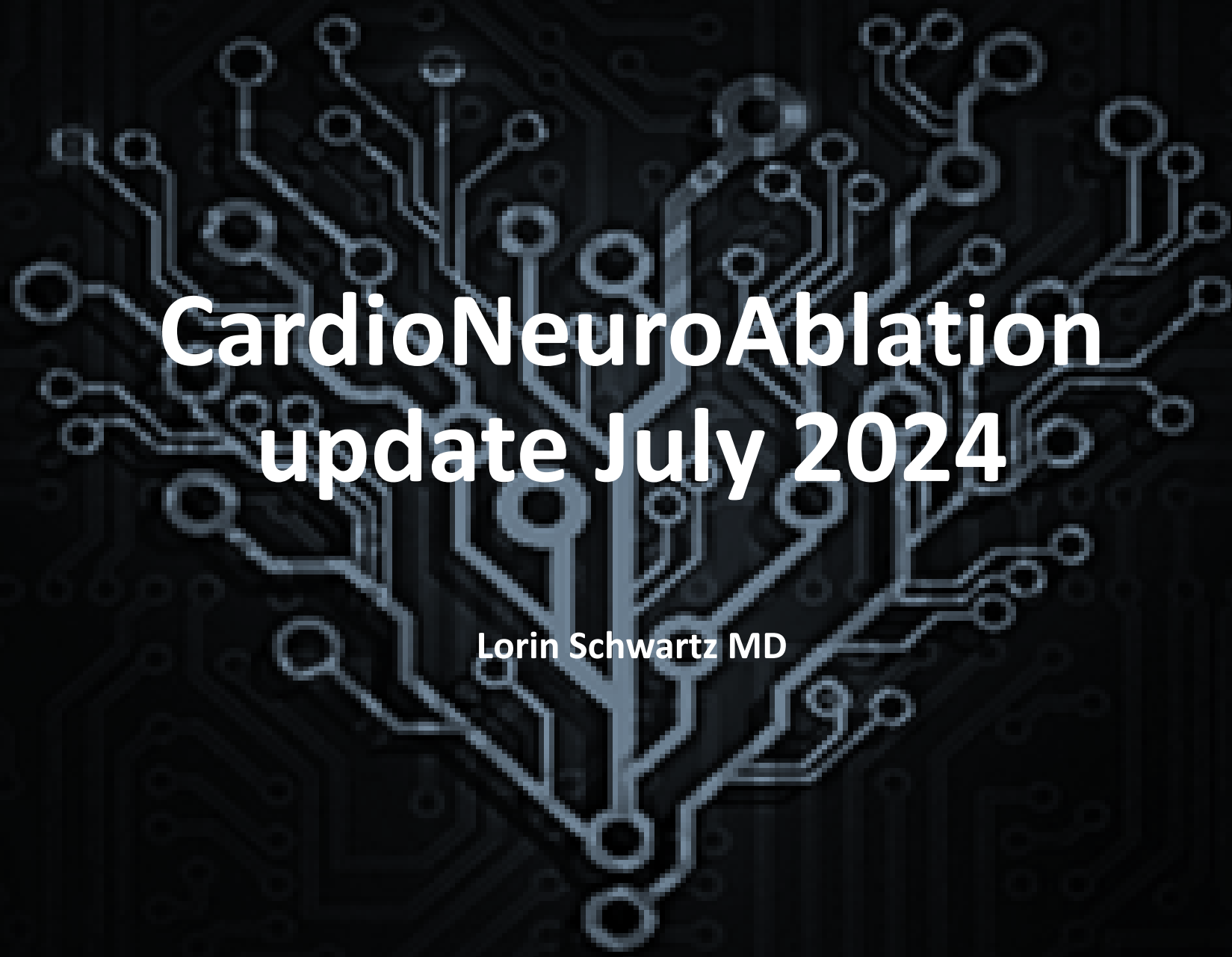
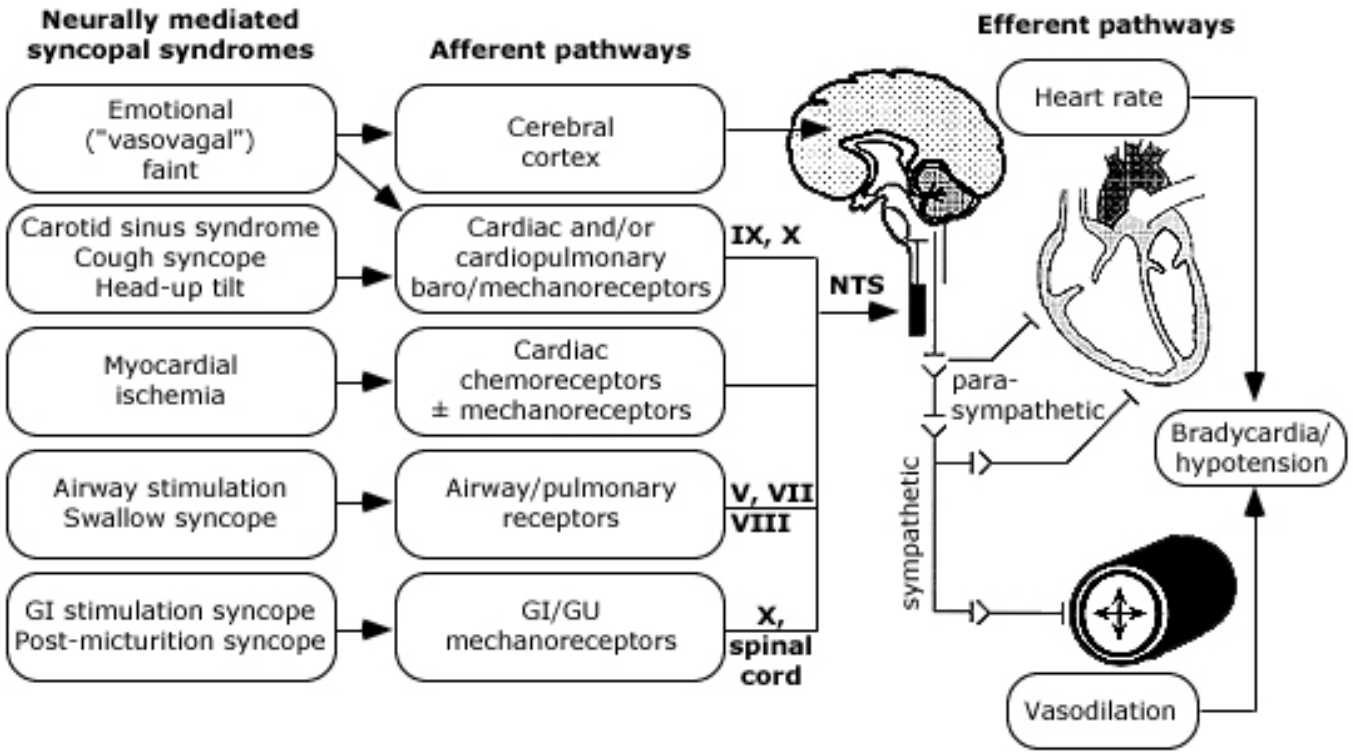
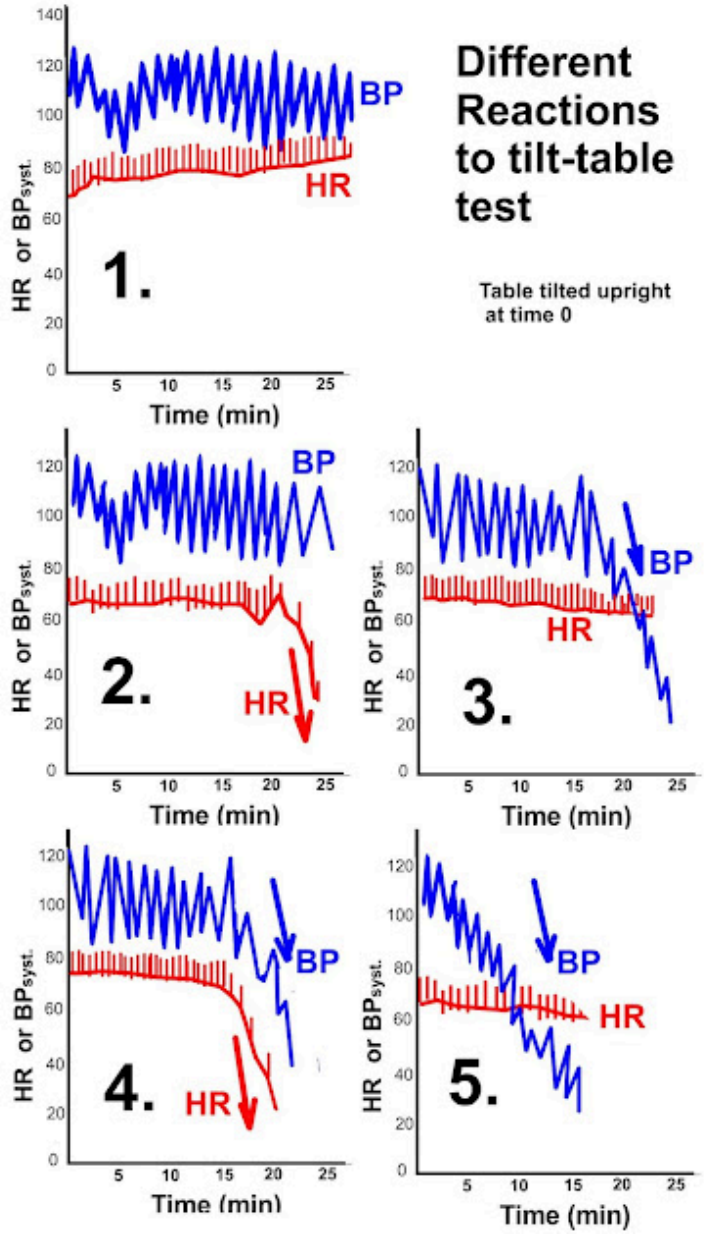


CardioNeuroAblation update July 2024

Lorin Schwartz MD

-> Trigger
-> Decrease in LV filling (tilt test)
-> Afferent receptor activation and
-> Initial increase in sympathetic outflow
-> Vigorous LV contraction (underfilled LV)
-> Rebound reduction in sympathetic activity
-> Leaving unopposed parasympathetic activity
-> Vasodilatation and/or bradycardia
-> SYNCOPE.....





