2023
11ème SÉMINAIRE de CARDIOLOGIE INTERVENTIONNELLE de TROYES
01 & 02 AVRIL
SALLE DU CONSEIL MUNICIPAL
HOTEL DE VILLE de TROYES

LE CŒUR EN RYTHME

La Stimulation Physiologique Permanente

Dr Jérémie Sorrel, Rythmologie Mulhouse

Déclaration de conflits d'intérêts

- Aucune rémunération pour la présentation

- Medtronic — Formateur France en Stimulation Physiologique
- Biotronik — Consultant Scintifique

Définitions

- Stimulation Hissienne
  - His Bundle Pacing
- Capture de Branche Gauche
  - Left Bundle Branch Pacing

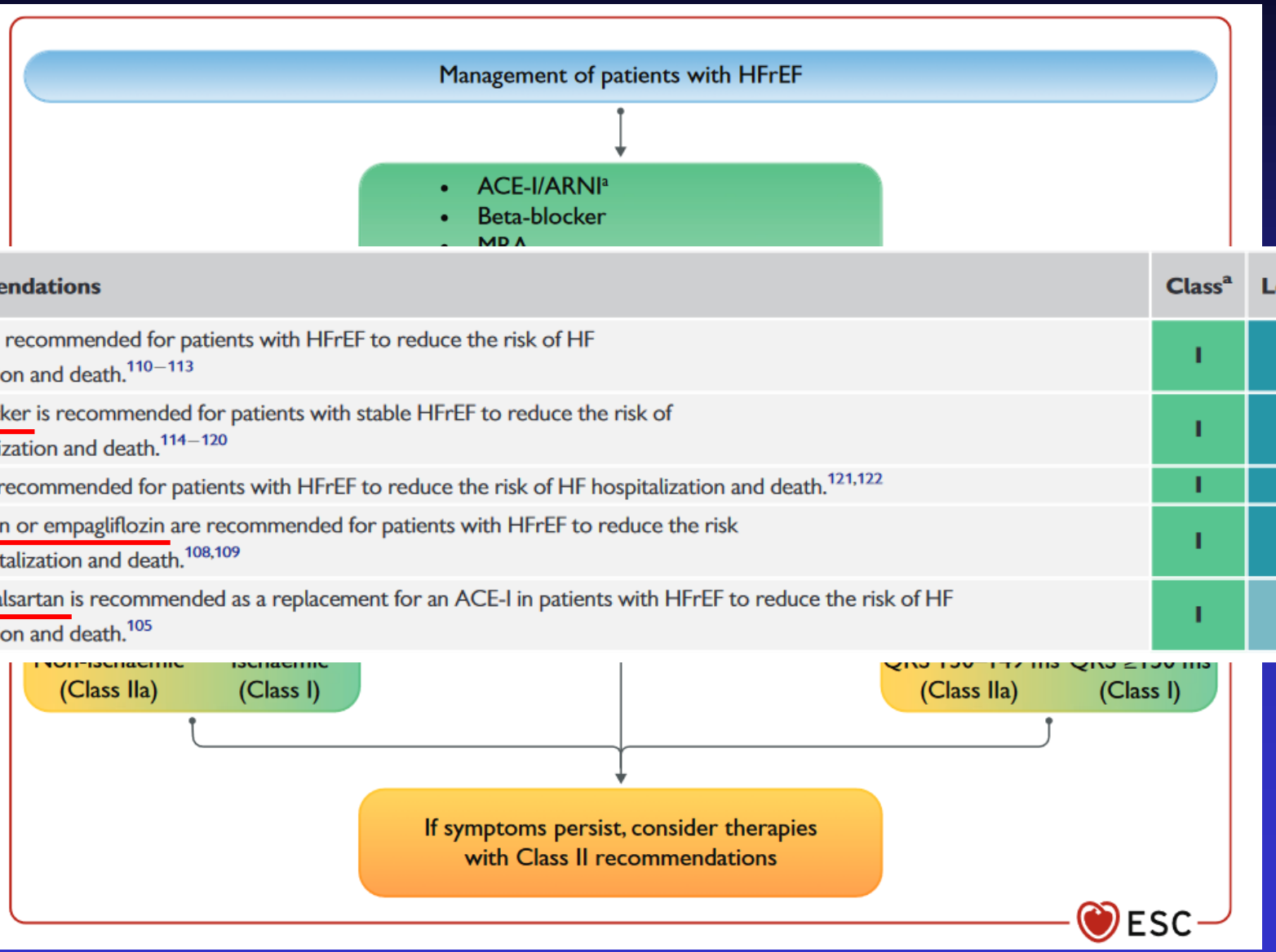
Stimulation des Voies de Conduction Physiologiques

Conduction System Pacing

Points forts

- Traitement de l'insuffisance cardiaque
- Toujours associée au TTT Médical Optimal (≥ 3 mois)
- FEVG ≤ 35%
- Bloc de Branche (QRS ≥ 130ms)

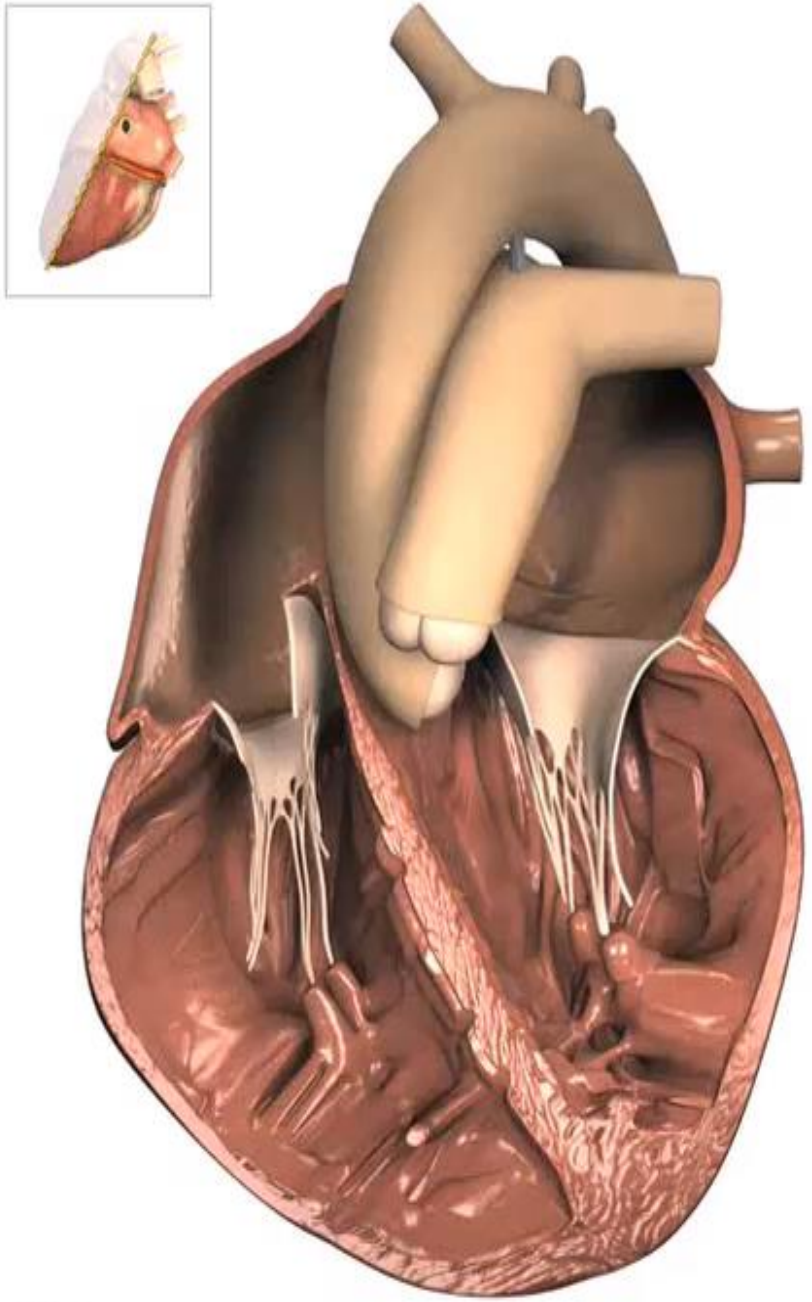
ESC Guidelines 2021



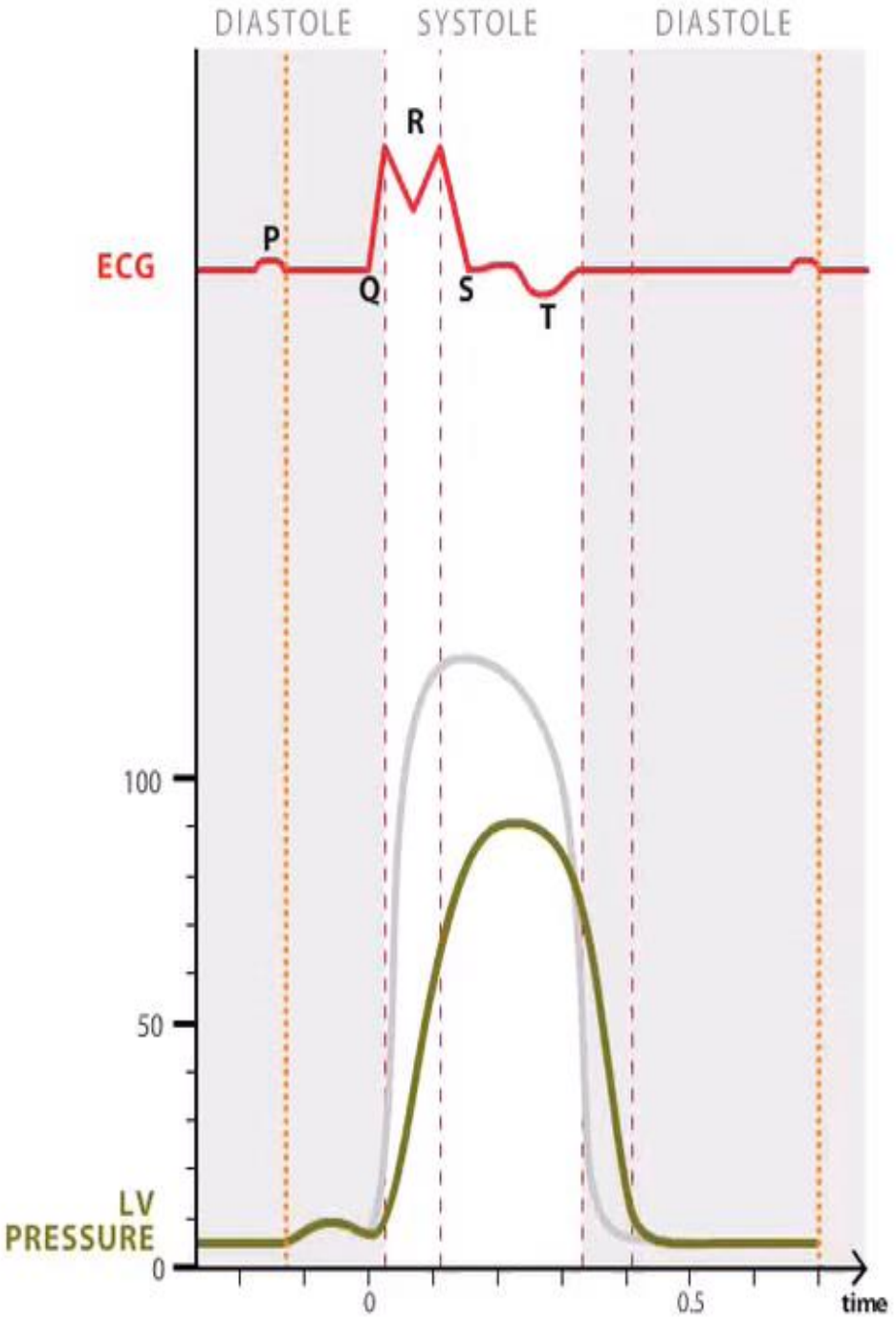
Recommendations	Class[a]	Level[b]
An ACE-I is recommended for patients with HFrEF to reduce the risk of HF hospitalization and death.[110–113]	I	A
A beta-blocker is recommended for patients with stable HFrEF to reduce the risk of HF hospitalization and death.[114–120]	I	A
An MRA is recommended for patients with HFrEF to reduce the risk of HF hospitalization and death.[121,122]	I	A
Dapagliflozin or empagliflozin are recommended for patients with HFrEF to reduce the risk of HF hospitalization and death.[108,109]	I	A
Sacubitril/valsartan is recommended as a replacement for an ACE-I in patients with HFrEF to reduce the risk of HF hospitalization and death.[105]	I	B

