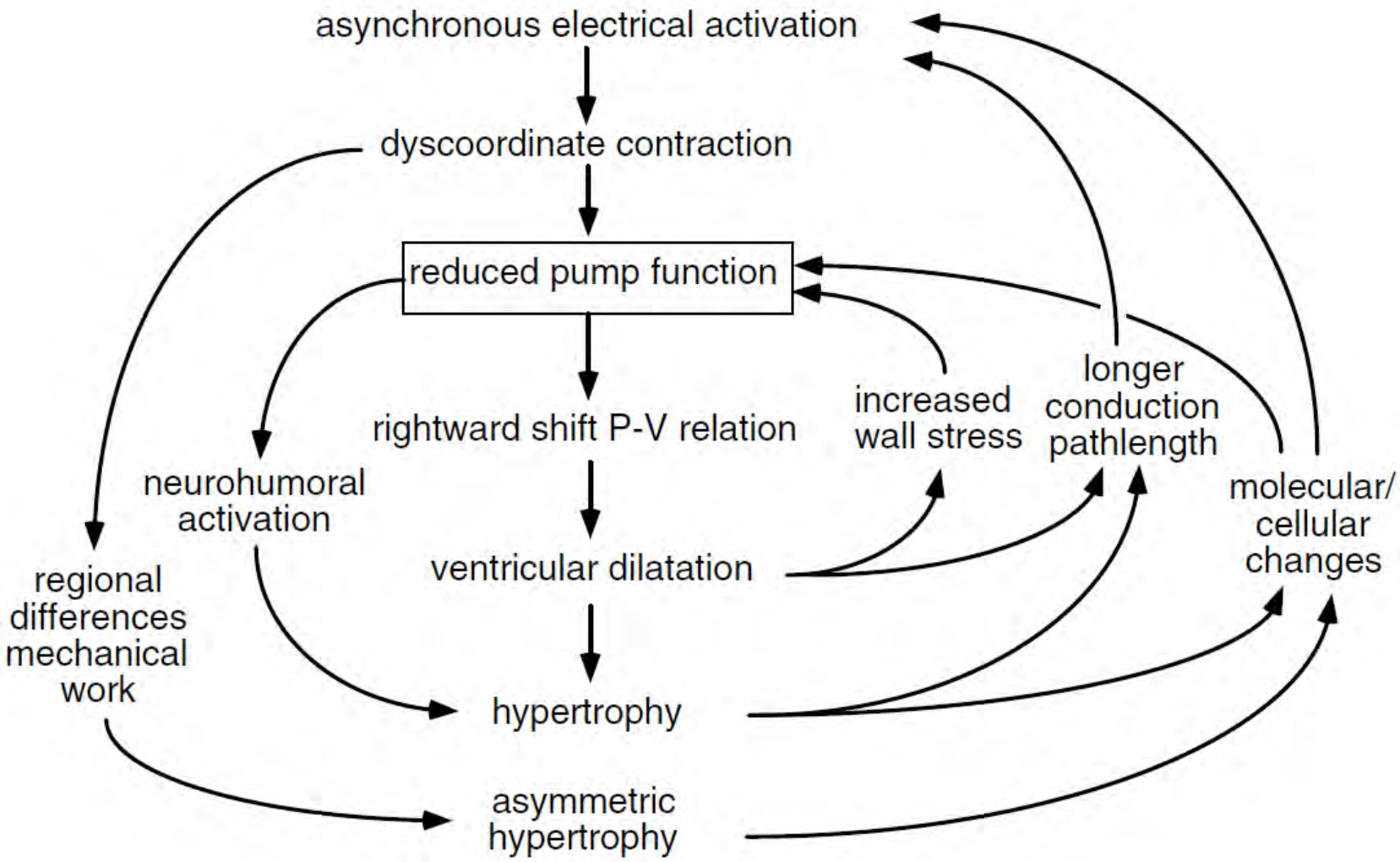
CHARITÉ

WHY we need CSP?

WHEN should we use CSP?

HOW do should we do CSP?

What is Wrong with Right Ventricular Pacing?



Vernooy *et al*., *JICE* 2003

Risk of Developing Pacing Induced Cardiomyopathy

No.	Study	Sample size	Study design			
1	Lee *et al*[21]	234	Retrospective			
2	Kaye *et al*[7]	118	Prospective			
3	Khurshid *et al*[50]	257	Retrospective			
4	Kiehl *et al*[51]	823	Prospective			
5	Kim *et al*[52]	130	Retrospective			
6	Perla *et al*[53]	749	Retrospective			
7	Abdin *et al*[54]	173	Retrospective			
8	Cho *et al*[55]	618	Retrospective			
9	Tayal *et al*[56]	27 704	Retrospective	HF symptoms including fatal HF	10.6%	2

CRT, cardiac resynchronisation therapy; HF, heart failure; LVEF, left ventricular ejection fraction; RV, right ventricle.

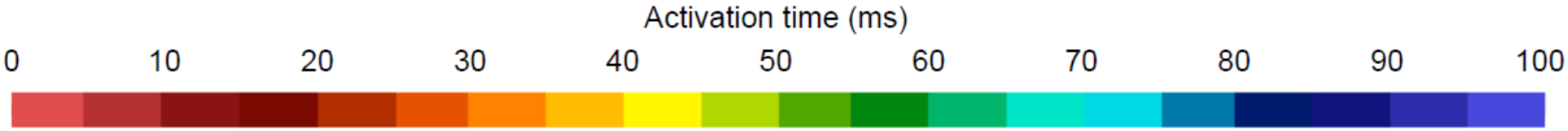
Risk factor	OR	95% CI	P value
Older age	1.62	1.22 to 2.16	0.001
Male sex	1.2	1.12 to 1.35	<0.001
Chronic kidney disease	1.66	1.32 to 2.10	<0.001
Previous myocardial infarction	1.81	1.54 to 2.12	<0.001
Pre-existing AF	1.32	1.23 to 1.42	<0.001
High myocardial scar score	1.23	1.01 to 1.49	0.010
Baseline LVEF	0.95 per 1% increase	0.93 to 0.97	<0.001
Native QRS duration	1.02 per ms increase	1.01 to 1.03	0.005
RV pacing burden	1.02 per 1% increase	1.01 to 1.02	<0.001
Paced QRS duration	1.02 per ms increase	1.01 to 1.03	<0.001