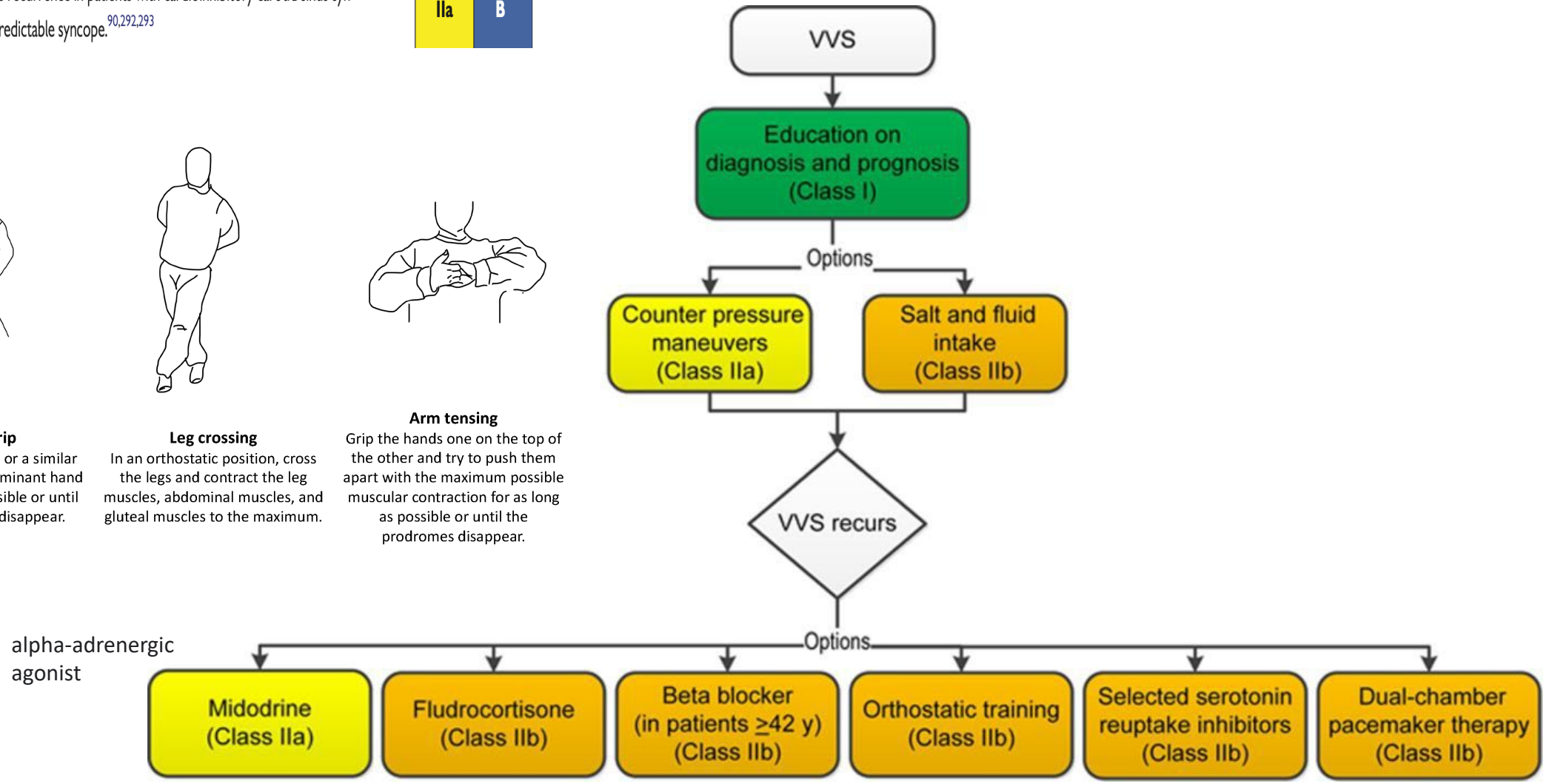
Modified from Braunwald's "Heart Disease" book

Cardiac pacing		
Cardiac pacing should be considered to reduce syncopal recurrences in patients aged >40 years, with spontaneous documented symptomatic asystolic pause(s) >3 s or asymptomatic pause(s) >6 s due to sinus arrest, AV block, or the combination of the two.[184,185,200,292]	IIa	B
Cardiac pacing should be considered to reduce syncope recurrence in patients with cardioinhibitory carotid sinus syndrome who are >40 years with recurrent frequent unpredictable syncope.[90,292,293]	IIa	B

Hand grip
Grip a rubber ball or a similar object with the dominant hand for as long as possible or until the prodromes disappear.

Leg crossing
In an orthostatic position, cross the legs and contract the leg muscles, abdominal muscles, and gluteal muscles to the maximum.

Arm tensing
Grip the hands one on the top of the other and try to push them apart with the maximum possible muscular contraction for as long as possible or until the prodromes disappear.



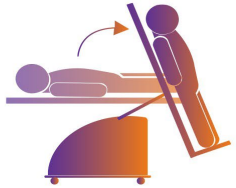
alpha-adrenergic agonist

Severe, unpredictable and recurrent vasovagal syncope

Education and lifestyle modifications

Physical counter-pressure maneuvers

Demonstration of cardioinhibitory mechanism



HUT

ILR

Spontaneous syncope in the presence of an asystolic pause >3 s

Symptomatic asystolic pause(s) >3 s

Asymptomatic pause(s) >6 s due to sinus arrest or AVB

Age <40 years

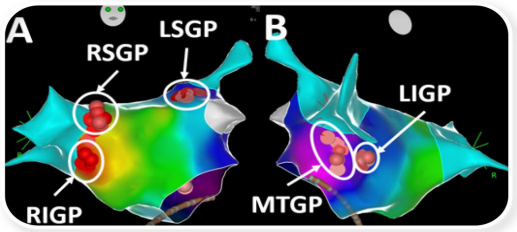
CNA first*

Age 40-60 years

Individualized approach

Age >60 years

DDD-CLS first



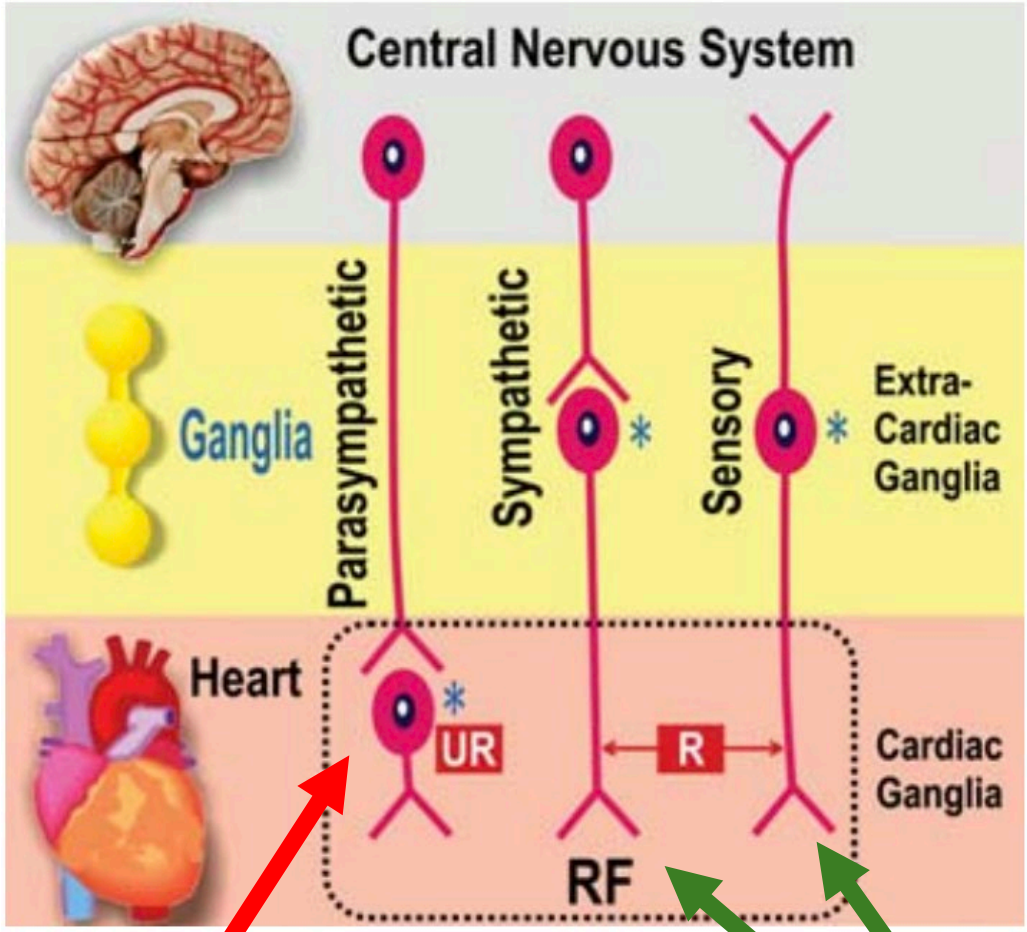
CNA if cardiac pacing has failed or a pacemaker if CNA has failed