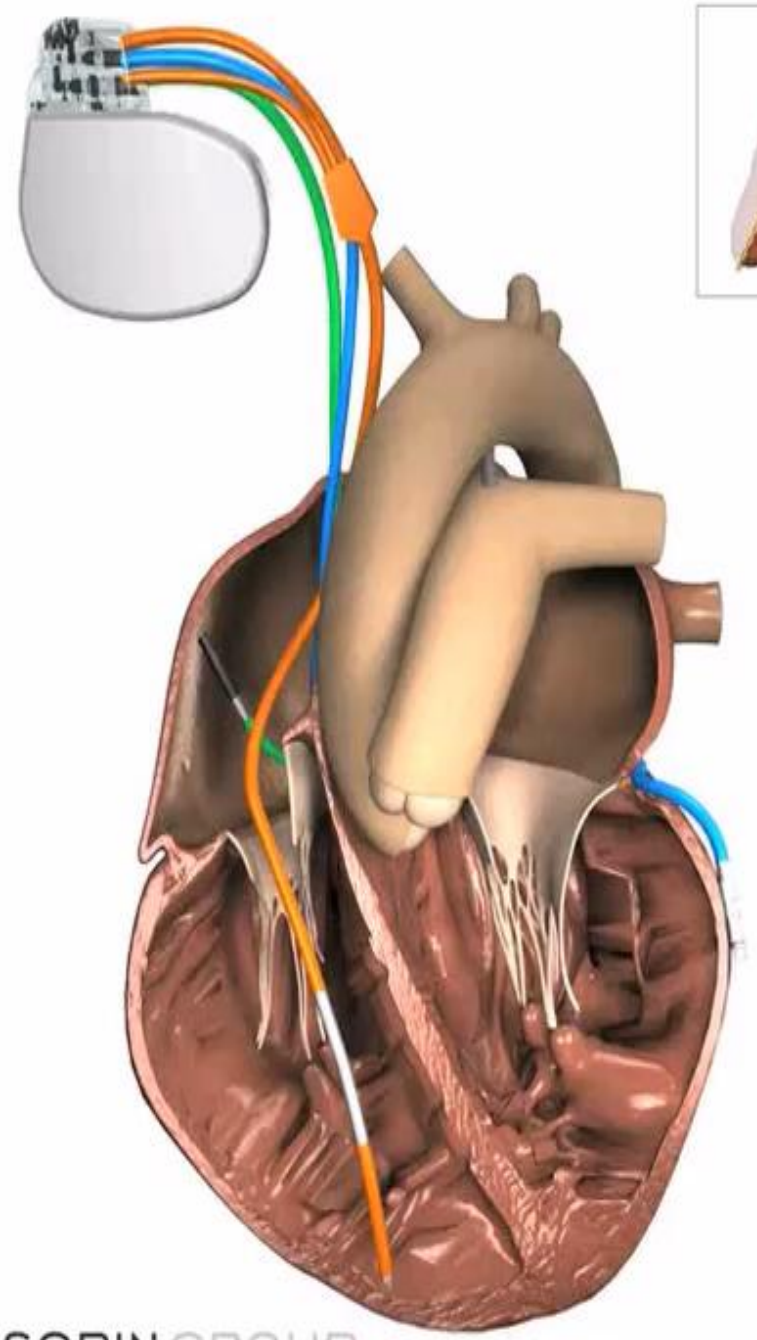
© ESC 2021

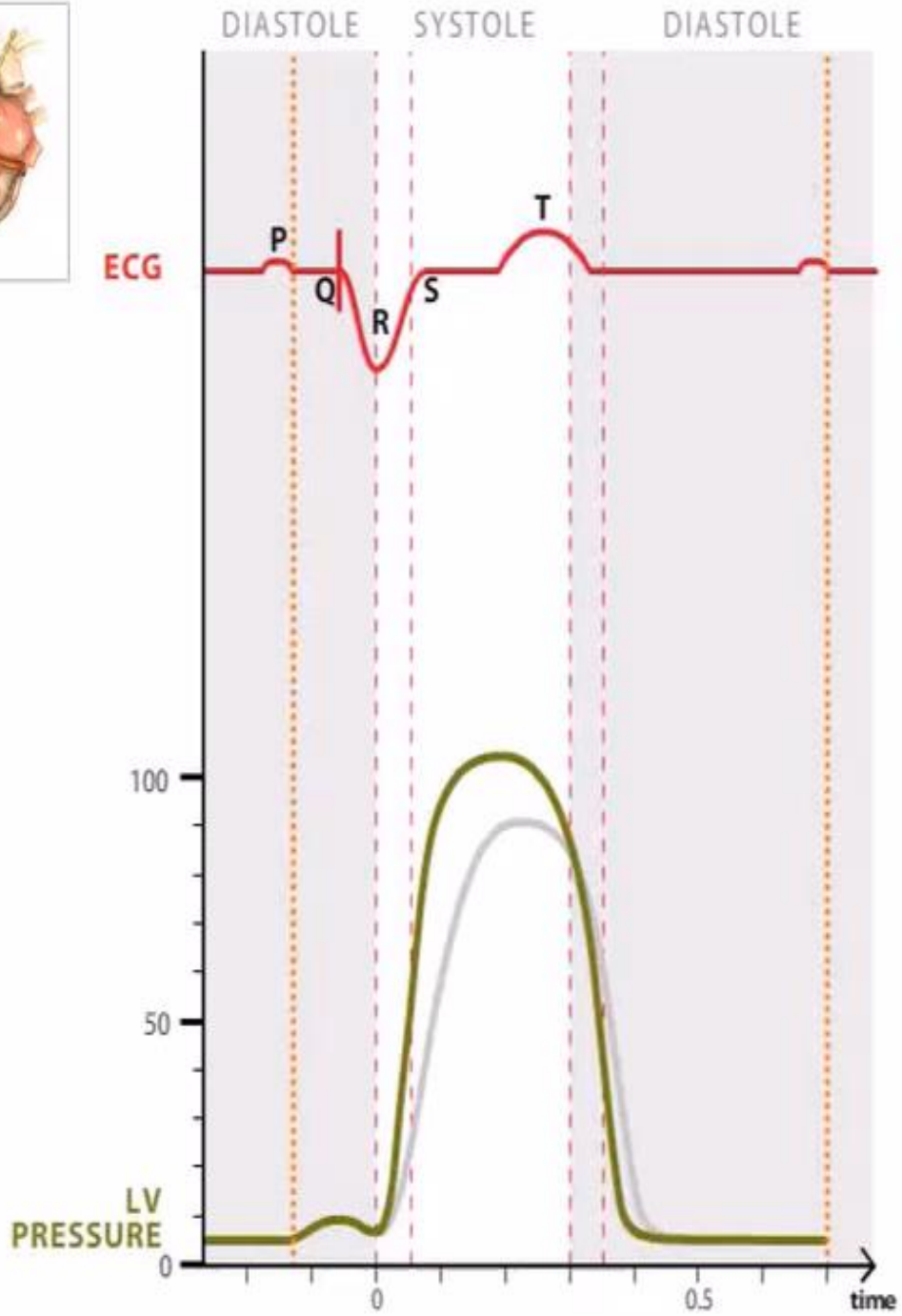
ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure, European Heart Journal (2021) 42, 3599-3726.



SORIN GROUP
AT THE HEART OF MEDICAL TECHNOLOGY







SORIN GROUP
AT THE HEART OF MEDICAL TECHNOLOGY

ESC Guidelines 2021

Recommendations	Class[a]	Level[b]
LBBB QRS morphology		
CRT is recommended for symptomatic patients with HF in SR with LVEF ≤35%, QRS duration ≥150 ms, and LBBB QRS morphology despite OMT, in order to improve symptoms and reduce morbidity and mortality.[37,39,40,254–266,283,284]	I	A
CRT should be considered for symptomatic patients with HF in SR with LVEF ≤35%, QRS duration 130–149 ms, and LBBB QRS morphology despite OMT, in order to improve symptoms and reduce morbidity and mortality.[37,39,40,254–266,283,284]	IIa	B
Non-LBBB QRS morphology		
CRT should be considered for symptomatic patients with HF in SR with LVEF ≤35%, QRS duration ≥150 ms, and non-LBBB QRS morphology despite OMT, in order to improve symptoms and reduce morbidity.[37,39,40,254–266,283,284]	IIa	B
CRT may be considered for symptomatic patients with HF in SR with LVEF ≤35%, QRS duration 130–149 ms, and non-LBBB QRS morphology despite OMT, in order to improve symptoms and reduce morbidity.[273–278,281]	IIb	B

Rythme sinusal

≥150ms

≥130ms

≥150ms

≥130ms

ESC Guidelines, Cardiac pacing and CRT, European Heart Journal (2021) 00, 1–94.

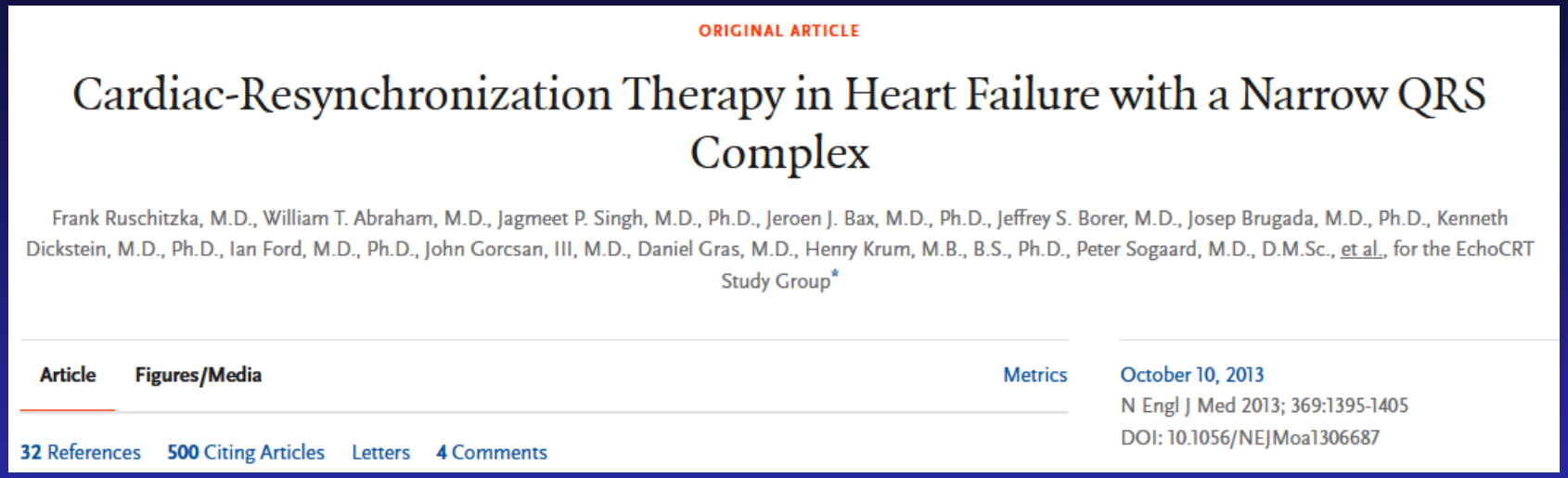
ESC Guidelines 2021

- CRT encore 30 à 40% de mauvais répondeurs
- Non recommandé si QRS < 130ms

QRS duration		
CRT is not indicated in patients with HF and QRS duration <130 ms without an indication for RV pacing.[264,282]	III	A

ESC Guidelines, Cardiac pacing and CRT, European Heart Journal (2021) 00, 1–94.

CRT et QRS fins



ORIGINAL ARTICLE

Cardiac-Resynchronization Therapy in Heart Failure with a Narrow QRS Complex

Frank Ruschitzka, M.D., William T. Abraham, M.D., Jagmeet P. Singh, M.D., Ph.D., Jeroen J. Bax, M.D., Ph.D., Jeffrey S. Borer, M.D., Josep Brugada, M.D., Ph.D., Kenneth Dickstein, M.D., Ph.D., Ian Ford, M.D., Ph.D., John Gorcsan, III, M.D., Daniel Gras, M.D., Henry Krum, M.B., B.S., Ph.D., Peter Sogaard, M.D., D.M.Sc., et al., for the EchoCRT Study Group*

Article Figures/Media Metrics

October 10, 2013
N Engl J Med 2013; 369:1395-1405
DOI: 10.1056/NEJMoa1306687

32 References 500 Citing Articles Letters 4 Comments

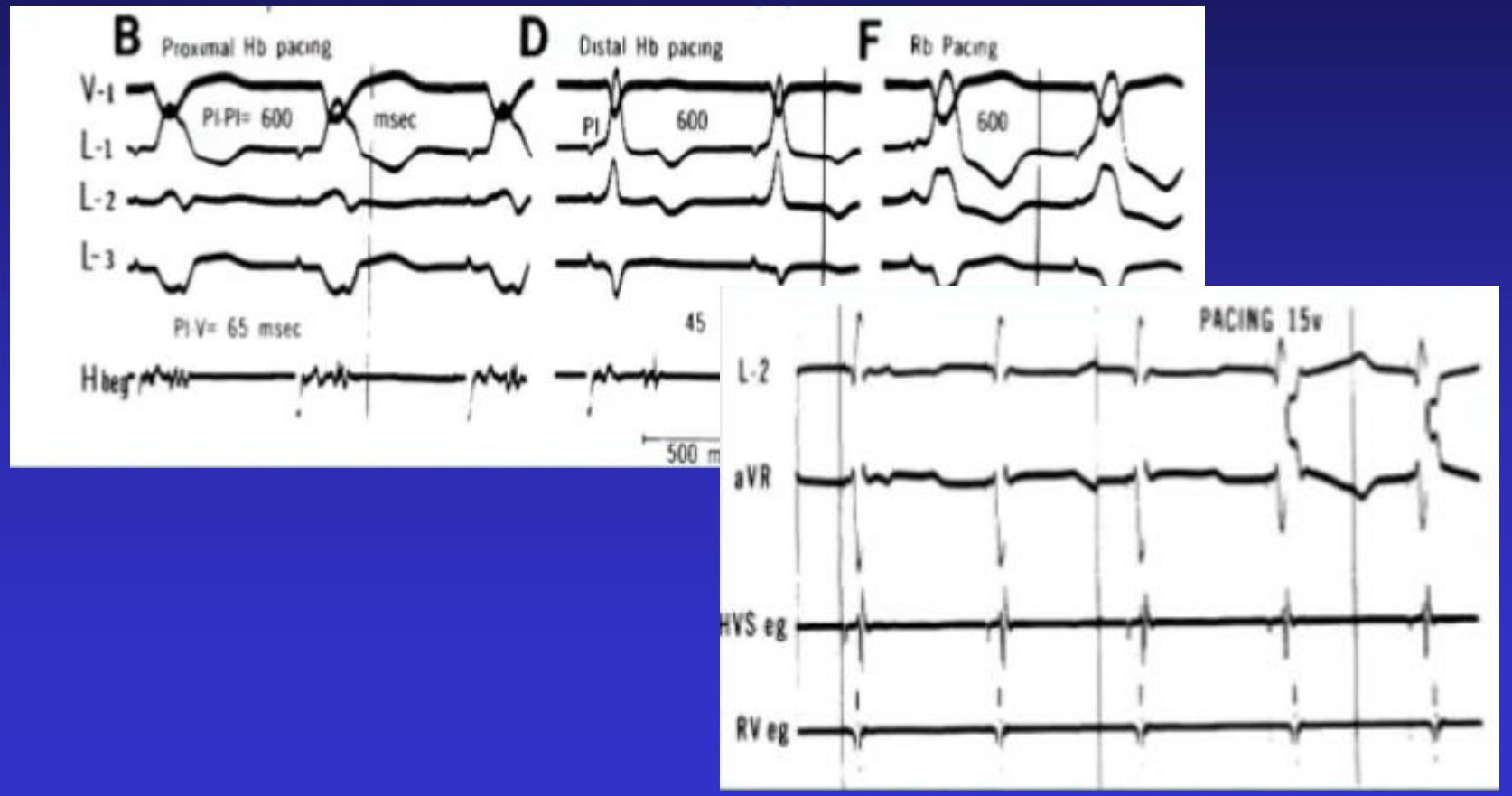
- Etude Echo CRT
- CRT ON/OFF
- NYHA 3 ou 4, FEVG ≤ 35%, QRS < 130ms