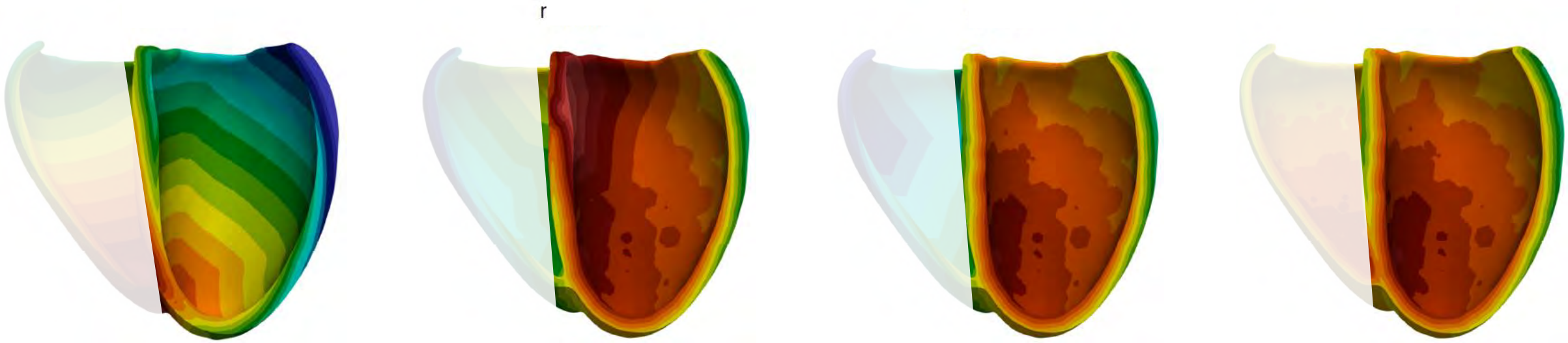
AF, atrial fibrillation; LVEF, left ventricular ejection fraction; RV, right ventricle.

Overall Prevalence: 13% LVEF<50% cutoff: 16% LVEF<40%: 11%

Ponnusamy *et al*., *Heart* 2023

Comparison of Different Pacing Strategies





Right ventricular apical pacing

Non-selective LBBP

Selective LBBP

Selective His-bundle pacing

Conduction System Pacing = Potential to Preserve Physiological Activation

Meiburg *et al*., *Europace* 2003

Conduction System Pacing vs. Right Ventricular Pacing

Randomized Clinical Trials

	Study Group	Study Population	n	Primary Endpoint
Kronborg MB *et al*., 2014	HBP vs RVP	AVB, QRS<120 ms, LVEF>40%	38	LVEF change
Mizner J *et al*., 2023	HBP vs. RVP	AVB, QRS>115 ms, LVEF≤60%	92	LVEF, QRS width
Wang J *et al*., 2020	LBBAP vs. RVP	AVB, LVEF≥50%	131	Depolarization-repolarization reserve
Zhang JM *et al*., 2019	LBBAP vs. RVP	AVB, SND	44	QRS width
Das A et al., 2020	LBBAP vs. RVP	AVB	53	LVEF change, QRS width
Yao L *et al*., 2022	LBBAP vs. RVP	AVB III	50	Left ventricular strain (GLS, GRS, GCS)
Gonzalez-Matos CE *et al*., 2024	CSP vs. RVP	AVB, LVEF>40%, VP burden>80%	75	LVEF change / LVEDD, HF admissions
Curila K *et al.,* 2025	CSP vs RVP	AVB, LVEF>45%	249	LVEF change, CRT upgrade+death+HF hospit.

His / Para-His Pacing vs. Right Ventricular Pacing

Kronborg *et al*., *Europace* 20

Europace (2014) **16**, 1189–1196
doi:10.1093/europace/euu011

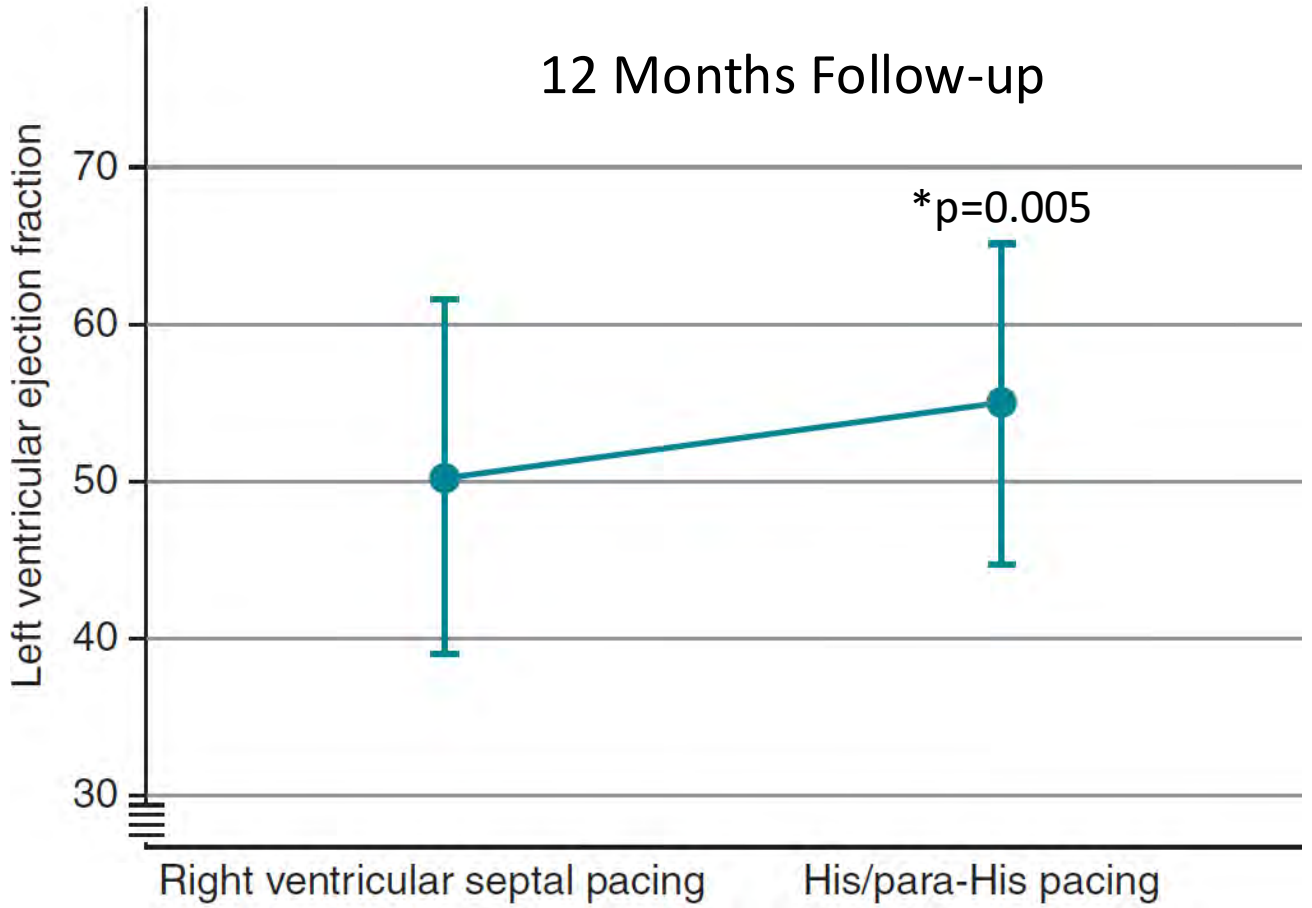
CLINICAL RESEARCH
Pacing and resynchronization therapy