Eur Heart J, Volume 44, Issue 27, 14 July 2023, Pages 2443–2446

Who to consider for cardioneuroablation

- Cardioinhibitory VVS
- Mixed VVS – if pause preceeds hypotension
- Cardioinhibitory carotid sinus syndrome
- Functional AVB
- Vagal hypertonicity
- Vagally-mediated AF as adjuvant to CPVI

Anatomy and interrelation of GPs

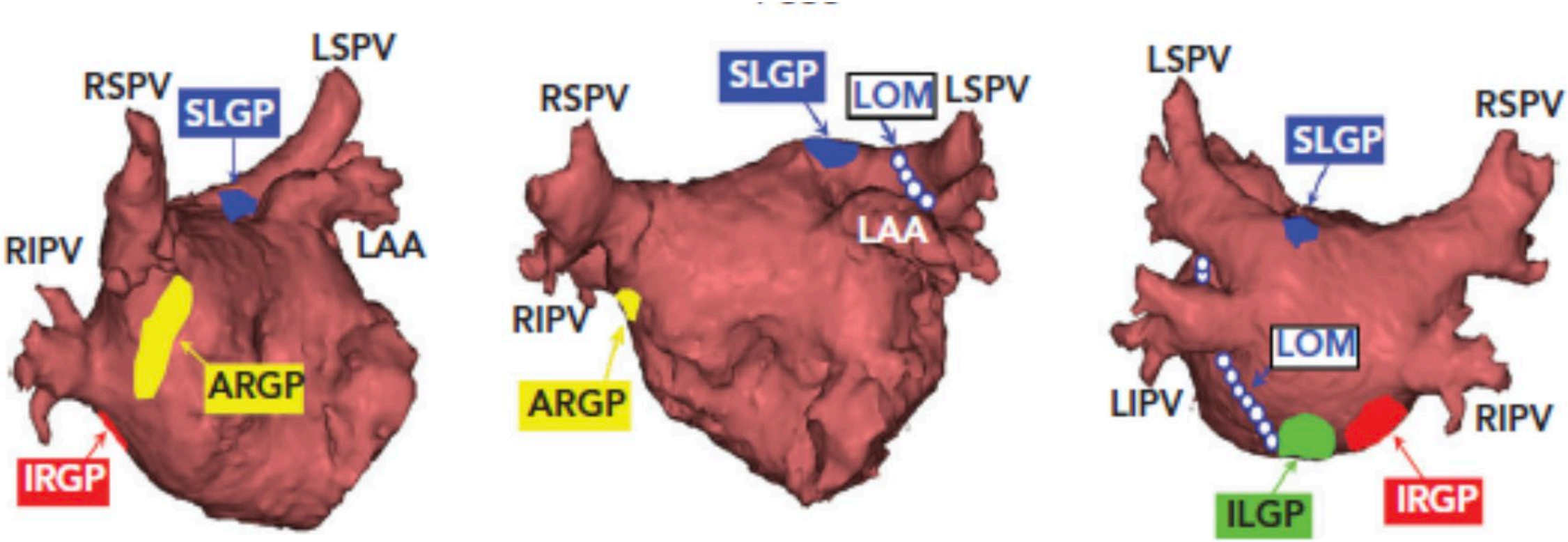


Lack of regeneration

Regeneration

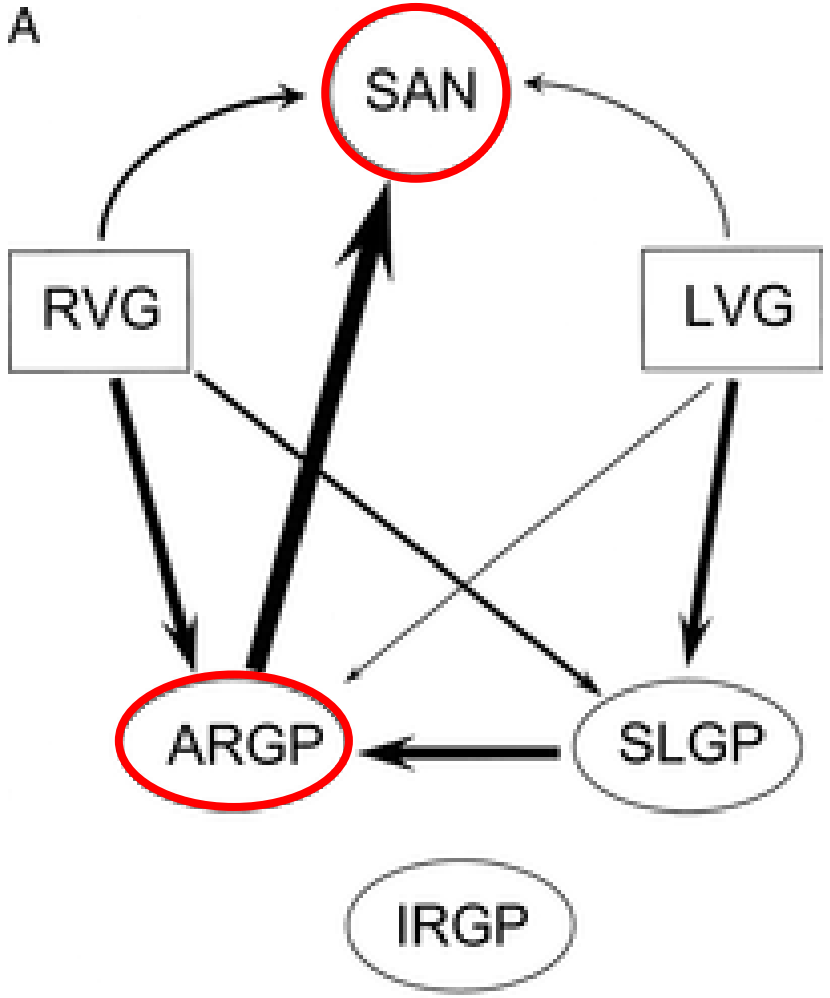
Jose Carlos Pachon et al, Europace (2011) 13, 1231–1242

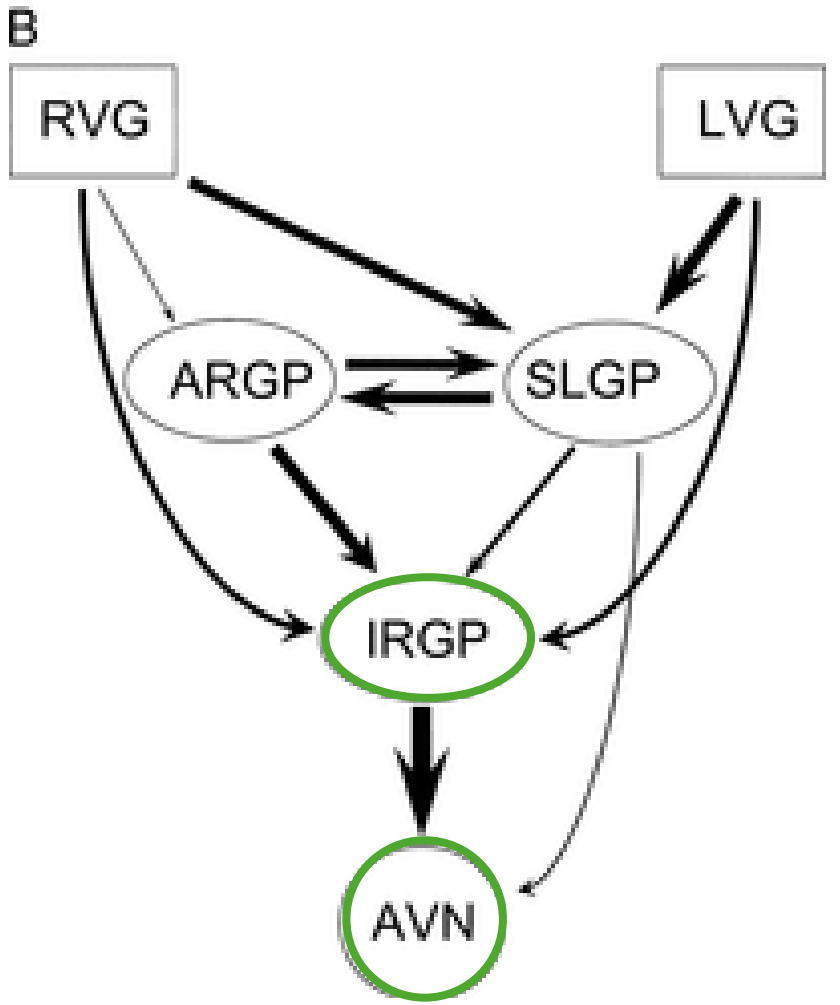
GP are localised in the epicardial fat, close to PV ostia and ligament of Marshall