STOP ETUDE pour futilité
↑ 81% DE MORTALITE dans le groupe CRT ON (HR 1,81, P=0,02)

Normalization of Bundle Branch Block Patterns by Distal His Bundle Pacing

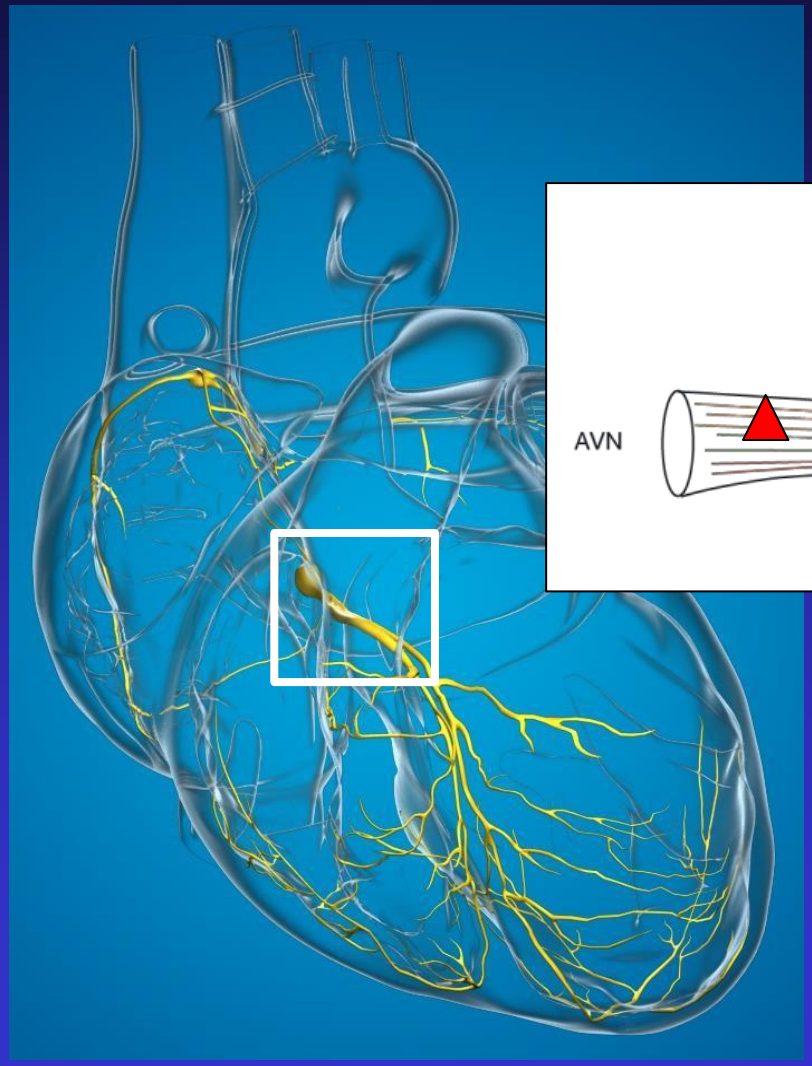
Clinical and Experimental Evidence of Longitudinal Dissociation in the Pathologic His Bundle

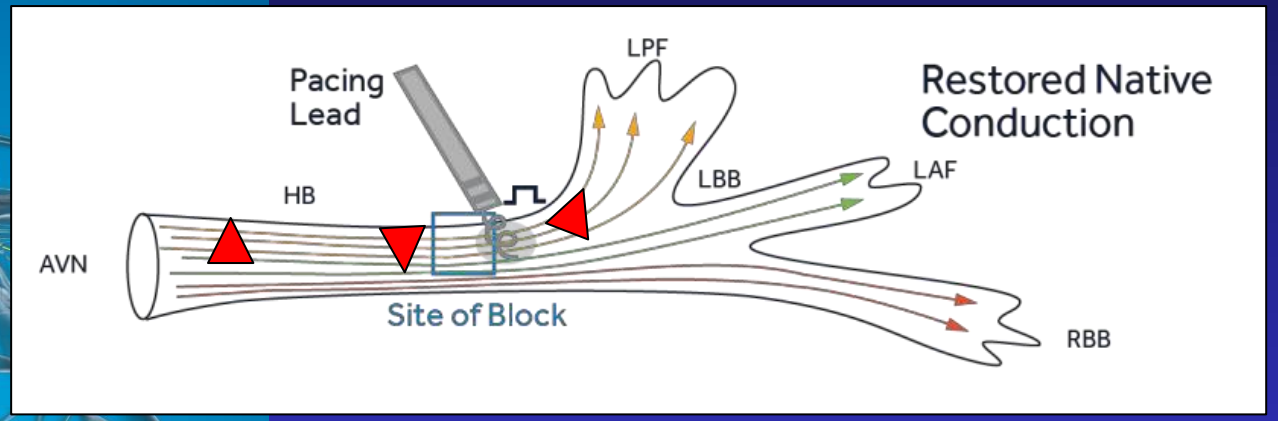
Nabil El-Sherif, M.D., Fernando Amat-Y-Leon, M.D., Clyde Schonfield, M.D., Benjamin J. Scherlag, Ph.D., Kenneth Rosen, M.D., Ralph Lazzara, M.D., and Christopher Wyndham, M.D.



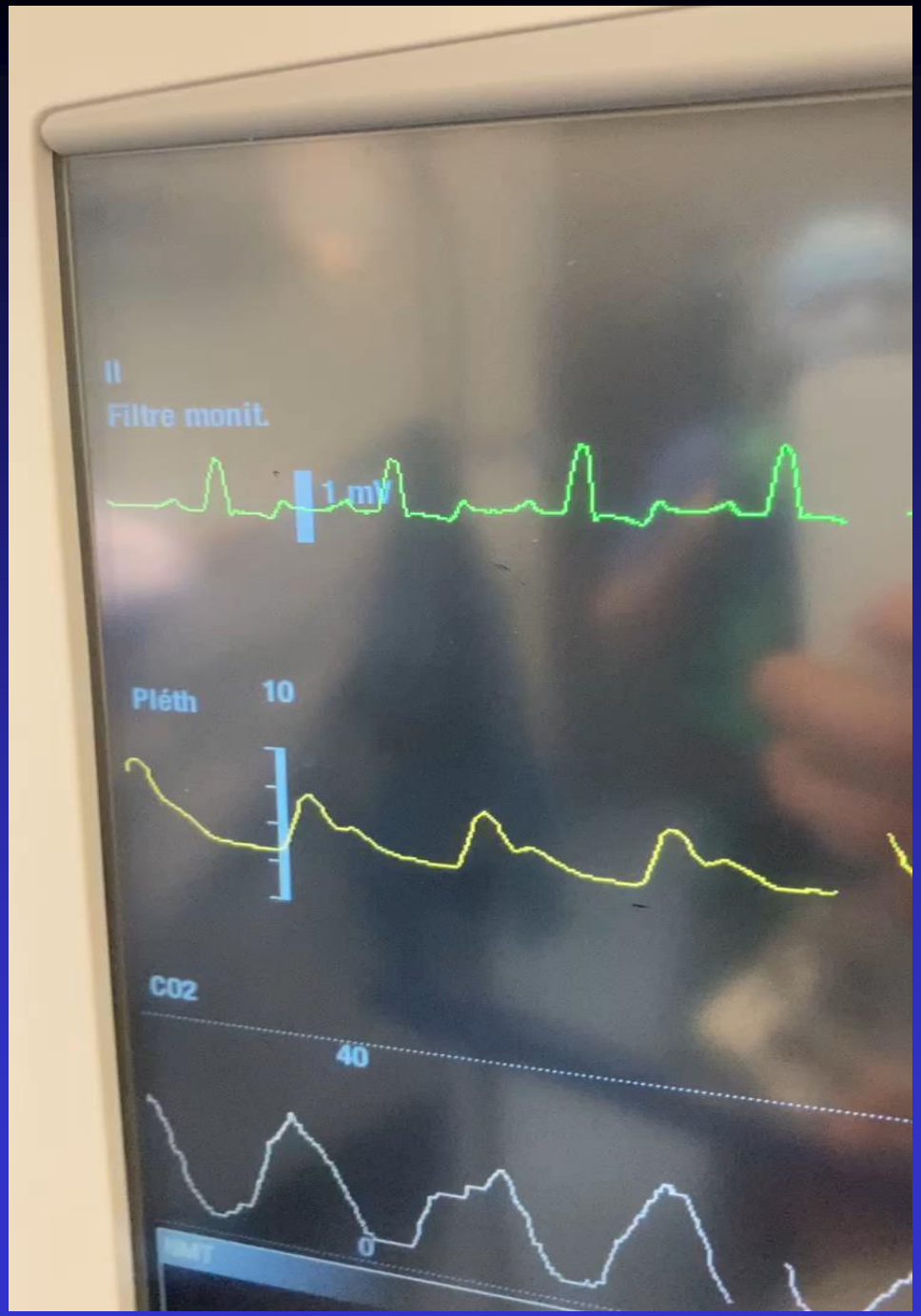
CIRCULATION, Vol 57, No 3, March 1978

Comment ça marche?