His or para-His pacing preserves left ventricular function in atrioventricular block: a double-blind, randomized, crossover study

Mads B. Kronborg*, Peter T. Mortensen, Steen H. Poulsen, Jens C. Gerdes, Henrik K. Jensen, and Jens C. Nielsen

- 38 patients (67± 10 ys)
- AV block
- LVEF > 40%
- QRS < 120 ms

Double-blind, Randomized, Crossover Study
HSP vs. RVS; n = 38



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His Bundle Pacing vs. Right Ventricular Pacing

Abelraham *et al*., *JACC* 2018

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY VOL. 71

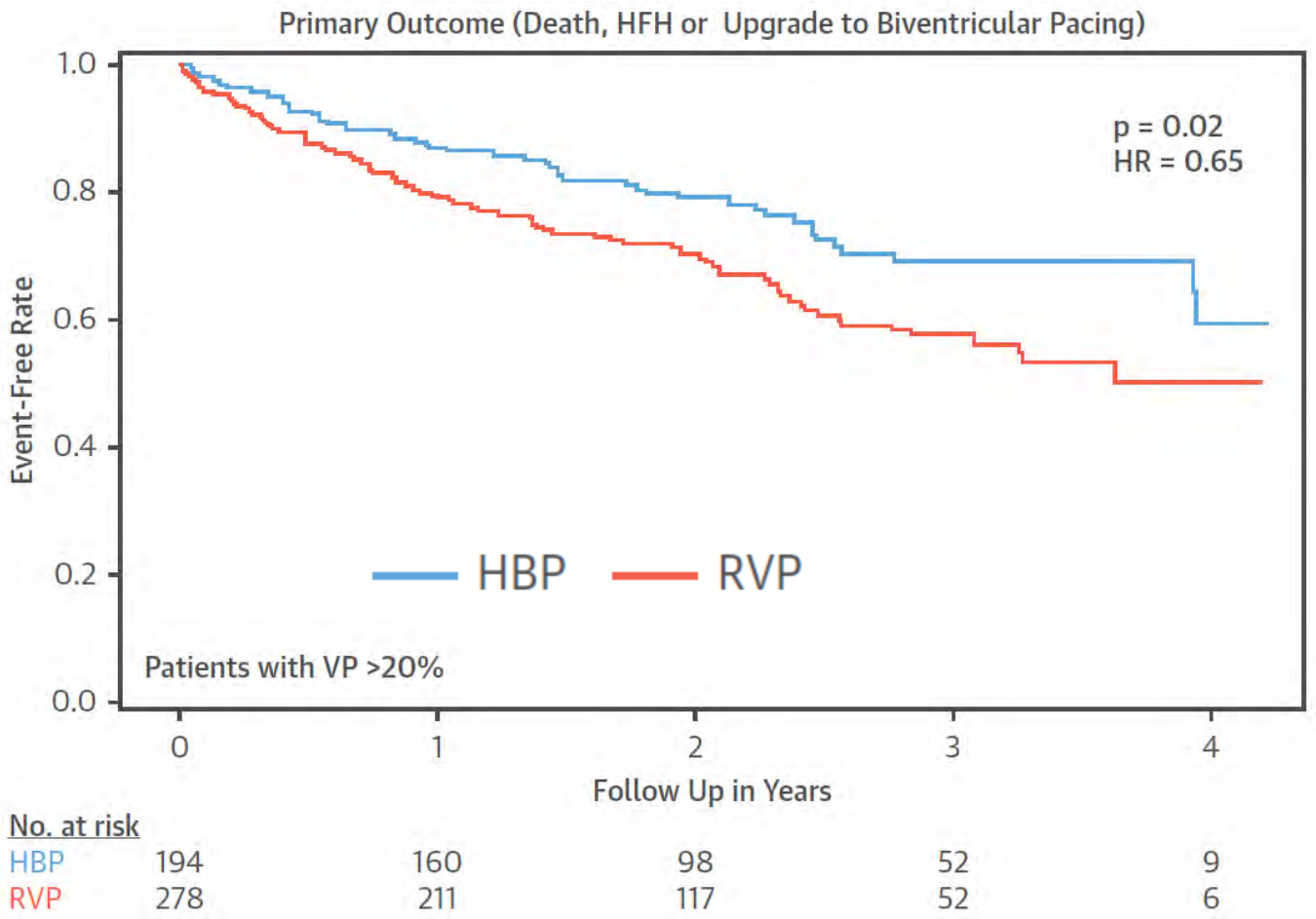
PUBLISHED BY ELSEVIER

Clinical Outcomes of His Bundle Pacing Compared to Right Ventricular Pacing

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

- 755 patients (332 HBP, 433 RVP)
- 2 sister hospitals
  - ✓ one aiming for HBP
  - ✓ one aiming für RVP

Non-randomized Cohort Comparison
HBP (n = 322) vs. RVP (n = 433)