Arrhythmia & Electrophysiology Review 2017;6(4):186–90

Canine model – 28 dogs





anterior right GP (ARGP)
inferior right ganglionated plexi (IRGP)
superior left ganglionated plexi (SLGP)

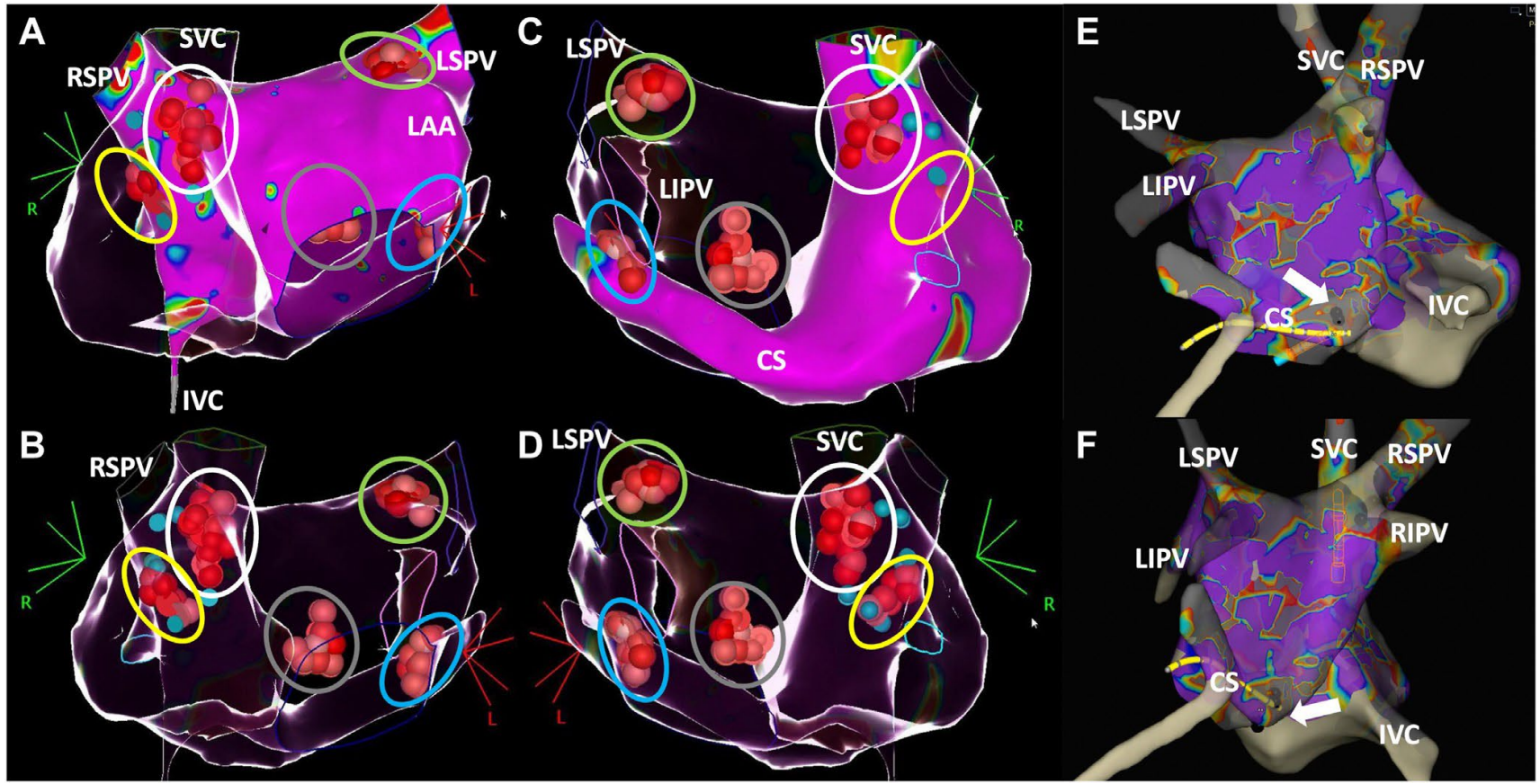
Yinglong Hou et al. *J Am Coll Cardiol* 2007; 50:61-68.

A: LA - AP view

B: LA - PA view

C: RA - PA view.

D: RA+LA PA view



White circle - superior RAGP - posterosuperior surface of the right atrium (RA) below the SVC/RA junction
Yellow circle - posterior (inferior) RAGP - adjacent to the interatrial groove
Green circle - superior LAGP - posterosuperior surface of the left atrium (LA) between the pulmonary vein
Gray circle - left inferior (posterolateral) GP - the posterolateral surface of the LA.
Blue circle - the Marshall tract GP
White arrow - posteromedial LAGP - postero-medial surface of the LA

Heart Rhythm 2024;21:100–105

GP terminology

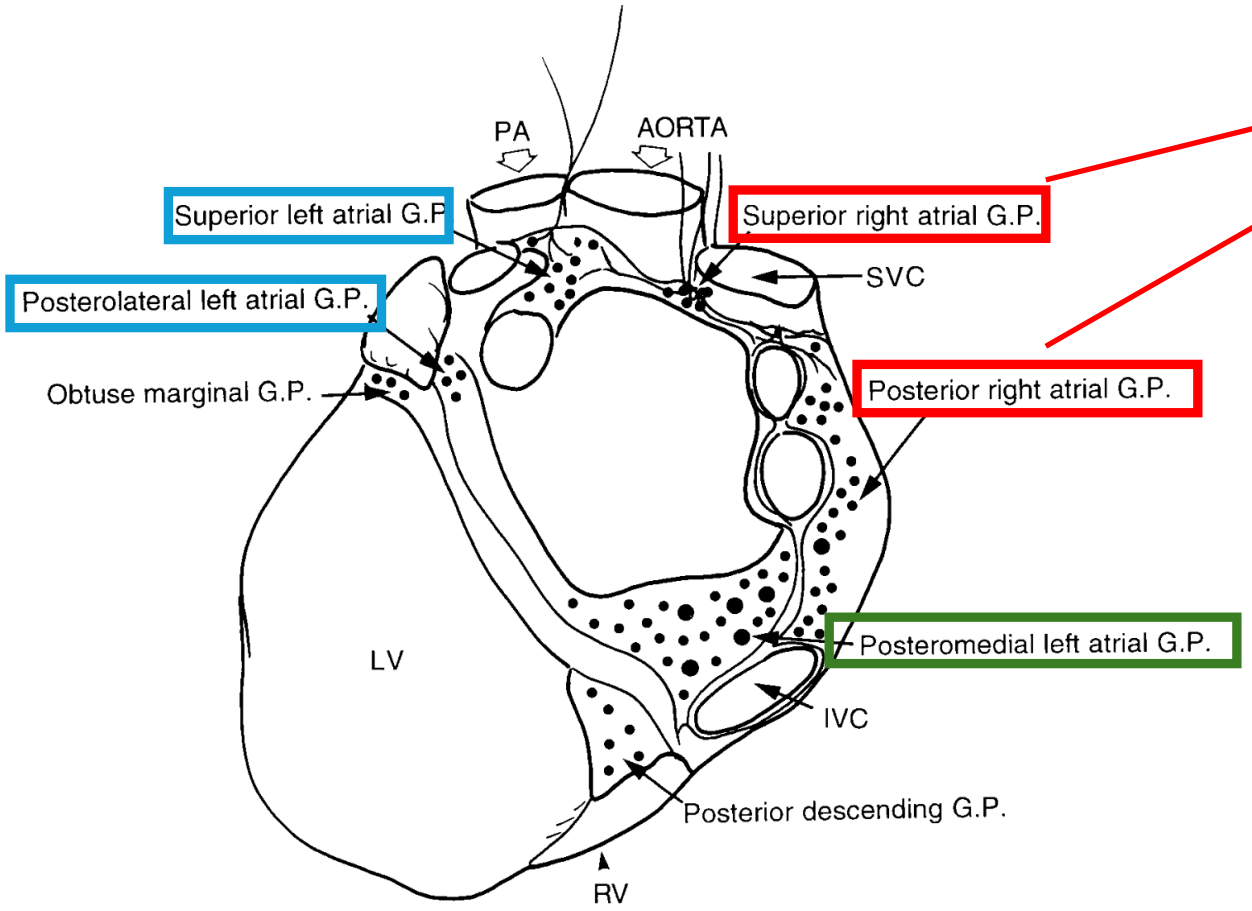


Fig. 1. Drawing of a posterior view of the human heart and major vessels illustrating the locations of posterior atrial and ventricular ganglionated plexuses. Note the mediastinal nerves coursing adjacent to the aortic root and joining the two superior atrial ganglionated plexuses. Positions of the superior vena cava (SVC), inferior vena cava (IVC), right ventricle (RV), and left ventricle (LV) are shown.