Nadine Ali et al., Arrhythm Electrophysiol Rev. 2018 Jun; 7(2): 103–110


II
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1 mV
Pléth
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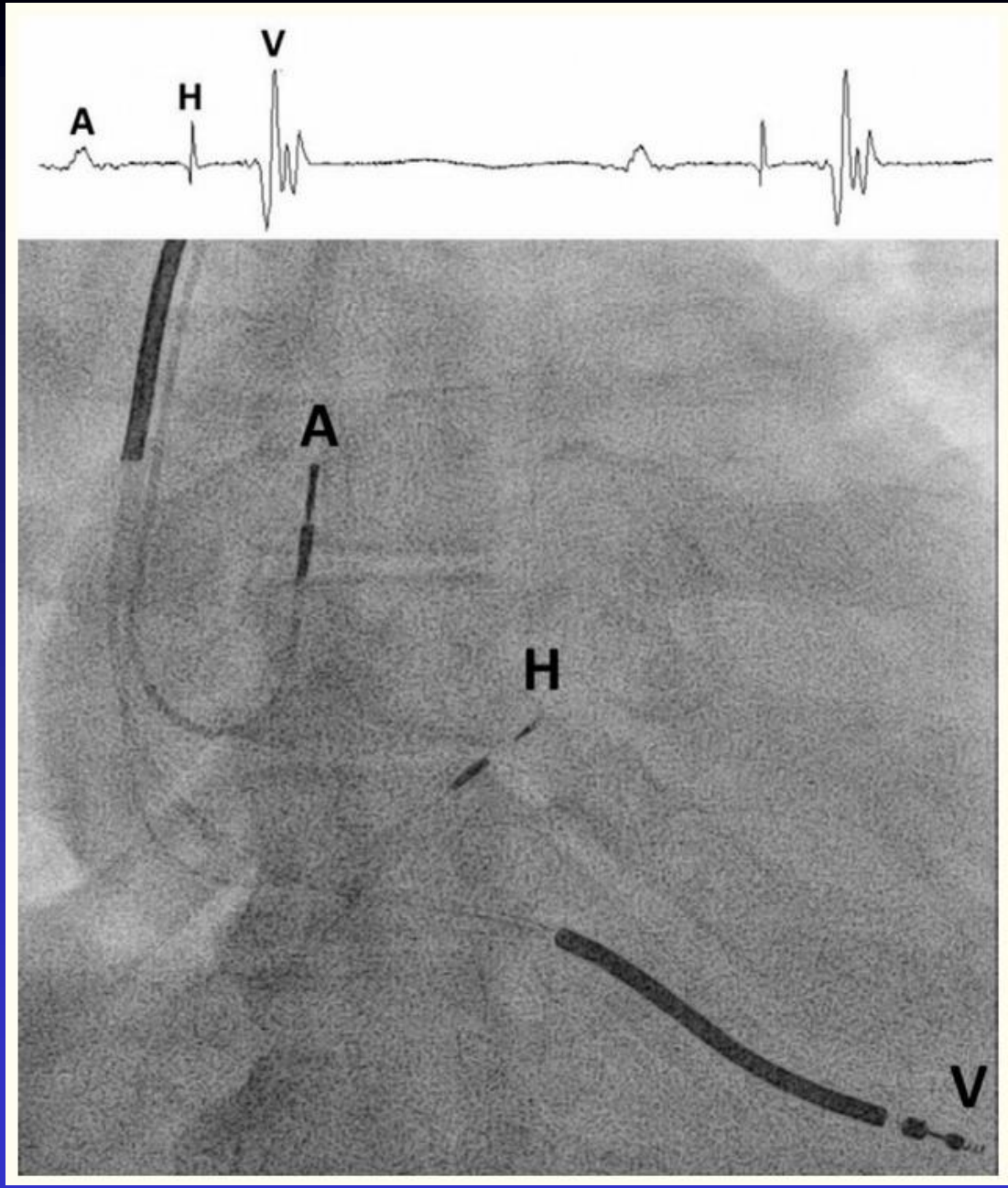
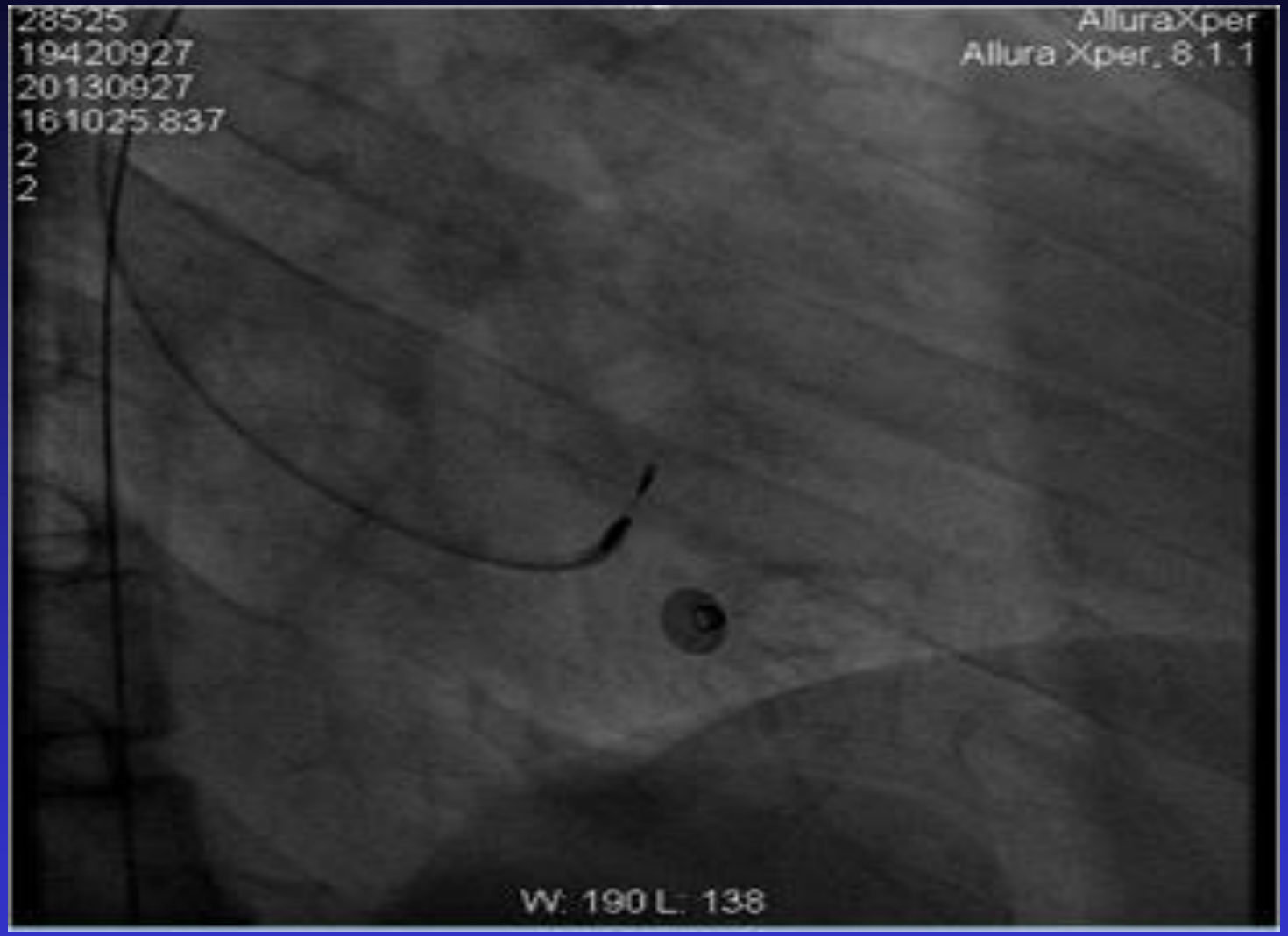


Stimulation Hissienne

Guidage Scopique et
Eléctrophysiologique

Parikshit S. Sharma et al., Clinical Heart Failure, Vol 15, ISSUE 3, P413-420, March 01, 2018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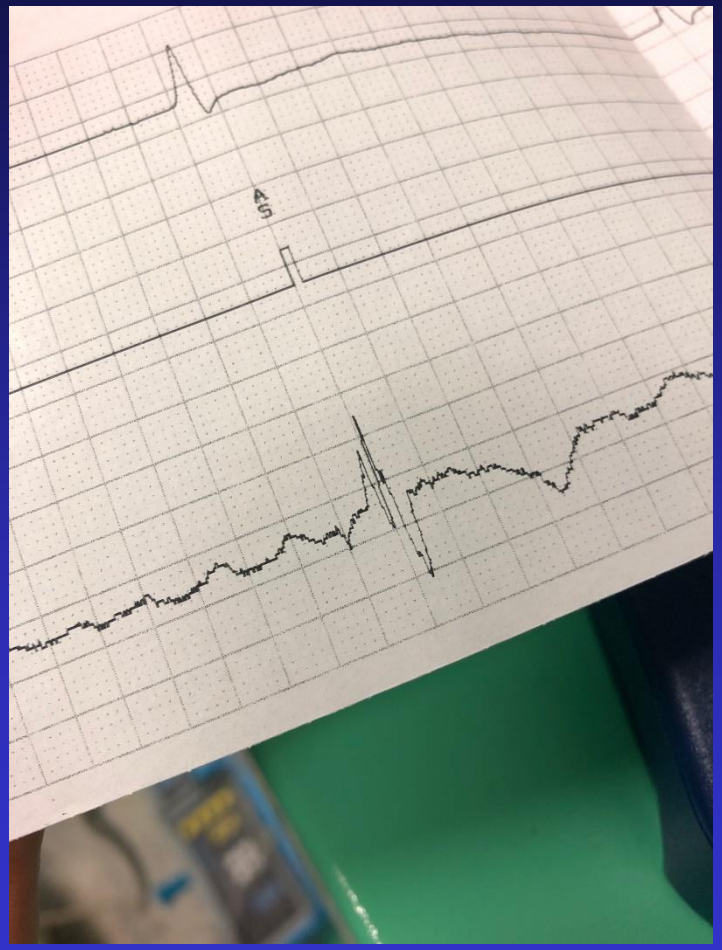
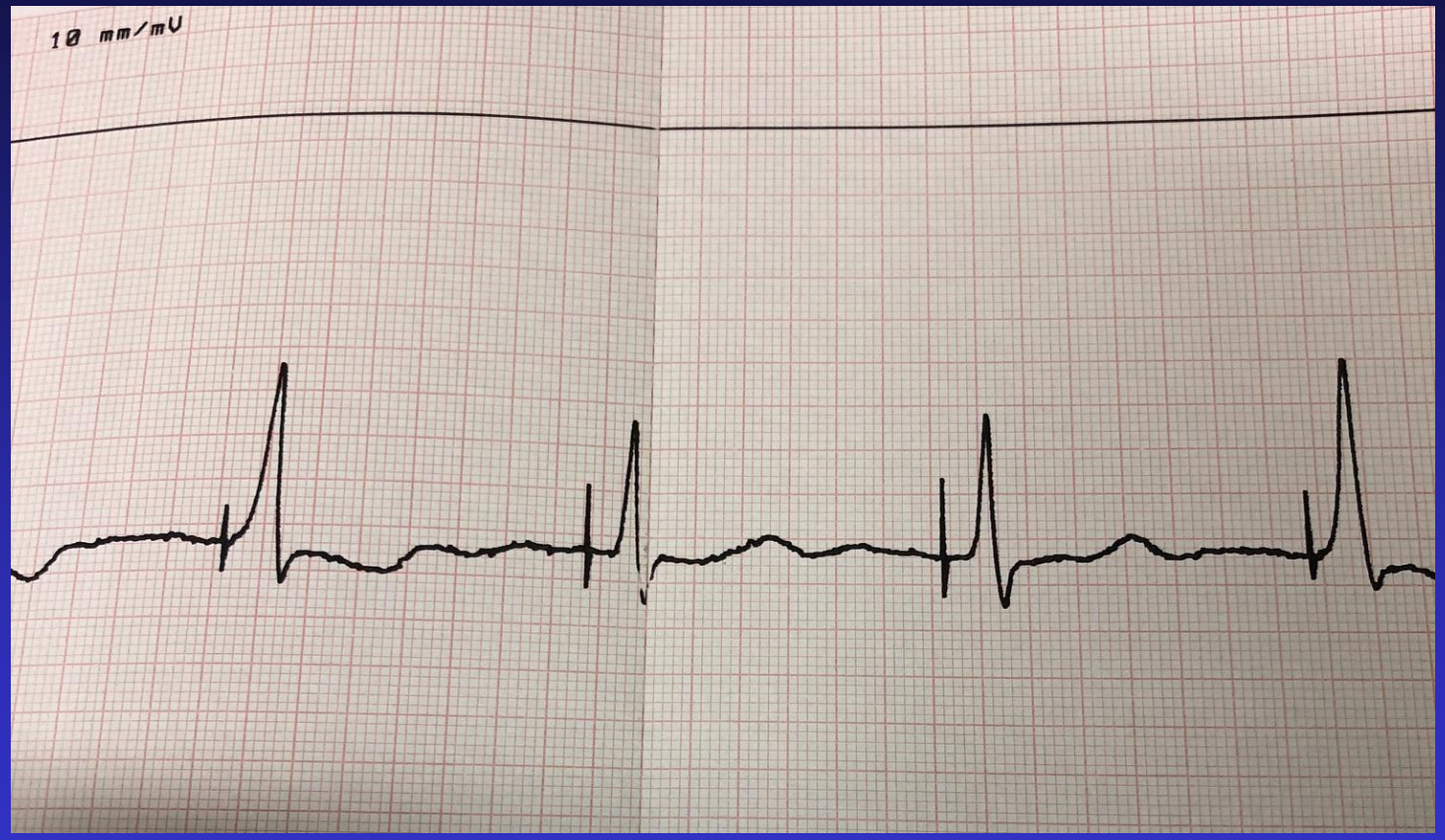
Stimulation Hissienne

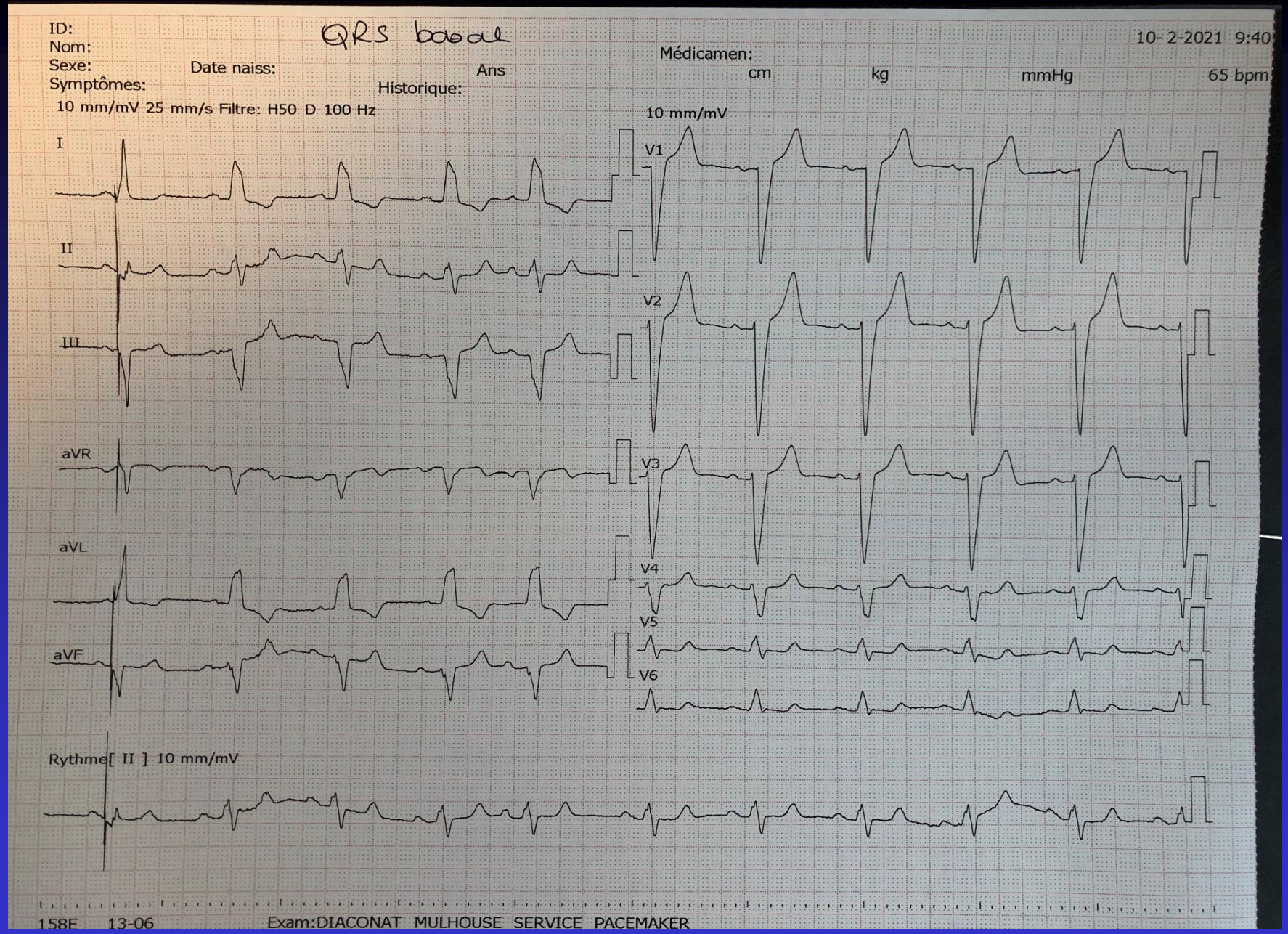


Potentiel Hissien « H »