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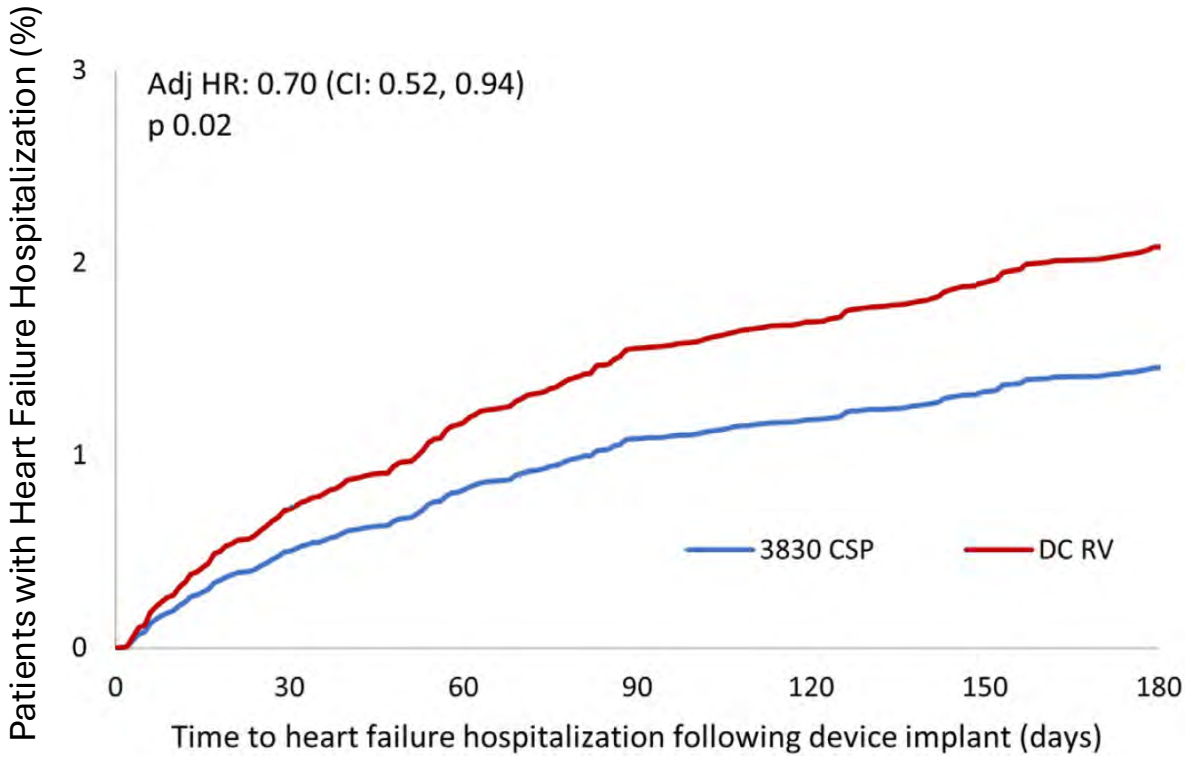
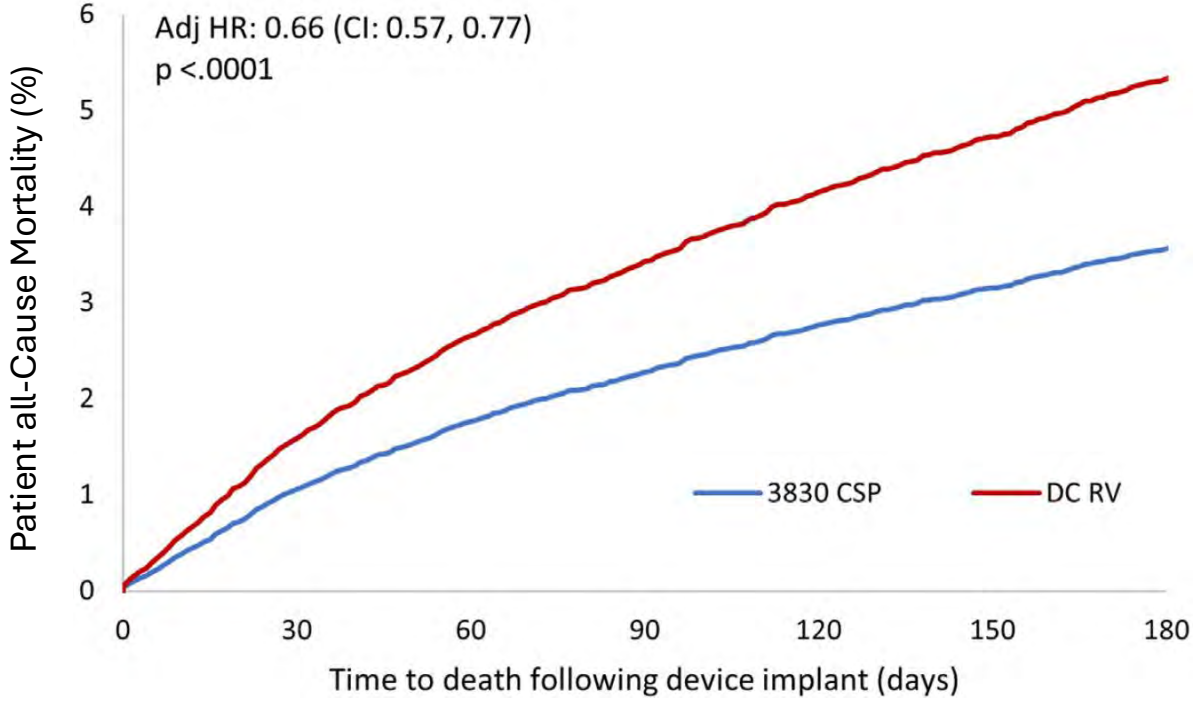
Conduction System Pacing vs. Right Ventricular Pacing

MEDICARE Population
CSP (n = 6.197) vs. RV-pacing (n = 16.989)