SAN innervation mostly originates from right superior GP and right posterior GP

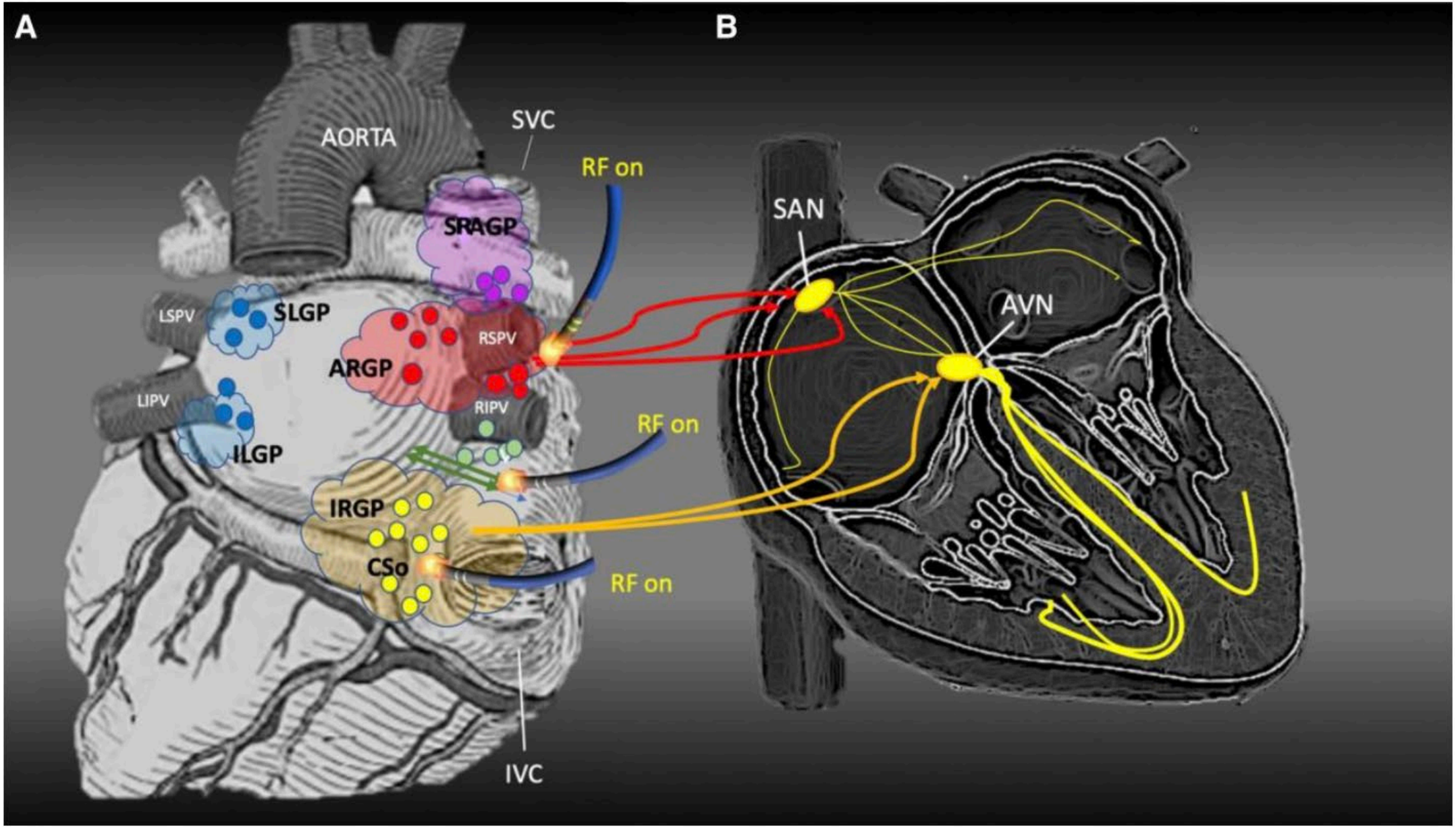
AVN innervation mostly originates from right posterior GP and left postero-medial GP

Proposed new terminology – Prof. Kulakowski

Superior paraseptal GP = RAGP, RSGP

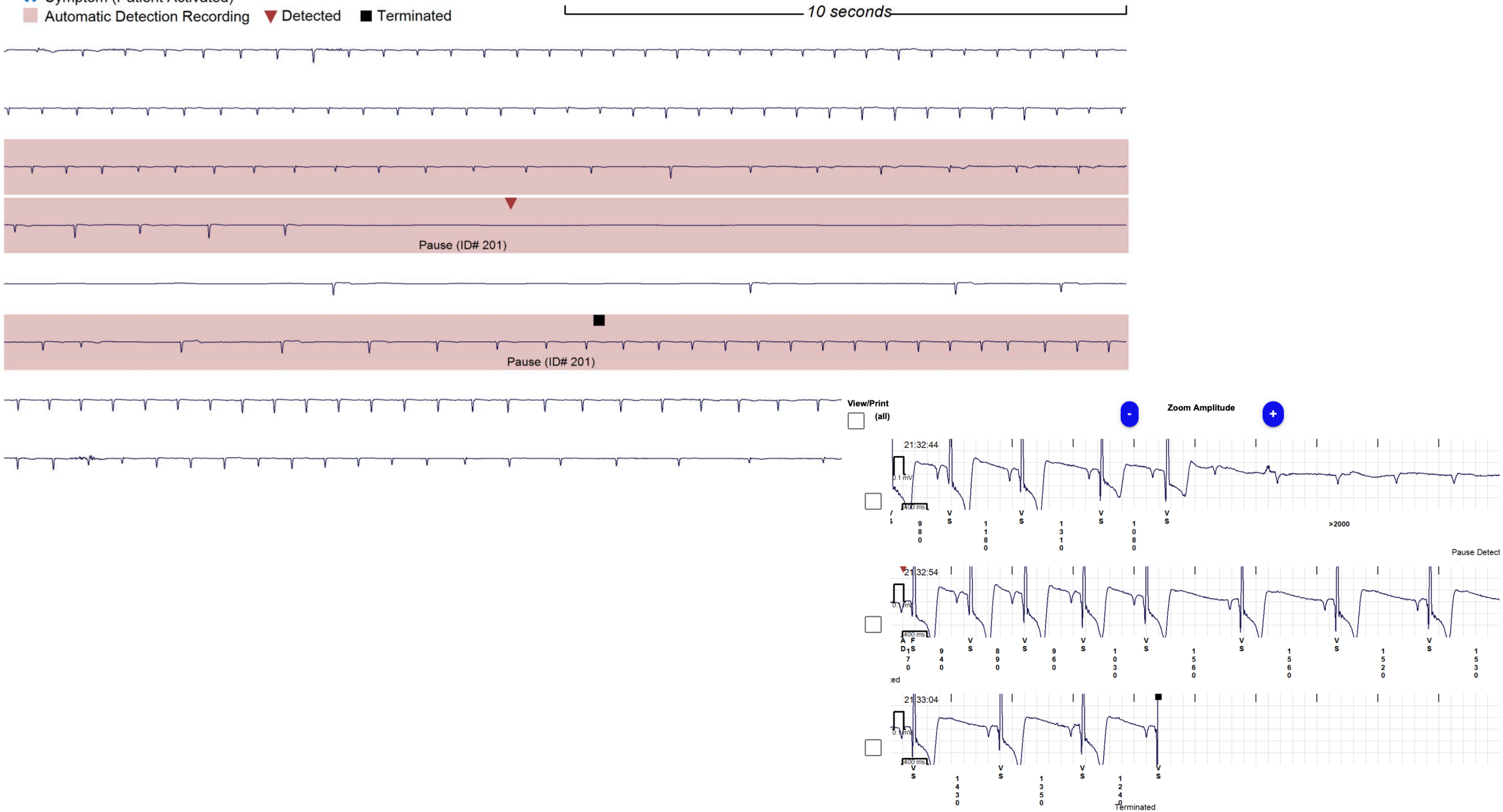
Inferior PS GP = PMLAGP, IRGP, LIGP

Armour et al. THE ANATOMICAL RECORD 247:289–298 (1997)r1997 WILEY-LISS, INC.



European Heart Journal Supplements (2023) 25 (Supplement C), C261–C264

Patient preparation


Automatic Detection Recording
Detected
Terminated
10 seconds
Pause (ID# 201)
Pause (ID# 201)
View/Print
(all)
Zoom Amplitude
21:32:44
21:32:54
21:33:04
Pause Detect
Terminated

Functional SNA and AVB

- Exclusion of intrinsic disease of the SAN/AVN
- Exercise test - chronotropic competence
- Atropine testing –
  - at least 24 hours before CNA.
  - IV Atropine sulfate bolus (0.04 mg/kg; maximum 3 mg) under continuous electrocardiography.
  - Positive test- heart rate increases by 25% or accelerates to 90 beats/min.
  - Reversal of AV block
- EPS – normal SNRT (if equivocal repeat under Atropine) / exclusion of infranodal disease

Consious sedation vs general anesthesia

- General anesthesia –
  - basal HR
  - May blunt vagal response
  - Muscle relaxants - Phrenic pacing

- Conscious sedation
  - May blunt basal HR – Delta HR may decrease with RF
  - Deep sedation may blunt vagal response

EAM mapping

- Bipolar map of both atria
- Annotation of sinus node, His bundle and phrenic nerve capture sites.
- GP localization

Techniques for GP identification:

1- High-frequency stimulation (HFS) to presumed GP sites

20 Hz, 10–30 V; pulse width 1-10 ms, 2-5 seconds duration

Positive vagal response (asystole, AV block or PP -or- RR increase > 50%)