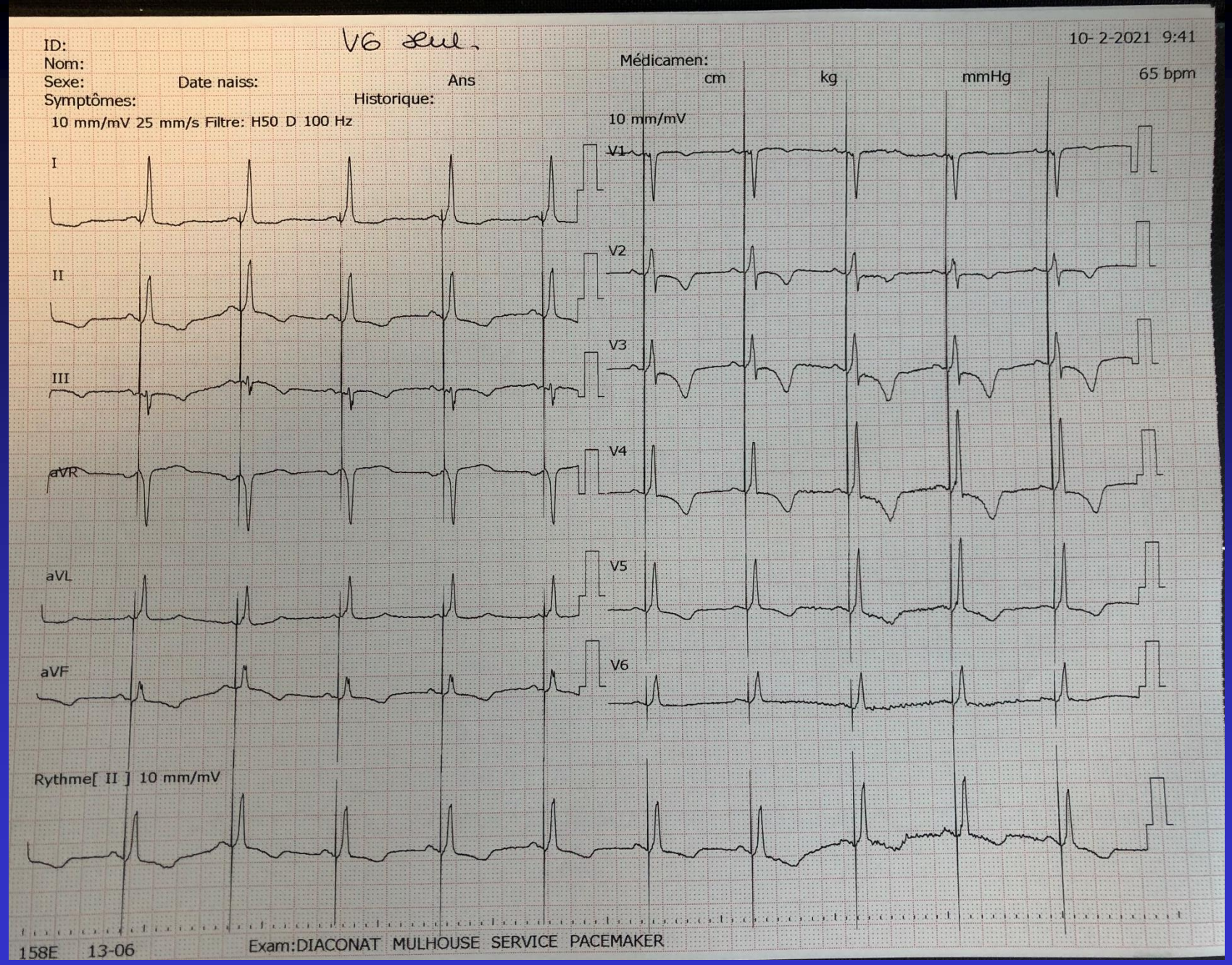
Stimulation Hissienne



Capture Selective/Non Selective

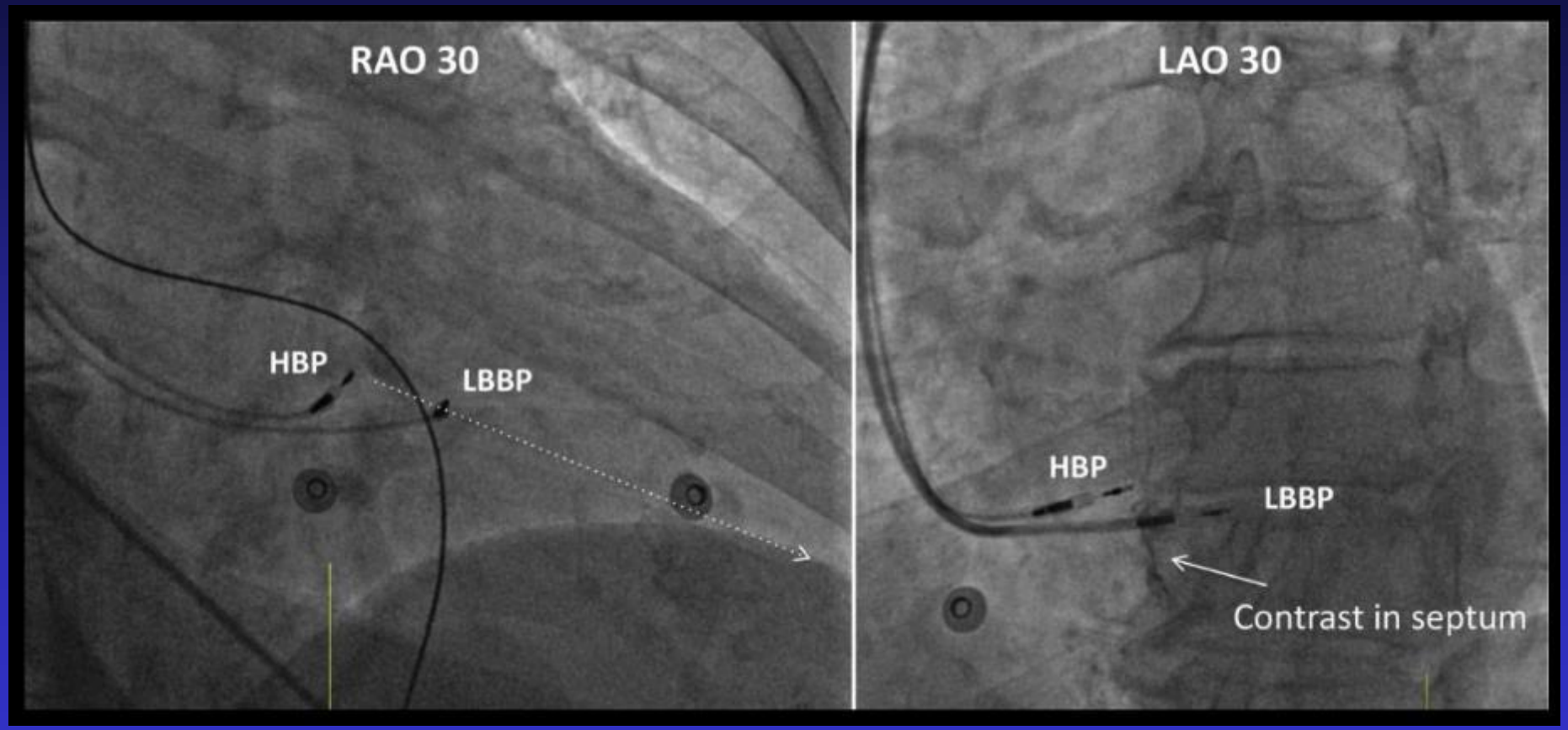


ECG 12 dérivation AVANT Stimulation Hissienne



ECG 12 dérivation APRES Stimulation Hissienne

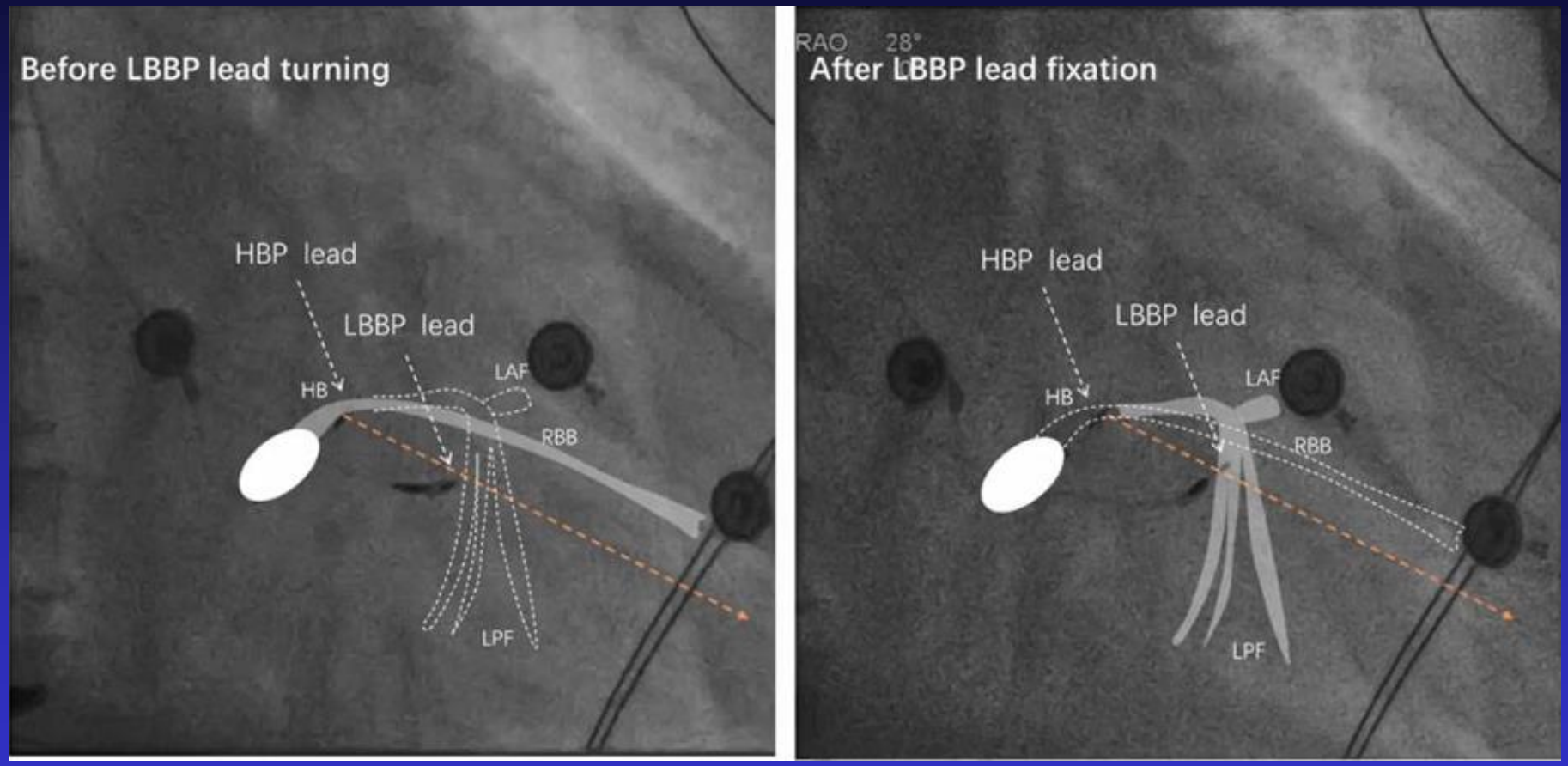
Stimulation de Branche Gauche



Localisation de la Branche Gauche en scopie

Vijayaraman P et al. Heart Rhythm. 2019. DOI: 10.1016/j.hrthm.2019.05.011

Stimulation de Branche Gauche



Vissage de la sonde dans la Branche Gauche

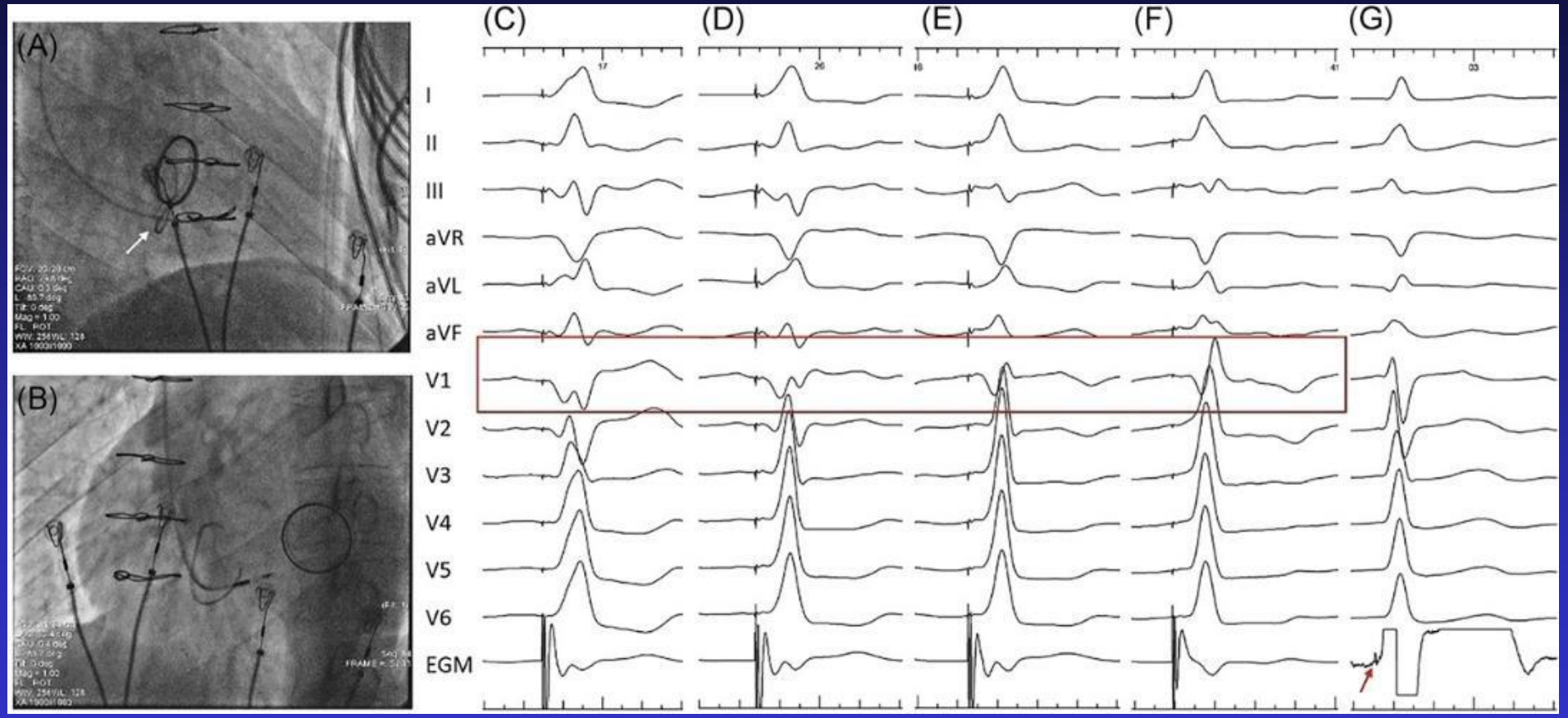
↑ 300-500 Ω

↓ ≈100 Ω

Aspect de Retard Droit en Stimulation