Vijayaraman *et al*., *Heart Rhythm* 2024

2025 ESC Consensus Statement on Indications for CSP

MAY BE APPROPRIATE TO DO

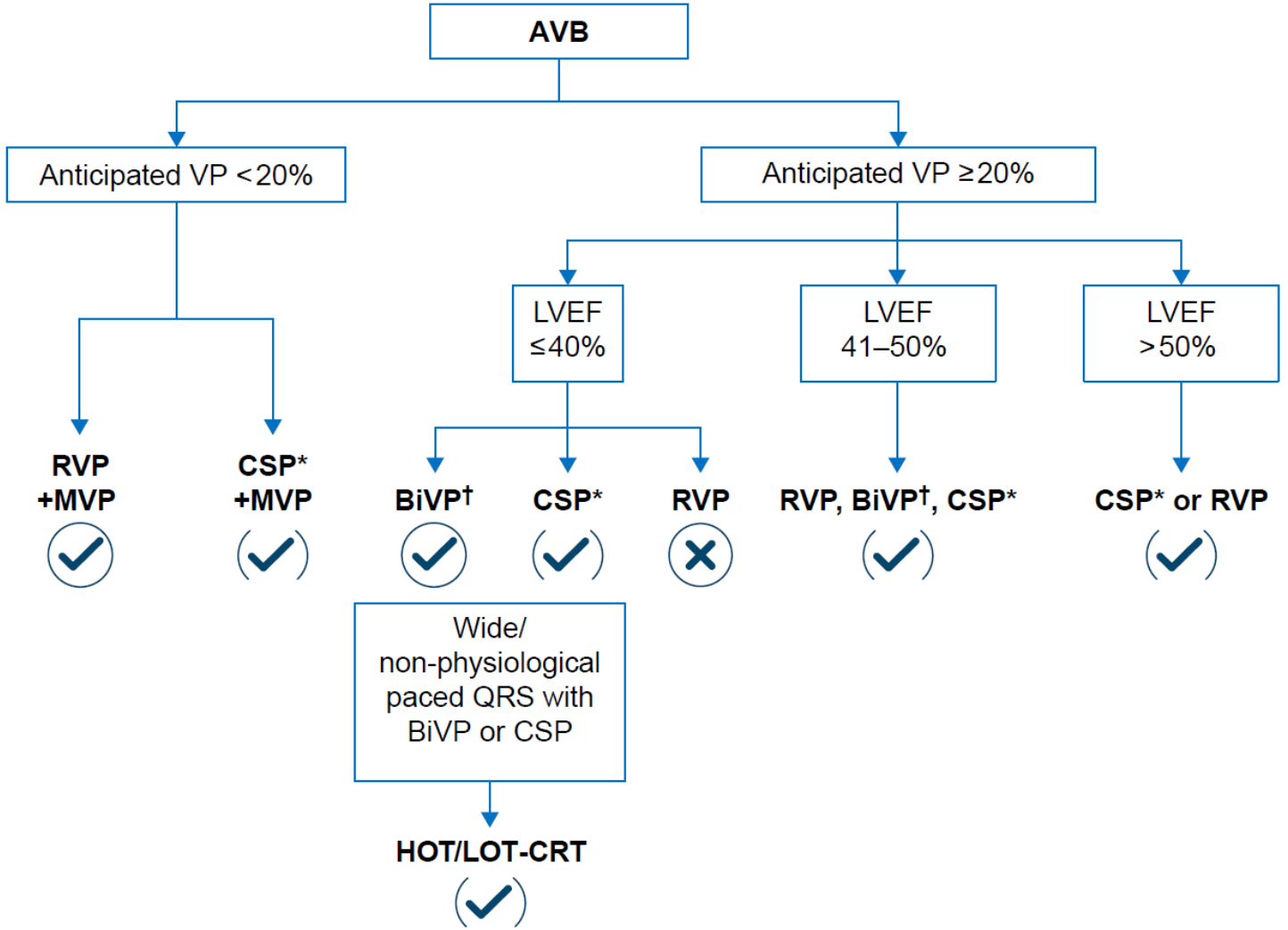
It may be appropriate to implant CSP in patients with AV-block and LVEF>40% with an anticipated VP burden >20%

It may be appropriate to implant CSP in patients with AV-block and LVEF<40% with an anticipated VP burden >20%

In patients with AV-block and infrequent (<20%) anticipated VP burden, it may be appropriate to implant CSP in combination with minimized ventricular pacing strategies

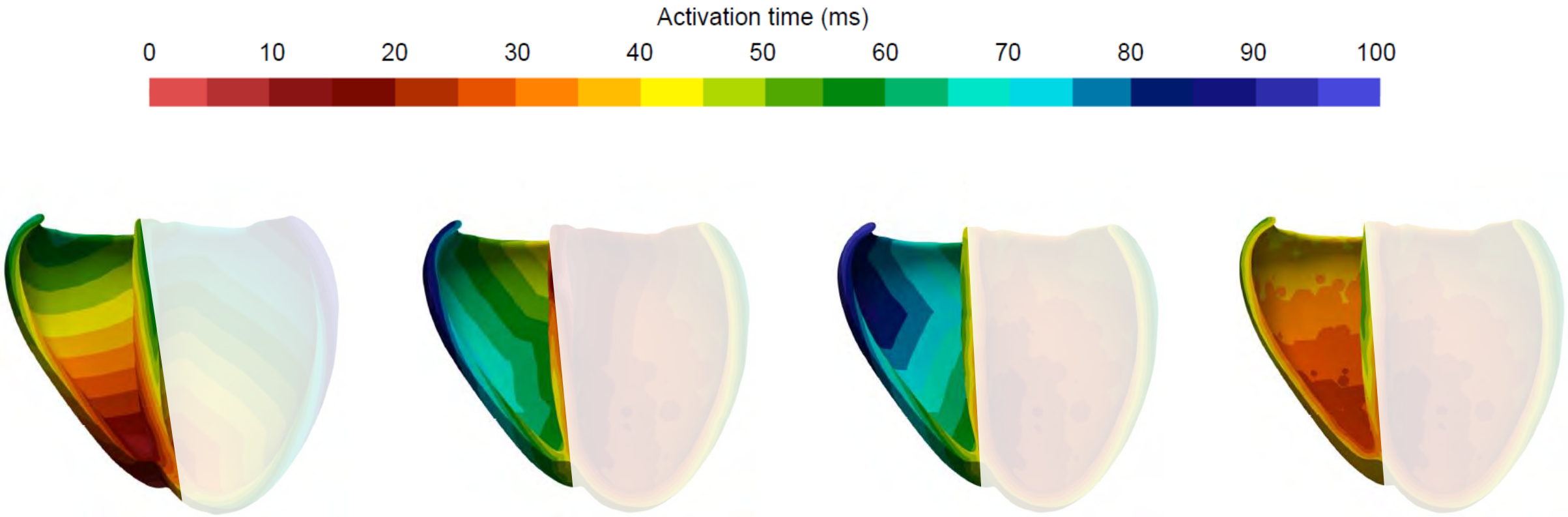
High quality RCT
> 1 moderate quality RCT
metanalysis of moderate quality RCT