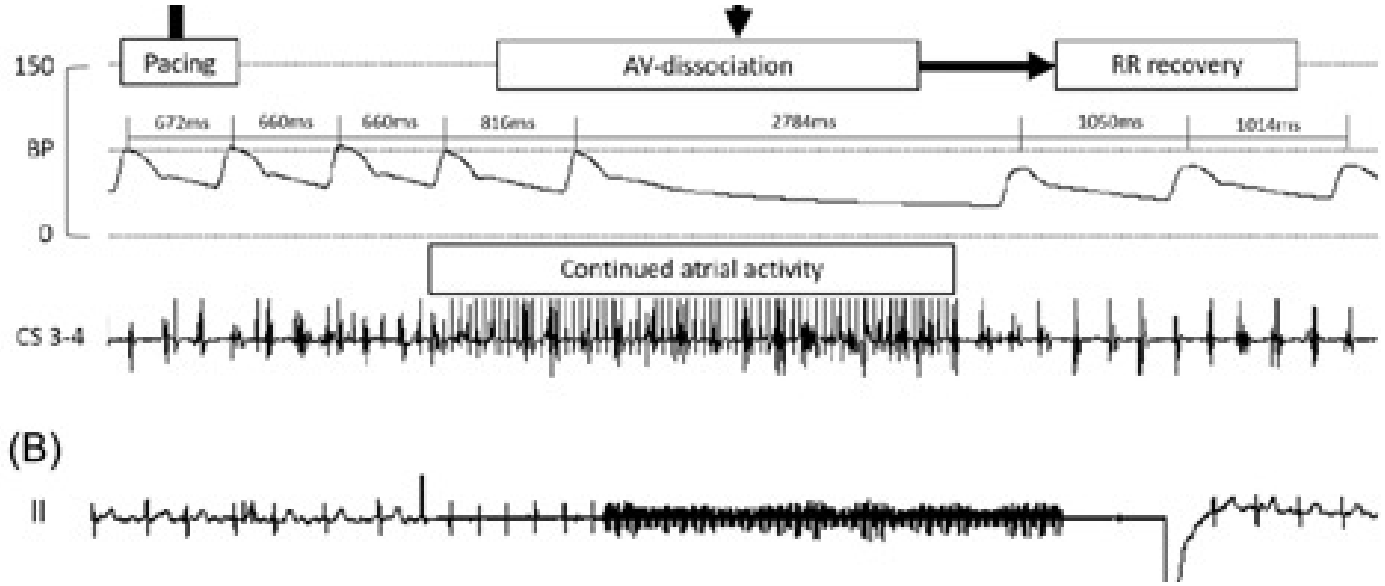
Vagal response areas tagging and RF delivery

Time consuming

not always reproducible

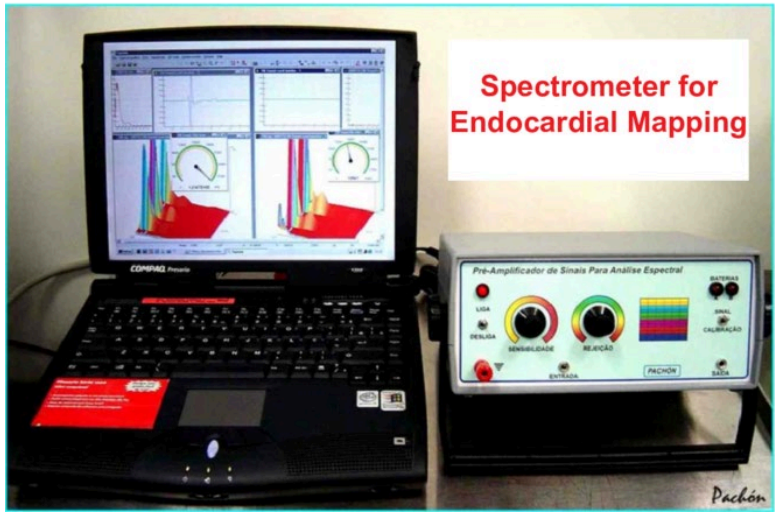
Painful if on sedation

AF induction



Techniques for GP identification:

2- Electrogram analysis –



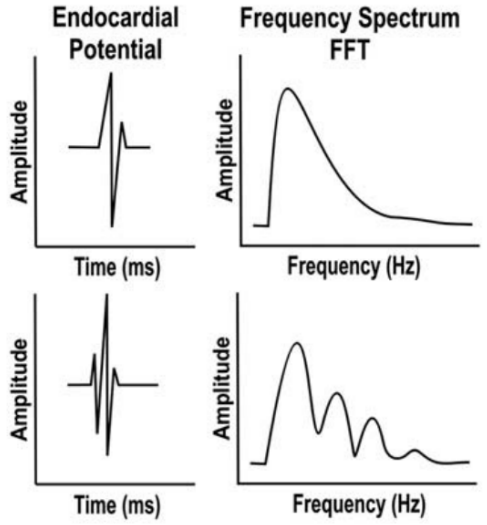
2004 Pachon et al -

fast Fourier transformation of the endocardial potentials.

Normal atrial myocardium – homogenous uniform aEGM.

GP sites - several fractions having frequencies higher than 100 Hz.

Possible higher high-pass filters (>100 Hz) leads to a better identification of fractioned potentials.



local fractionated signals

may be due to fibrosis, double potentials etc.

Sensitivity and specificity???

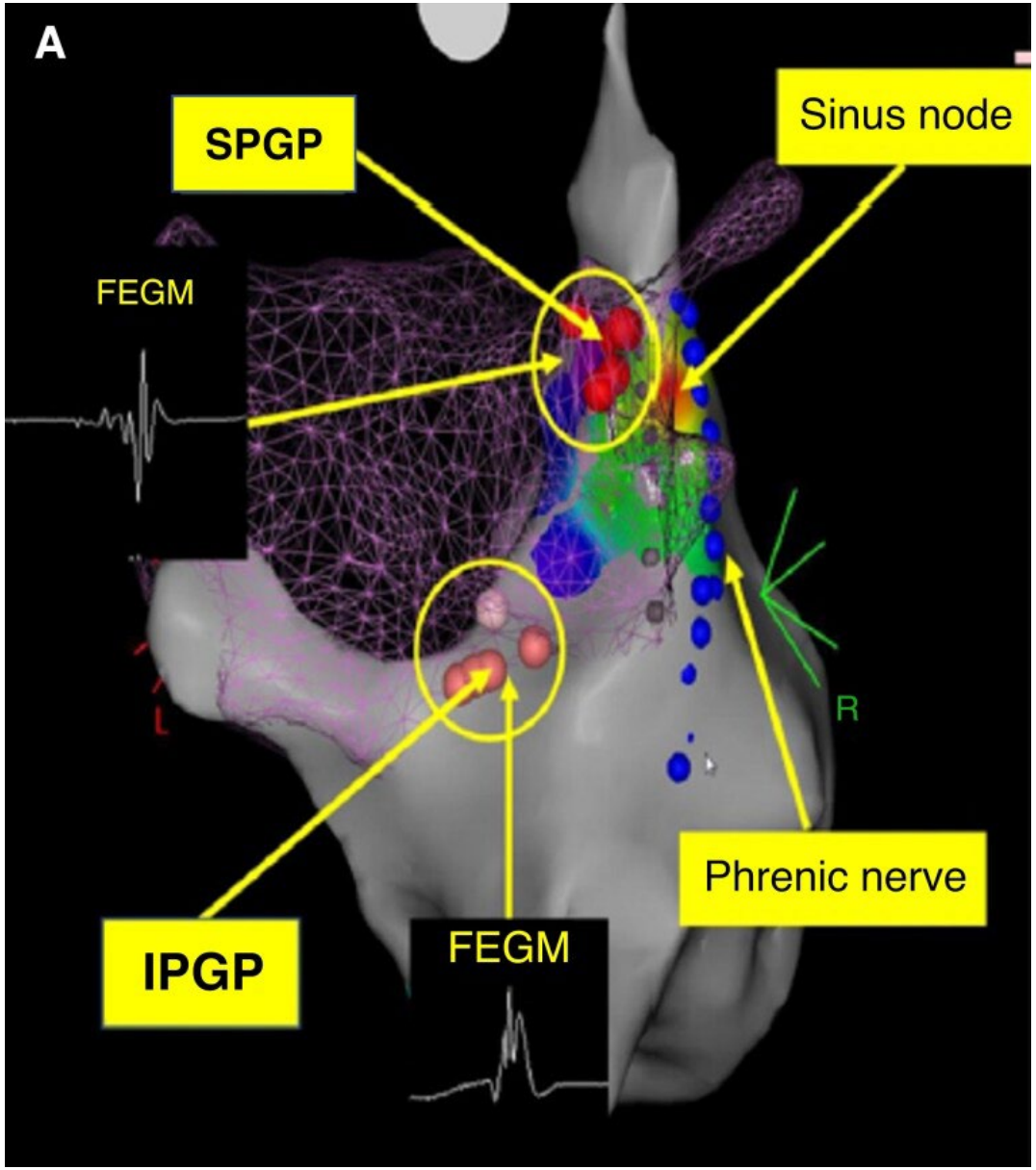
Techniques for GP identification:

2- Electrogram analysis –

Aksu workflow -

filter settings of 100/200–500 Hz.

aEGM with >3 deflections are tagged as possible GP sites.