Vijayaraman P et al. Heart Rhythm. 2019. DOI: 10.1016/j.hrthm.2019.05.011

Stimulation de Branche Gauche



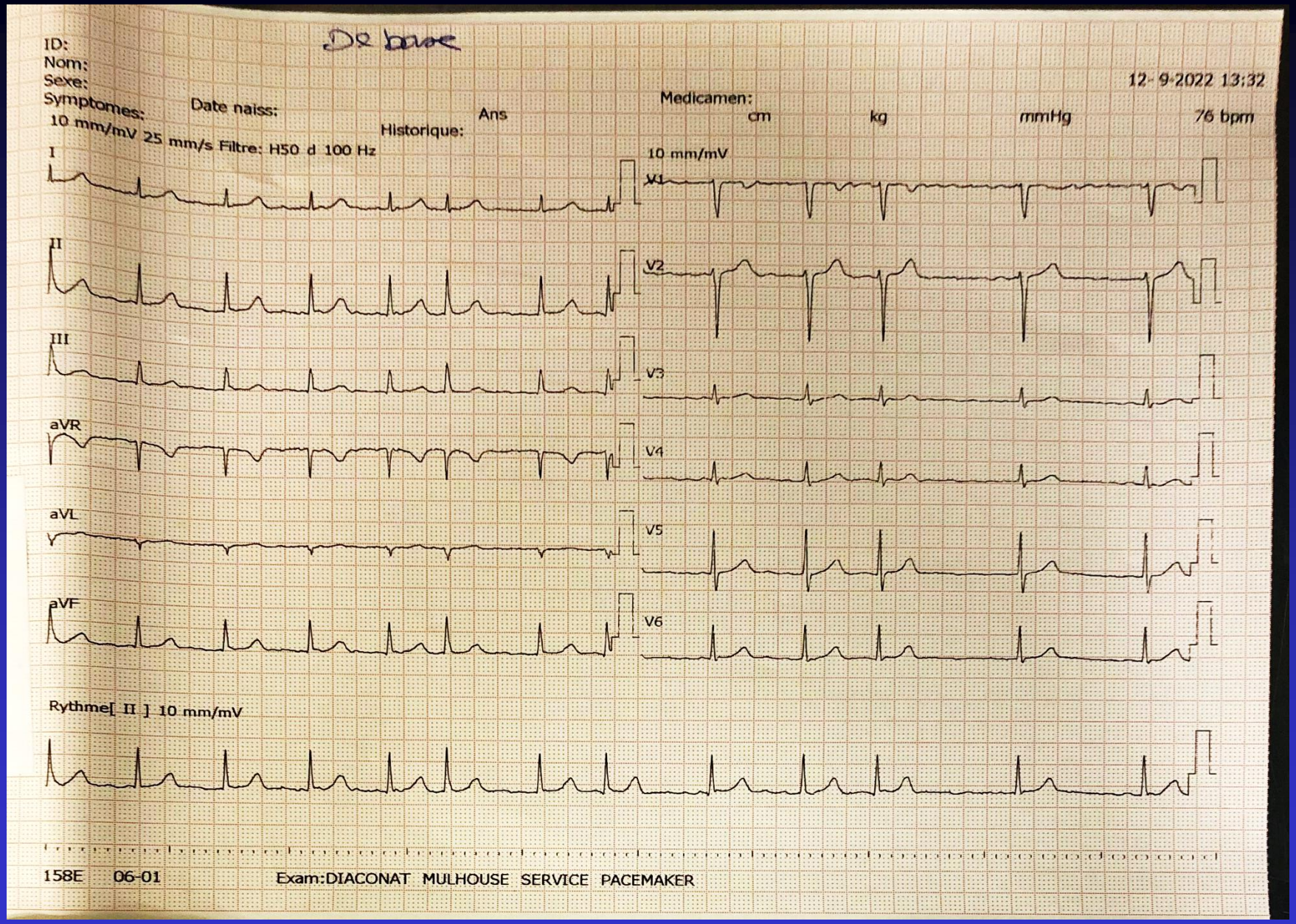
Vissage de la sonde dans la Branche Gauche

Vijayaraman P et al. Heart Rhythm. 2019. DOI: 10.1016/j.hrthm.2019.05.011

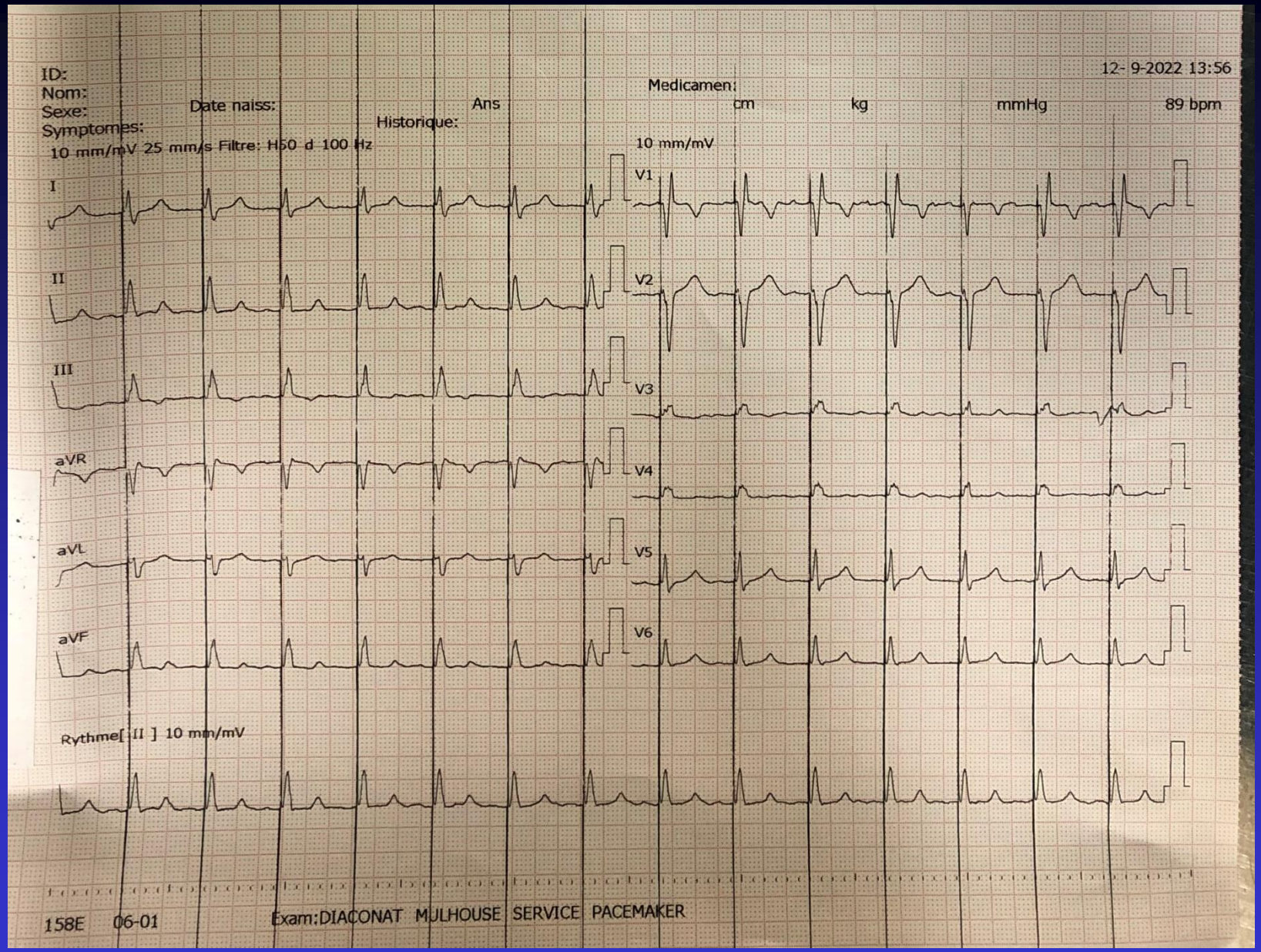
Stimulation de Branche Gauche

Scopie capture Branche Gauche

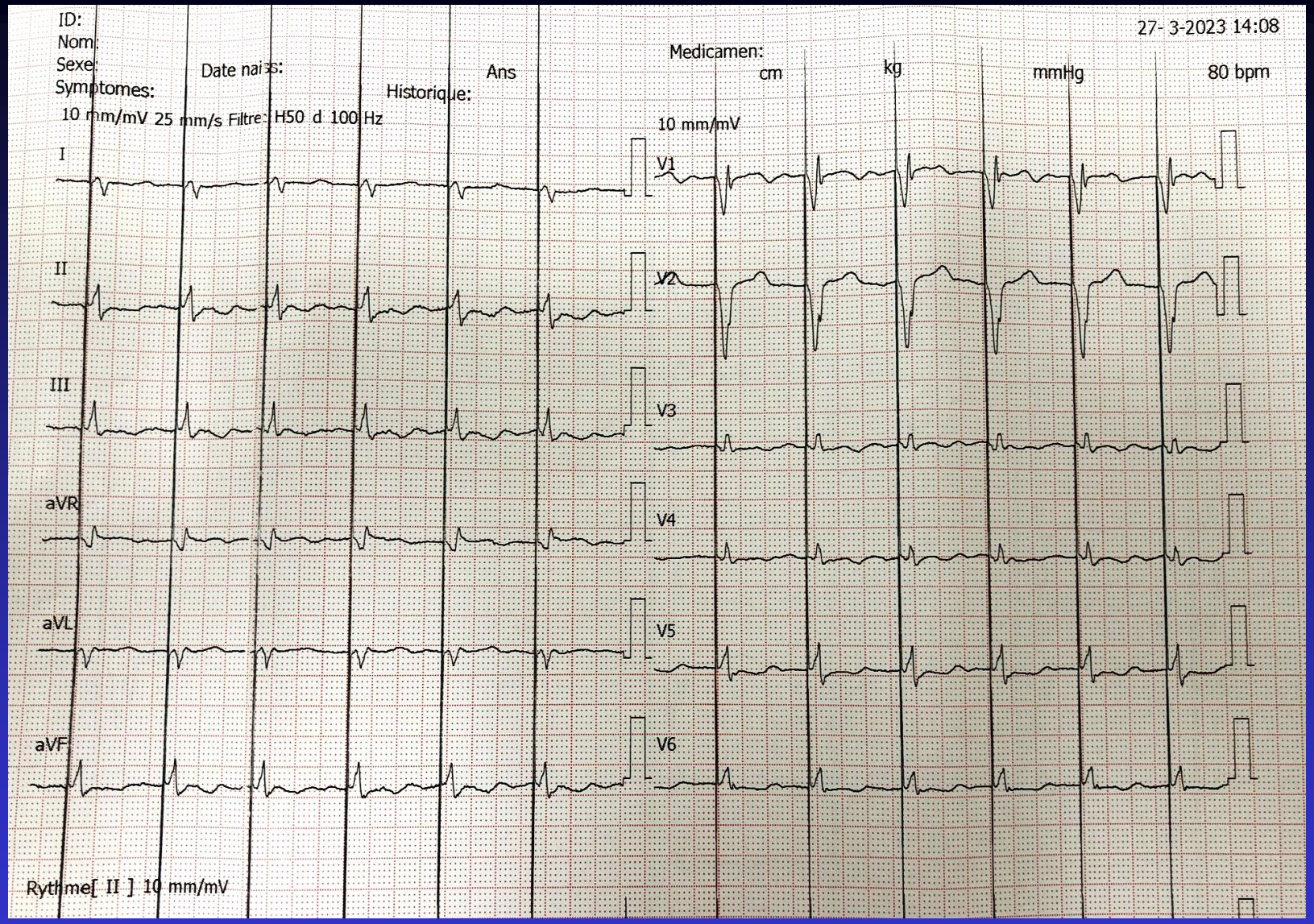
Vijayaraman P et al. Heart Rhythm. 2019. DOI: 10.1016/j.hrthm.2019.05.011



ECG 12 dérivation BASAL



ECG 12 dérivation APRES Capture de Branche Gauche



ECG 12 dérivation APRES Capture de Branche Gauche

HBP ou LBBP?