High quality, large observational studies



✓✓ Advice TO DO; ✓ May be appropriate TO DO; ✗ Advice NOT DO DO

Electrical Effects of CSP vs. RVP on the Right Ventricle



Right ventricular apical pacing

Non-selective LBBP

Selective LBBP

Selective His-bundle pacing

Meiburg *et al*., *Europace* 2003

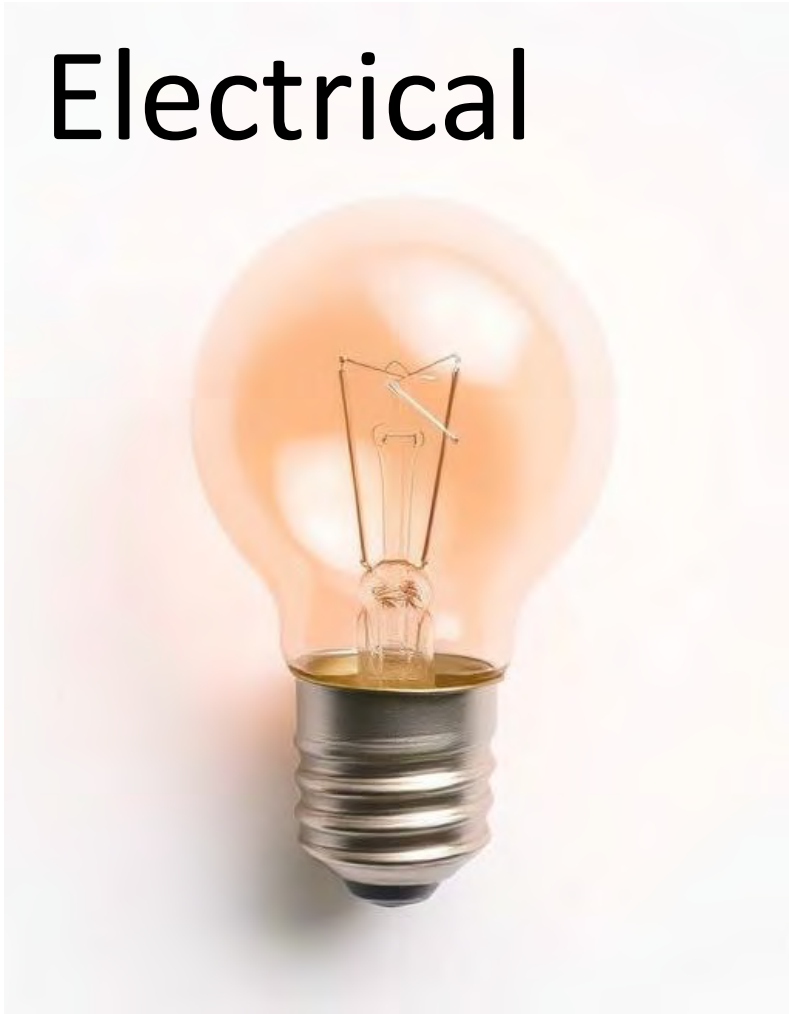
Mechanism of Tricuspid Regurgitation

1. Iatrogenic LBBB

2. RV Dyssynchrony

3. Lowered LV Systolic and Diastolic function

4. Lower RV Function

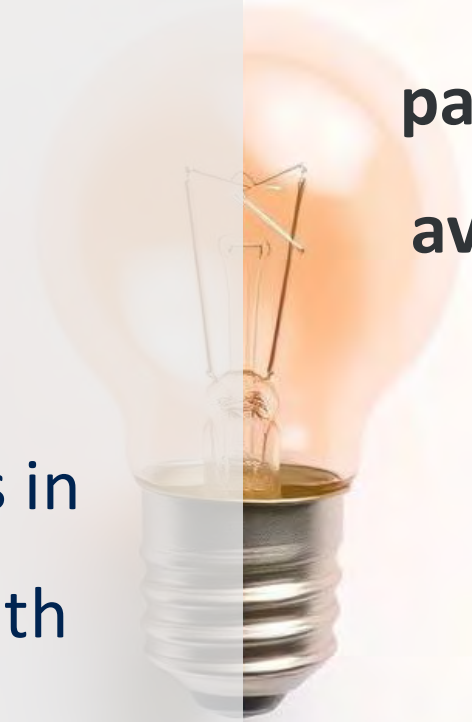


Murphy SP *et al*., *J Cardiovasc Electrophysiol* 2024

Mechanism of Tricuspid Regurgitation

Electrical dyssynchrony caused by RV pacing is associated with TR worsening

independently of changes in RV size or interference with valve closures

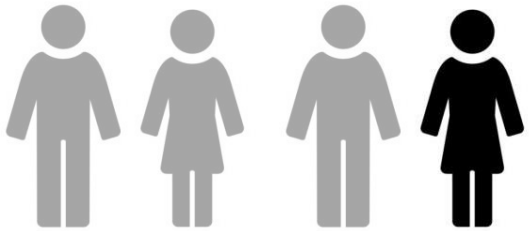


Conduction system pacing may prevent TR by avoiding dyssynchronous contraction

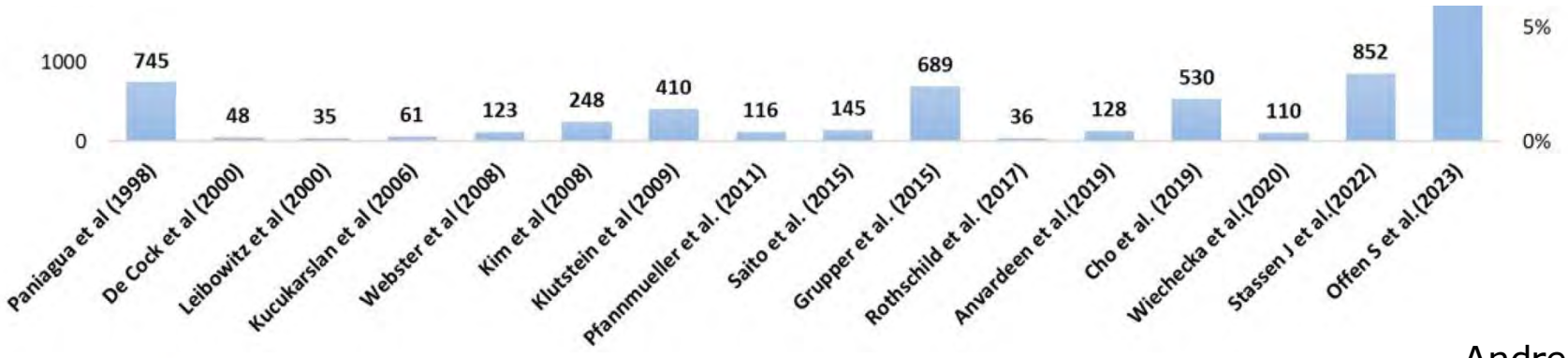
Vaturi M *et al*., *Euro J Echocardiogr* 2010