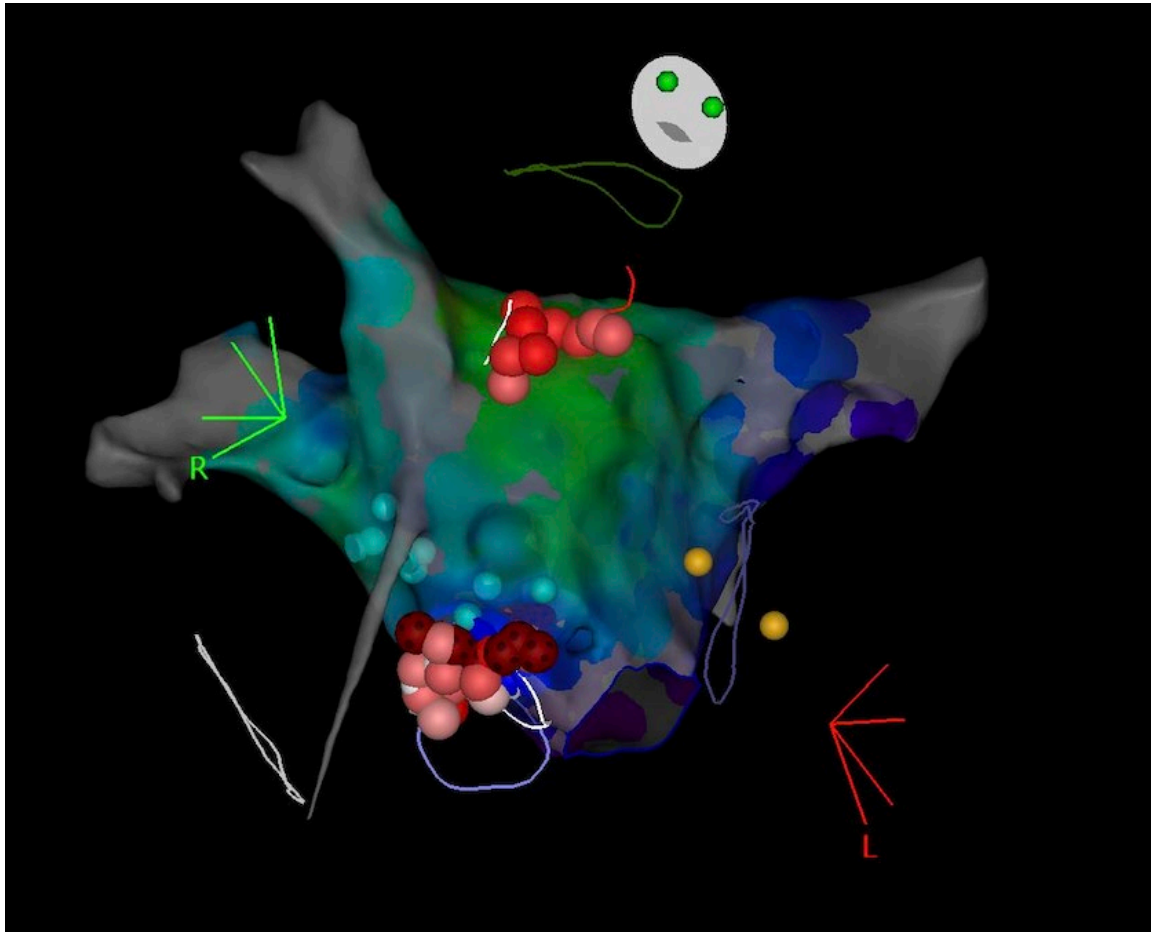


Heart Rhythm 2024;21:100–105

Techniques for GP identification:

3- Empirical anatomical -

Pure electroanatomical (EAM) by CT merging



journal of Interventional Cardiac Electrophysiology 47(2) November 2016

Feasibility of CT-Guided CNA

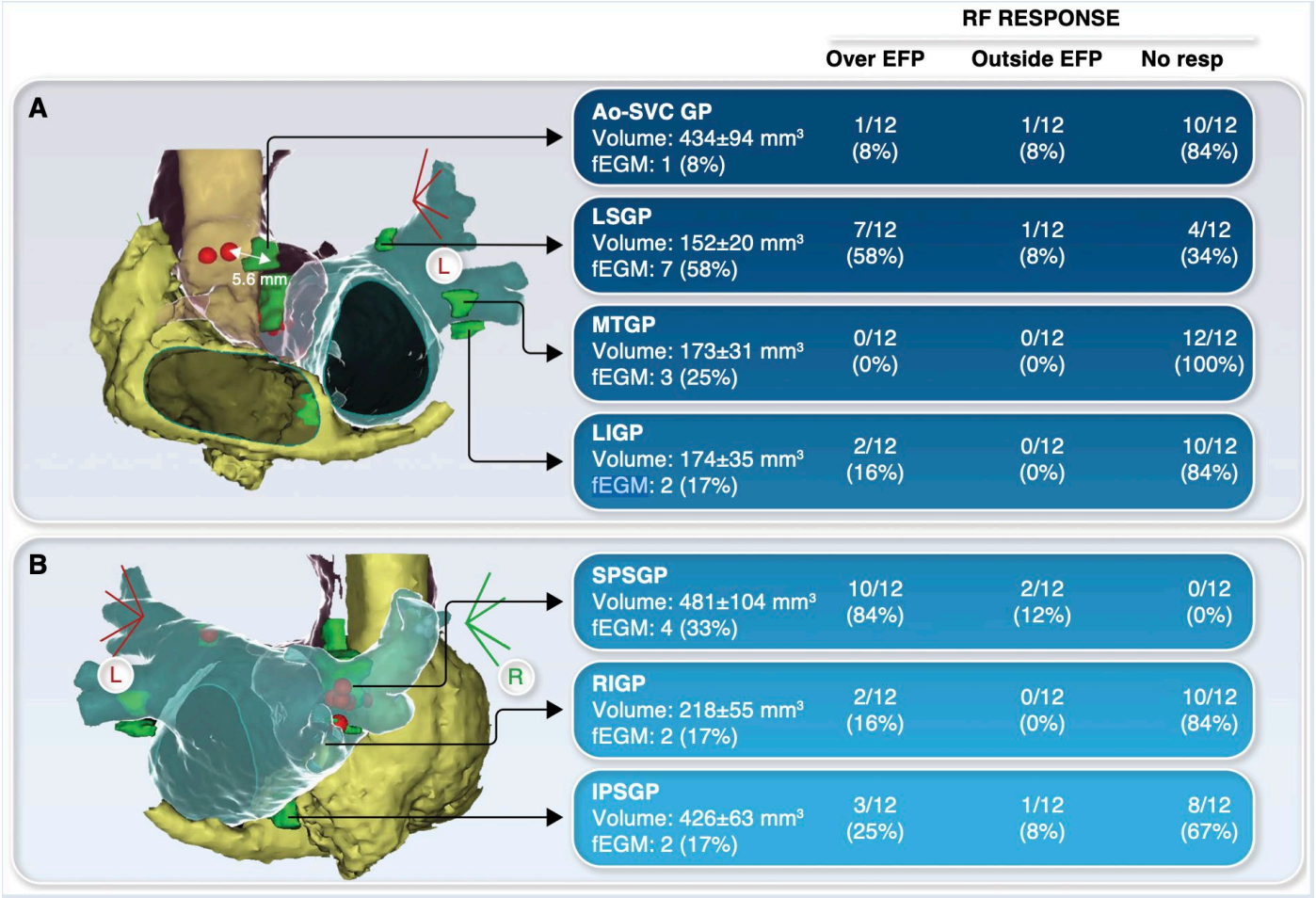
12 VVS pts. 6 male, 53 ± 13 years
Positive Tilt test
Positive Atropine test

CT - ADAS3D (developed for myocardial fibrosis analysis)

Procedure end-points:

- Abolition of RF-induced vagal response for left PV GPs
- Increase in basal HR ≥25% for SPSGP,RIGP and Ao-SVC GPs
- Shortening of AH interval for IPSGP.

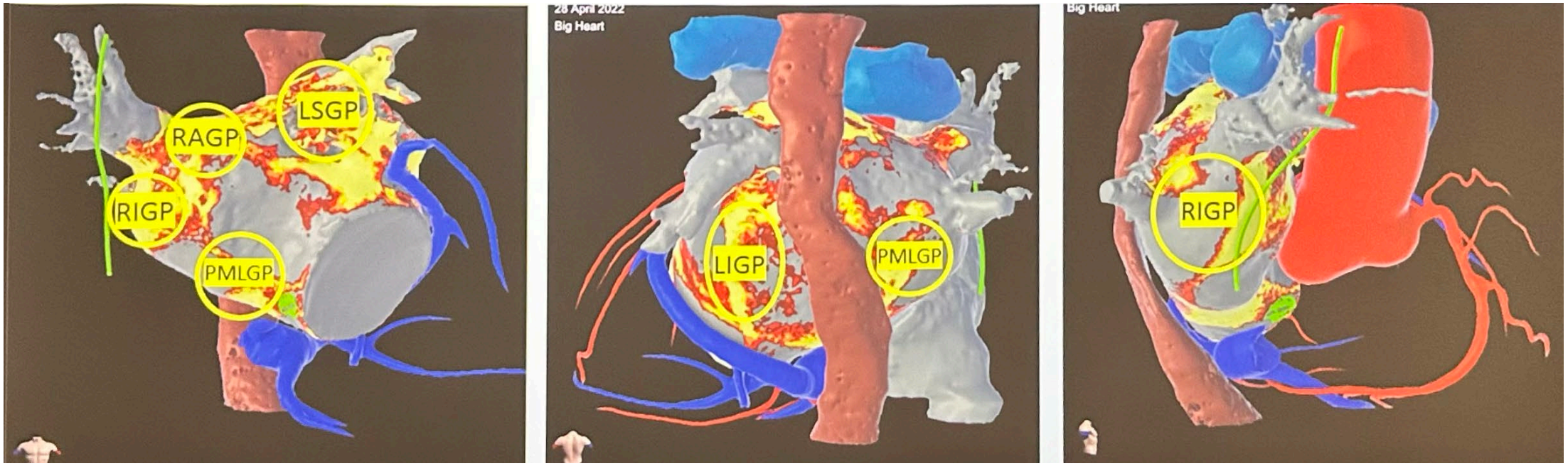
This study shows that CT-based EFP-guided CNA for CI-VVS is feasible, can assist RF delivery with high precision and has the potential to overcome the interpatient variability that affects CNA when performed solely by anatomic landmarks.