Supplementary Table 12 **Comparison of advantages and limitations of right ventricular pacing, His bundle pacing, and left bundle branch area pacing**

RV pacing	HBP	LBBAP
Advantages		
Long experience with good data on safety and efficacy Wide implementation of the technique Relatively short learning curve No requirement for an electrophysiological recording system or intraoperative 12-lead ECG Use of standard leads Clear labelling of MRI conditionality Good data on lead extraction	Endpoints well defined for successful His capture Use of standard (extendible helix) leads is possible Extractability has been demonstrated[93] Evidence for short-term safety and efficacy (although more randomized data are necessary)	Larger target area than with HBP Higher success rate in case of proximal block and potential to correct more distal conduction disease Low capture thresholds Good sensing parameters Consistent myocardial capture (in addition by anodal capture with the ring electrode) to avoid asystole in case of loss of left bundle capture No requirement for backup pacing leads AV nodal ablation without risk of compromising lead function (due to distant position of the pacing lead)
Limitations		
Non-physiological pacing with potential detrimental effect on cardiac function and clinical outcome Perforation of the ventricular free wall for non-septal pacing sites	Small target area Requires acquisition of new skills that may be unfamiliar to the device specialist (e.g. location of His bundle and interpretation of endocardial signals) Ideally requires an electrophysiological recording system for mapping the His (although also possible using a pacing system analyser and 12-lead ECG recorder) Relatively high capture thresholds resulting in earlier battery depletion	Successful conduction tissue capture may be more difficult to demonstrate Results in paced QRS with incomplete RBBB pattern (and possibly less electrical synchrony compared with HBP, especially in patients with normal baseline QRS) Electrophysiological recording system useful for mapping the left bundle branch or Purkinje potential and confirming left bundle branch capture with measurement of stimulus to R-wave peak duration (although

Continued

ESC Guidelines, Cardiac pacing and CRT, European Heart Journal (2021) 00, 1–94.

HBP ou LBBP?

Supplementary Table 12 ***Continued***

RV pacing	HBP	LBBAP
	Sensing issues (atrial and His oversensing, ventricular undersensing)[94]	also possible using a pacing system analyser and 12-lead ECG recorder)
	Limited to correction of proximal conduction block only	Currently only performed with a single lead model
		Risk of transseptal perforation (during and after implantation)
	Risk if distal conduction block develops over follow-up	May be challenging in patients with septal scar or septal hypertrophy
	High (approximately 7%) requirement for lead revision.[61,95] Limited experience with respect to lead performance during long-term follow-up	Limited (but growing) evidence for safety and efficacy.
	Backup ventricular leads may be indicated in case of sensing issues or for patient safety, resulting in more endovenous material, higher cost, and more complex programming[94]	No experience with respect to lead performance during long-term follow-up
		Long-term extractability needs to be demonstrated
	Risk of compromise of lead function with AV node ablation (due to proximity of ablation site to pacing lead)[68]	
	MRI conditionality may not be labelled, depending on the configuration (e.g. presence of a backup lead)	

ECG = electrocardiogram; HBP = His bundle pacing; LBBAP = left bundle branch area pacing; MRI = magnetic resonance imaging; RV = right ventricular.

ESC Guidelines, Cardiac pacing and CRT, European Heart Journal (2021) 00, 1–94.

Support Scientifique

Pour le patient

Clinical outcomes of conduction system pacing compared to biventricular pacing in patients requiring cardiac resynchronization therapy

Pugazhendhi Vijayaraman, MD, FHRS,[*†] Dipen Zalavadia, MD,[*] Abdul Haseeb, MD,[*] Cicely Dye, MD,[‡] Nidhi Madan, MD,[‡] Jamario Renaldo Skeete, MD,[‡] Sharath C. Vipparthy, MD,[‡] Wilson Young, MD, PhD,[†§] Venkatesh Ravi, MD,[‡] Clement Rajakumar, BS,[†] Parash Pokharel, MD,[¶] Timothy Larsen, DO,[‡] Henry D. Huang, MD, FHRS,[‡] Randle H. Storm, MD, FHRS,[¶] Jess W. Oren, MD,[¶] Syeda Atiqa Batul, MBBS, MD,[*] Richard G. Trohman, BS, MBA, MD, FHRS,[‡] Faiz A. Subzposh, MD,[*] Parikshit S. Sharma, MD, MPH, FHRS[‡]

From the [*]Geisinger Heart Institute, Wilkes Barre, Pennsylvania, [†]Geisinger Commonwealth School of Medicine, Scranton, Pennsylvania, [‡]Rush University Medical Center, Chicago, Illinois, [§]Geisinger Heart Institute, Scranton, Pennsylvania, and [¶]Geisinger Heart Institute, Danville, Pennsylvania.

Vijayaraman and al, Heart Rythm 2022; 1-9, May 2022

Support Scientifique

Pour le patient

CRT conventionnel vs CSP (HBP/LBBP)

- Etude observationnelle, per protocole (patients inclus aprés succés BVP ou CSP)

- Critère primaire combiné :

Hospitalisations pour I. cardiaque et Décès

- 447 patients (BVP 219 ; CSP 258 [HBP 87, LBBAP 171])
- Age moyen 72 ± 12 ans, LVEF was 26% ± 6%
- Suivi moyen 27 ± 12 mois

Vijayaraman and al, Heart Rythm 2022; 1-9, May 2022 © 2022 Heart Rythm Society.

Support Scientifique

Pour le patient

- <u>Taux de succés</u>

  CSP 86% (205/239 patients) → 34 patients BVP
  BVP 74% (185/238 patients) → 53 patients CSP

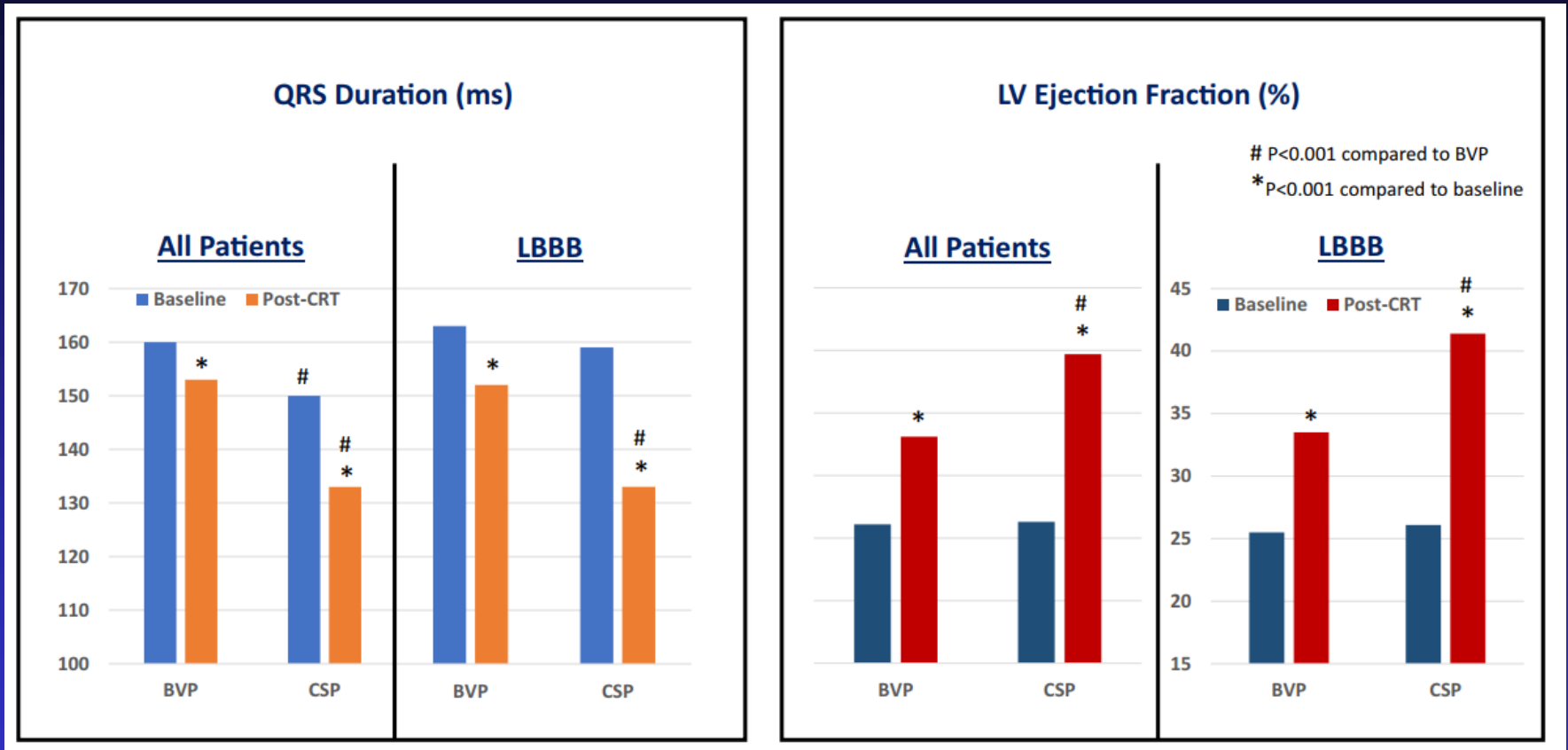
- <u>Seuils</u> plus bas en CSP vs BVP

  BVP 1.3 ± 0.6V @ 0.6 ± 0.2ms
  LBBAP 0.8 ± 0.4V @ 0.5 ± 0.1ms et HBP 1.1 ± 0.7V @ 0.9 ± 0.2ms, P = 0.01

- Elévations de seuil tardifs (≈ 3%) et revisions de sonde (≈2,5%) NS

Vijayaraman and al, Heart Rythm 2022; 1-9, May 2022 © 2022 Heart Rythm Society.

Support Scientifique

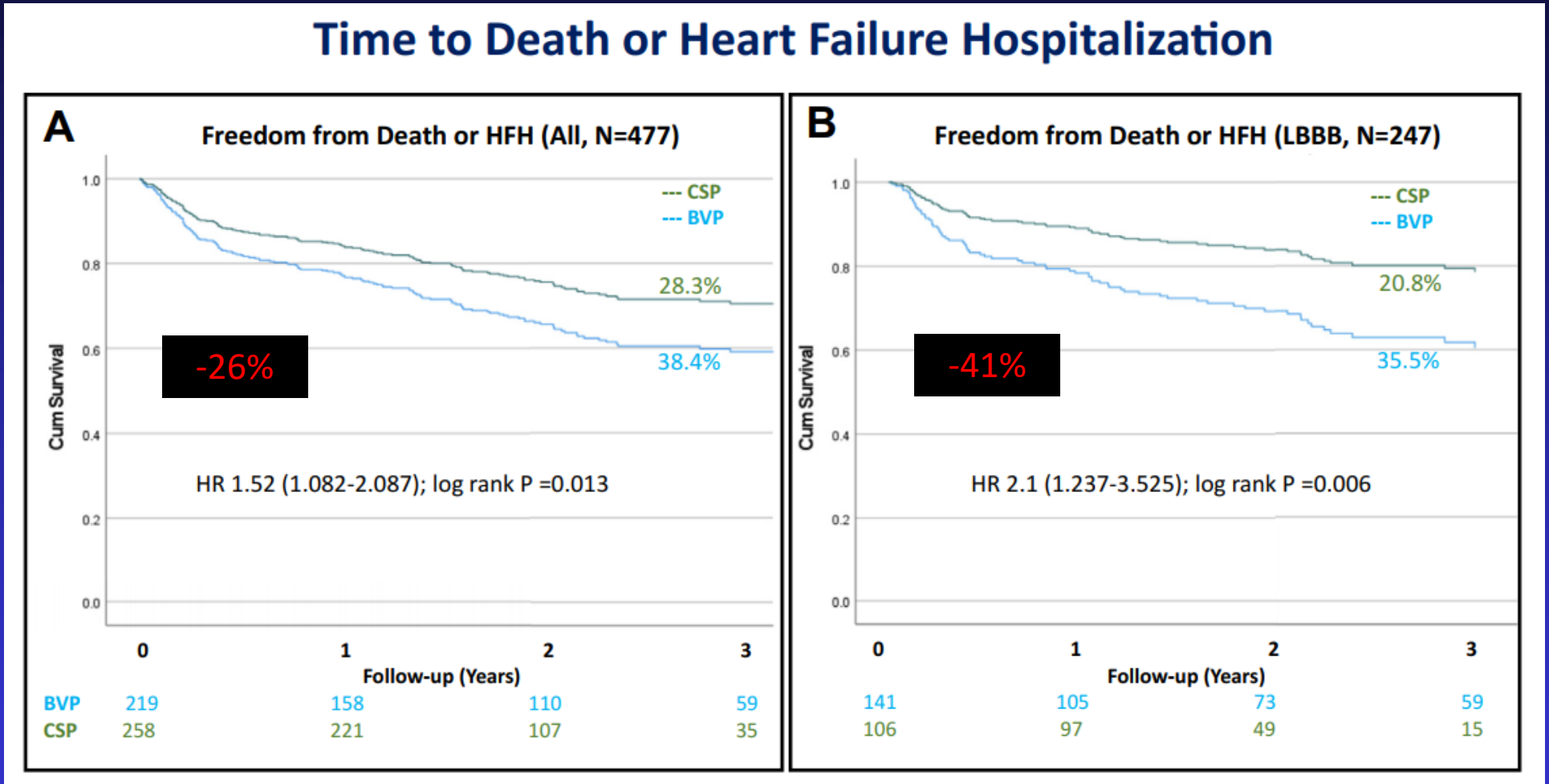


BVP 153 ± 24ms vs CSP 133 ± 21ms (*P* = .001)