Prevalence of CIED-associated Tricuspid Regurgitation

One out of 4 patients is affected (24%)



Mortality increase
by 140%



Andreas M *et al*., *Eur Heart J* 2024

Tricuspid Regurgitation: LBBAP vs. His-Bundle Pacing

Received: 18 March 2022 | Accepted: 31 May 2022
DOI: 10.1111/anec.12986

REVIEW ARTICLE

WILEY

Tricuspid regurgitation in His bundle pacing: A systematic review

Syed Mu
Abdul Sa
Bilal Mus

Distance between the lead-implanted site and tricuspid valve annulus in patients with left bundle branch pacing: Effects on postoperative tricuspid

In patients requiring sparing of the tricuspid valve (e.g. transcatheter repair), it is advised that HBP is preferred over LBBAP

HBI
tati
egurgi-

- none, if paced from the atrial aspect of the tricuspid valve

- Lead-TA-dist ≤ 16.1 mm is an independent predictor of TR deterioration

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Infranodal / Nodal AV-Block: LBBAP vs. His-Bundle Pacing

JACC: CLINICAL ELECTROPHYSIOLOGY

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Prospective, Observational Study
HBP (n = 140) vs. LBBAP (n = 179)

His-Purkinje Conduction System Pacing in A

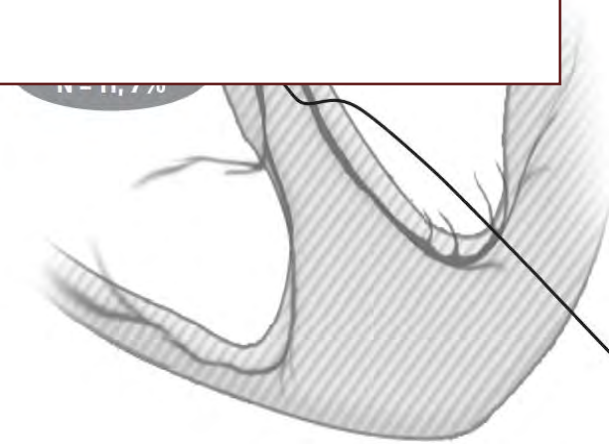
New I

Pugazhenc
Angela Na

- 33
  (CS
- AV

In patients with significant aortic valve disease (which may require future intervention), infra-nodal AV block, it is advised that LBBAP is preferred over HBP

anodal AVB
21±25.7
1%)
2.2%)
33±22.85



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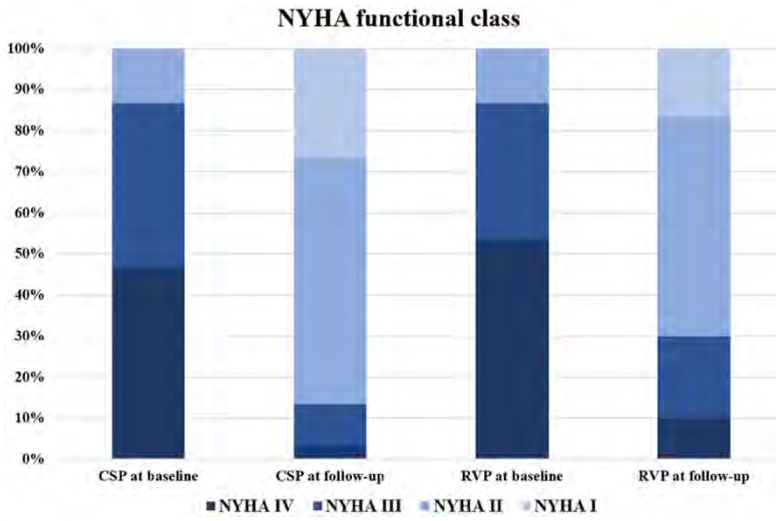
Pacing in Specific Situations: AV-block post-TAVI

frontiers in Cardiovascular Medicine

ORIGINAL RESEARCH
published: 30 November 2021
doi: 10.3389/fcvm.2021.772548

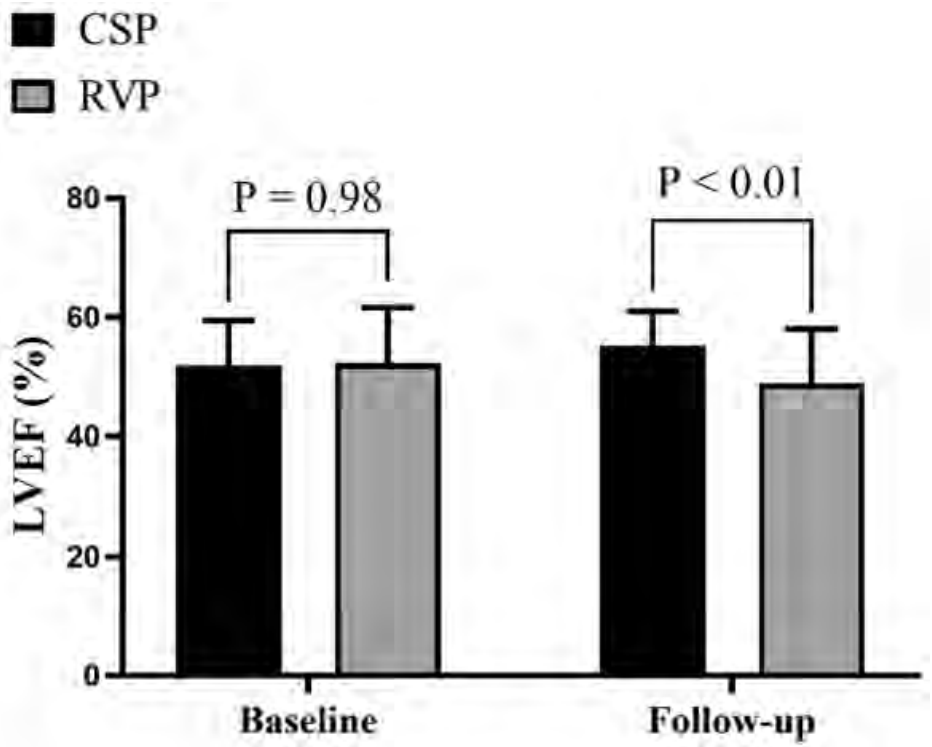
Conduction System Pacing for Post Transcatheter Aortic Valve Replacement Patients: Comparison With Right Ventricular Pacing

*Hong-Xia Niu†, Xi Liu†, Min Gu†, Xuhua Chen, Chi Cai, Minsi Cai, Shu Zhang and Wei Hua**



Non-randomized Single-Center Study

CSP (HBP = 10, LBBAP = 20) vs. RVP (n = 30)



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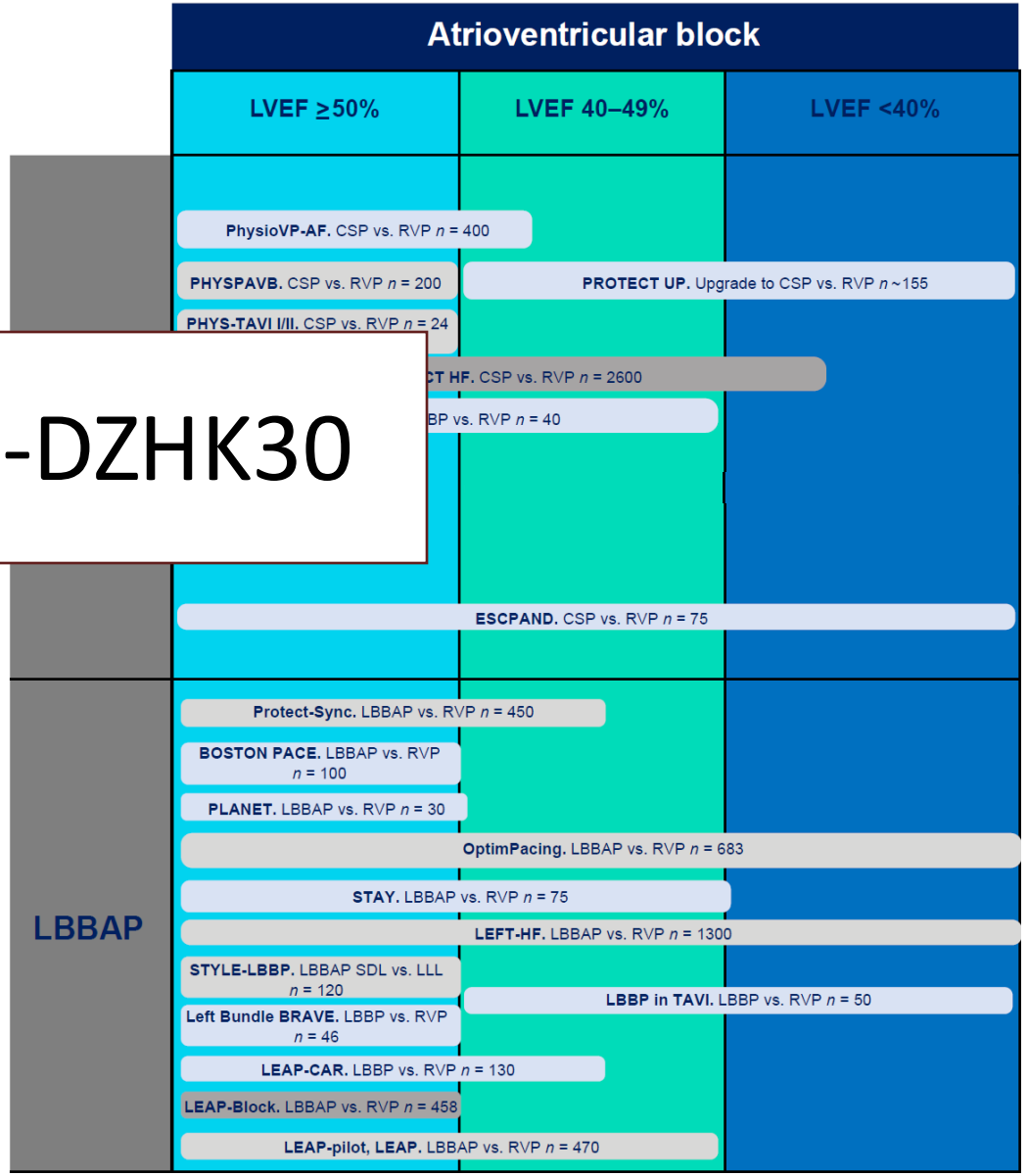
Ongoing Randomized Clinical Trials on CSP in Bradycardia

Trial Name	Study Group	Study Population	
			SOFT PRIMARY EN
BOSTON PACE	LBBAP vs. RVP	LVEF≥50% + AVB with VP>40%	100
STAY	LBBAP vs RVP	LVEF>40% and AVB with VP>50%	75
LEAP-CAR	LBBP vs RVP	LVEF>45% + advanced AVB	130
LBBP in TAVI	LBBAP vs RVP	TA	
PROTECT-UP	CRT upgrade vs RVP	PI	
PhysioVP-AF	HBP/LBBAP vs RVP	SI	
ESCPAND	HBP/LBBAP vs RVP	H ≥50%+diastolic dysfunction	
			COMBINED SOFT AND HA
LEAP	LV septal pacing vs RVP	LVEF>35% and AVP with VP>20%	470
Protect-Sync	LBBAP vs RVP	PM indication with anticipated VP>40%	450
OptimPacing	LBBAP vs RVP	LVEF≥35%,AVB II/III or AV with HR<50/min	683
PHYSPAVB	HBP/LBBAP vs RVP	LVEF>50% + AVB with PM indication	200
LEFT-HF	LBBAP vs RVP	LVEF>35% and AVB with VP>90%	130
			HEART PRIMARY EN
LEAP-BLOCK	LBBAP vs RVP	AVB and LVEF≥50%	458
PROTECT-HF	HBP/LBBAP vs RVP	AVB or fascicular block with PM indication or AF+AVNA	260

Preserve-Synch-DZHK30



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Thanks a lot for your attention!

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