BVP 26.1 ± 6.3 → 33.1% ± 12%
CSP 26.4 ± 6.5 → 39.7% ± 13%
(*P* = .001)

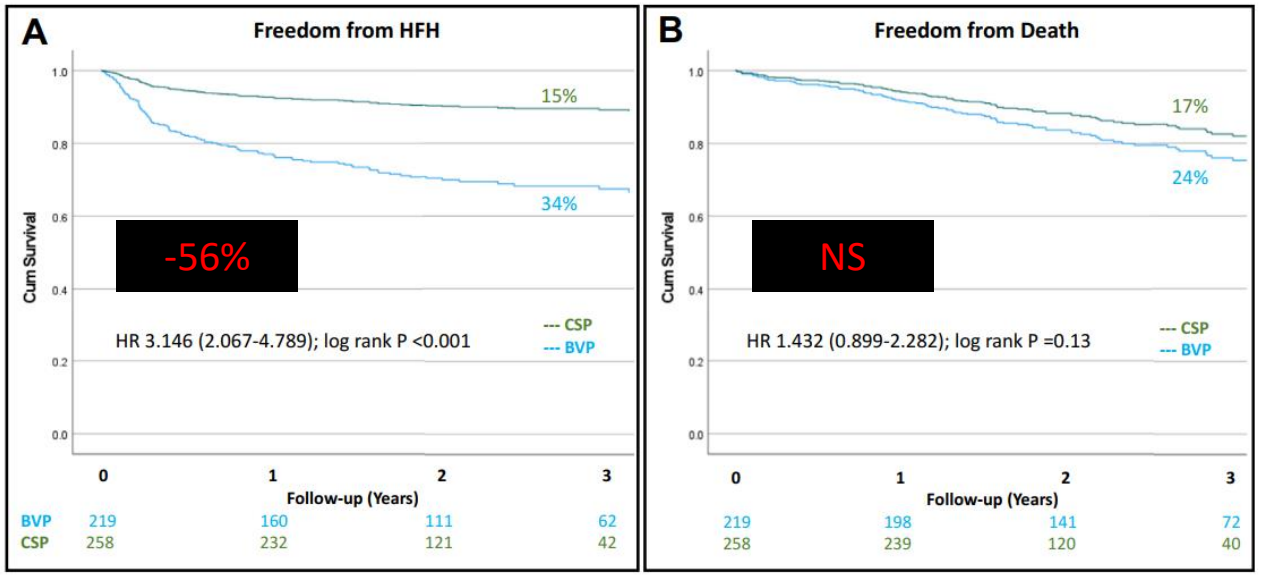
Vijayaraman and al, Heart Rythm 2022; 1-9, May 2022 © 2022 Heart Rythm Society.

Support Scientifique

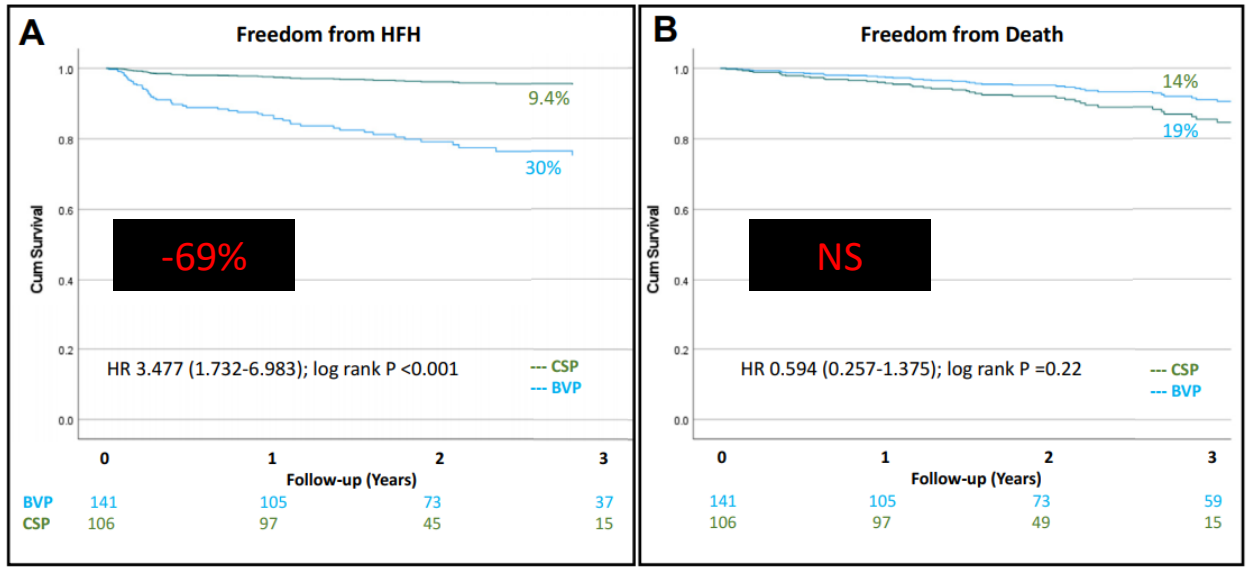


Vijayaraman and al, Heart Rythm 2022; 1-9, May 2022 © 2022 Heart Rythm Society.

Secondary Outcomes in All Patients (N=477)



Secondary Outcomes in Patients with LBBB (N=247)



Vijayaraman and al, Heart Rythm 2022; 1-9, May 2022 © 2022 Heart Rythm Society.

Support Scientifique

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY VOL. 80, NO. 13, 2022

PUBLISHED BY ELSEVIER

ORIGINAL INVESTIGATIONS

Randomized Trial of Left Bundle Branch vs Biventricular Pacing for Cardiac Resynchronization Therapy

Yao Wang, MD, PhD,[a,*] Haojie Zhu, MD,[b,*] Xiaofeng Hou, MD,[a] Zhao Wang, MD, PhD,[b] Fengwei Zou, MD,[c] Zhiyong Qian, MD, PhD,[a] Yongyue Wei, MD, PhD,[d] Xiang Wang, BSc,[d] Longyao Zhang, MD,[d] Xiaofei Li, MD,[b] Zhimin Liu, MD,[b] Siyuan Xue, MD,[a] Chaotong Qin, MD,[a] Jiaxin Zeng, MD,[a] Hui Li, MD,[b] Hongping Wu, MD,[a] Hong Ma, MD,[a] Kenneth A. Ellenbogen, MD,[e] Michael R. Gold, MD, PhD,[f] Xiaohan Fan, MD, PhD,[b] Jiangang Zou, MD, PhD,[a,g] on behalf of the LBBP-RESYNC Investigators

Wang et al, JACC; Vol. 80, NO. 13, 2022 September 27,2022:1205-1216

Support Scientifique

Pour le praticien

CRT conventionnel vs LBBP

- **Etude prospective, randomisée**
- Cardiomyopathie NON ischémique, BBGC
- Crossover autorisé si échec (ITT et per protocole)

- Critère primaire

Comparaison de l'Evolution de la FEVG

- Critère secondaire
  - Autres mesures ETT, NT-ProBNP, NYHA, test de marche de 6 minutes, durée des QRS, réponse à la CRT

Wang et al, JACC; Vol. 80, NO. 13, 2022 September 27,2022:1205-1216

Support Scientifique

Pour le praticien

CRT conventionnel vs LBBP

- 40 patients (50% femmes)
- Age moyen 63 ± 7 ans, LVEF was 29,7% ± 5,6%
- Suivi moyen 6 mois (préspécifié)
- Crossover 10% groupe LBBP et 20% groupe BiVP-CRT

Wang et al, JACC; Vol. 80, NO. 13, 2022 September 27,2022:1205-1216

Support Scientifique

Pour le praticien

CRT conventionnel vs LBBP

- Résultats

↑ plus importante de la FEVG à 6 mois pour LBBP
+5.6% LBBP vs BiVCRT; 95% CI: 0.3-10.9; P : 0.039 (ITT)

- Amélioration Volume Télésystolique VG et NT-ProBNP
- Pas de difference NYHA, test de marche de 6 minutes, durée des QRS, réponse à la CRT

Wang et al, JACC; Vol. 80, NO. 13, 2022 September 27,2022:1205-1216

TABLE 2 The Procedure-Related Data of LBBP and Coronary Sinus Left Ventricular Lead Implantation

	LBBP-CRT (n = 20)	BiVP-CRT (n = 20)
Success rate	18 (90)	16 (80)
Paced QRSd, ms	131.5 ± 12.5	136.6 ± 12.9
LVAT, ms	79.73 ± 9.94	
Threshold, mV		
At implantation	0.69 ± 0.26	0.92 ± 0.40
3-month	0.65 ± 0.22	1.34 ± 0.80
6-month	0.82 ± 0.20	1.12 ± 0.67
Impedance, Ω		
At implantation	579 ± 160	522 ± 183
3-month	483 ± 69	566 ± 210
6-month	476 ± 93	592 ± 214
Procedure time, min	129.25 ± 31.69	155.92 ± 40.70
X-ray exposure time, min	11.95 ± 5.77	18.66 ±10.12
Implantation time of lead, min	44.17 ± 22.22	55.50 ± 28.36
Devices		
CRTD	14 (70)	17 (85)
CRTP	6 (30)	3 (15)
Complication		
Pneumothorax	0 (0)	1 (5)
Pericardial tamponade	0 (0)	0 (0)
Lead dislodgement, %	1 (5)[a]	0 (0)

Values are n (%) or mean ± SD. [a]1 patient in the LBBP-CRT group had dislodgement of the coronary sinus left ventricular lead 2 days after the procedure.

CRT = cardiac resynchronization therapy; CRTD = cardiac resynchronization therapy with defibrillator; CRTP = cardiac resynchronization therapy without defibrillator; LVAT = left ventricular activation time; QRSd = QRS duration; other abbreviations as in Table 1.

Wang et al, JACC; Vol. 80, NO. 13, 2022 September 27,2022:1205-1216

Support Scientifique

Recommendations	Class[a]	Level[b]
In patients treated with HBP, device programming tailored to specific requirements of HBP is recommended.[430,431]	I	C
In CRT candidates in whom coronary sinus lead implantation is unsuccessful, HBP should be considered as a treatment option along with other techniques such as surgical epicardial lead.[318,424,440,443]	IIa	B
In patients treated with HBP, implantation of an RV lead used as 'backup' for pacing should be considered in specific situations (e.g. pacemaker dependency, high-grade AVB, infranodal block, high pacing threshold, planned AVJ ablation) or for sensing in the case of issues with detection (e.g. risk of ventricular undersensing or oversensing of atrial/His potentials).[423,426,444]	IIa	C

ESC Guidelines, Cardiac pacing and CRT, European Heart Journal (2021) 00, 1–94.

Support Scientifique

HBP with a ventricular backup lead may be considered in patients in whom a 'pace-and-ablate' strategy for rapidly conducted supraventricular arrhythmia is indicated, particularly when the intrinsic QRS is narrow.[197,199,200,318]	IIb	C
HBP may be considered as an alternative to RV pacing in patients with AVB and LVEF >40%, who are anticipated to have >20% ventricular pacing.[42,433]	IIb	C

bundle branch area pacing cannot therefore be formulated at this stage. However, conduction system pacing (which includes HBP and left bundle branch area pacing) is very likely to play a growing role in the future, and the current recommendations will probably need to be revised once more solid evidence of safety and efficacy (from randomized trials) is published. A comparison of RV pacing, HBP, and left bundle

ESC Cardiac Pacing and CRT Guidelines, European Heart Journal (2021) 42, 3427–3520.

Conclusion

- 2 nouvelles techniques de capture de voies de conduction « physiologiques » du patient (Conduction System Pacing)
  - Stimulation Hissienne
  - Capture de Branche Gauche

- Intérêts pour le patient
  - Probable amélioration de la morbi-mortalité
  - ↓ Hospitalisations pour Insuffisance cardiaque et ↓ mortalité

Conclusion

- Intérêts pour le praticien
  - Moins de temps d'intervention
  - Moins d'irradiation
  - Taux de complications similaire, moins graves?

Nécessité d'une étude prospective randomisée multicentrique de grande ampleur


THANK YOU
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ATTENTION
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Miguel Navarro