Berruezo el al Europace 2023; 25: 1-3

InHeart module

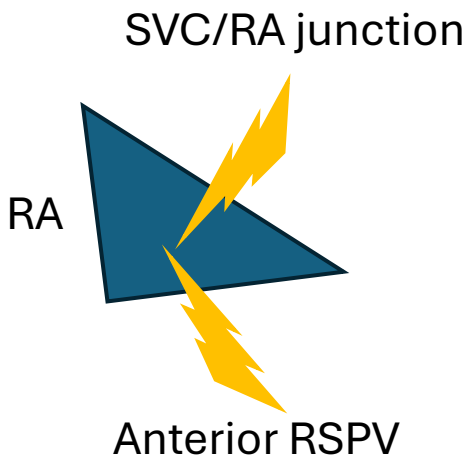
- **AI-Powered Segmentation**
- cloud-based software solution
- CT or MRI image transformation to interactive 3D models + segmentation.

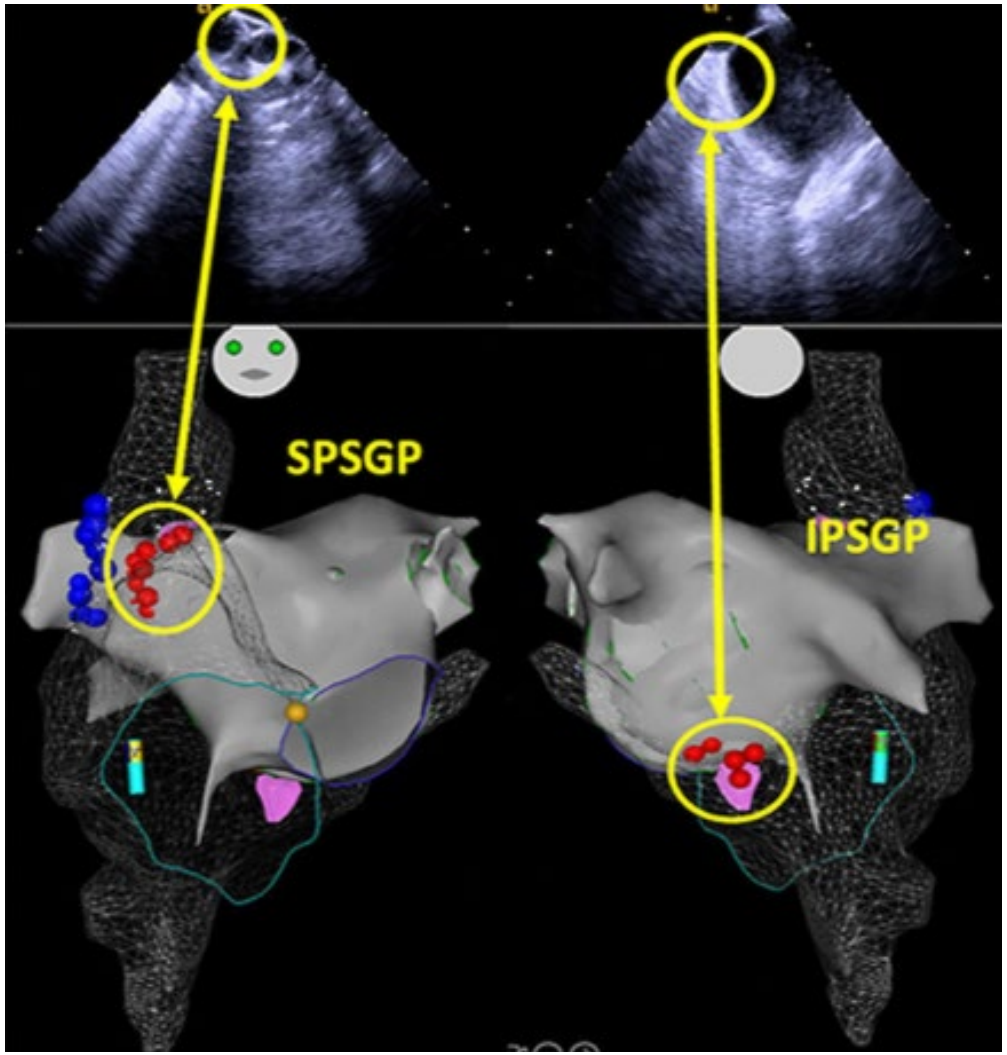


3- Empirical anatomical - ICE

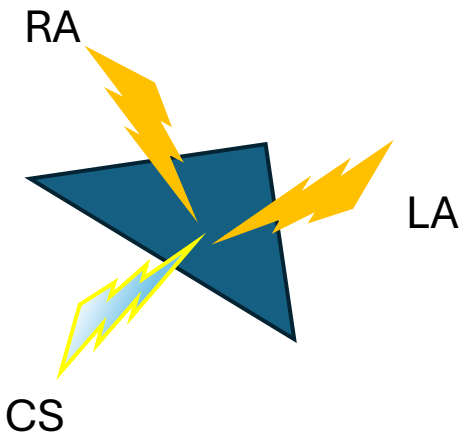
Shows online real-time anatomy
creation of 3D EAM by CartoSound module
Efficacy of RF application by tissue whitening.

Superior paraseptal GP = RAGP, RSGP





Inferior paraseptal GP = PMLAGP, IRGP, LIGP



Superior paraseptal GP = RAGP, RSGP

Inferior PS GP = PMLAGP, IRGP, LIGP

Which GP should be targeted???

Table 1: The Major Clinical Studies of Cardioneuroablation

Study	Cases of VVS	Types of VVS	Identification of GP	Location of GP	RAGP Ablation	Endpoint of Ablation	Follow-up	Syncope Recurrence	Complications
Pachon et al. 2005[7]	5	Type 2	SA + AA	LA + RA	Yes	Elimination of potential	9 months	n=0/5	None
Pachon et al. 2011[12]	43	Type 1 and 2	SA+AA	LA + RA	Yes	Elimination of potential	45 months	n=3/43	None
Yao et al. 2012[8]	10	Type 2	HFS	LA	Yes	Elimination of VR	30 months	n=0/10	None
Sun et al. 2016[10]	57	Type 2	HFS + AA	LA	Yes	Elimination of VR	36 months	HFS: n=0/10 AA: n=5/47	None
Aksu et al. 2016[24]	8	Type 1 and 2	SA + AA + HFS	LA + RA	Yes	Elimination of VR/ elimination of potential	11 months	n=0/8	None
Debruyne et al. 2018[20]	12	Type 1 and 2	AA*	RA	Yes	P–P interval shorten/ total ablation time	6 months	n=3/12	None
Aksu et al. 2019[25]	20	Type 1 and 2	SA + AA + HFS	LA + RA	Yes	Elimination of VR	12 months	n=2/20	None
Hu et al. 2019[11]	115	Type 1, 2 and 3	AA + HFS	LA	Yes	Elimination of VR	21 months	n=4/115	None
Aksu et al. 2020[26]	25	Type 1 and 2	FEGM + AA + HFS	LA + RA	Yes	Elimination of potential	9 months	n=0/25	None
Aksu et al. 2021[27]	46	Type 1 and 2	FEGM + AA + HFS	LA + RA	Yes	Elimination of potential	15 months	n=2/46	None
Debruyne et al. 2021[28]	31	Type 1 and 2	AA*	RA	Yes	Increase of HR/total ablation time	12 months	n=9/31	None
Hu et al. 2021[29]	28	Type 1	AA + HFS	LA	Yes	Elimination of VR/ elimination of potential	16 months	n=0/28	None
Calo et al. 2021[30]	18	Type 1 and 2	AA	RA	Yes	Elimination of potential	34 months	n=3/18	None
Aksu et al. 2022[22]	51	Type 2	AA + HFS	LA + RA	Yes	Elimination of VR/ elimination of potential	22 months	n=3/51	None
Piotrowski et al. 2022[23]	24	Type 2	FEGM + AA	LA + RA	Yes	Increase of HR/ elimination of potential	24 months	n=2/24	None

**CT-guided anatomical approach. AA = anatomical approach; FEGM = fractionated electrogram mapping; GP = ganglionated plexi; HFS = high-frequency stimulation; HR = heart rate; P–P interval = time between successive P waves; LA = left atrium; RA = right atrium; RAGP = right anterior GP; SA = spectral analysis; VR = vagal response; VVS = vasovagal syncope; type of VVS is based on the VASIS classification.*

identification of GP:

- Spectral analysis
- Anatomical approach
- HFS stimulation
- Fractionated EGM

GP targets:

- LA only
- RA only
- LA+RA

Endpoints:

- elimination of potentials
- elimination of Vagal response
- increase in HR

Follow-up:

- Clinical outcomes
- Holter - SDNN
- Repeated HUT
- ILR

Li L, Po S, Yao Y Arrhythmia & Electrophysiology Review 2023;12:e18.

Cardioneuroablation for vasovagal syncope: A systematic review and meta-analysis

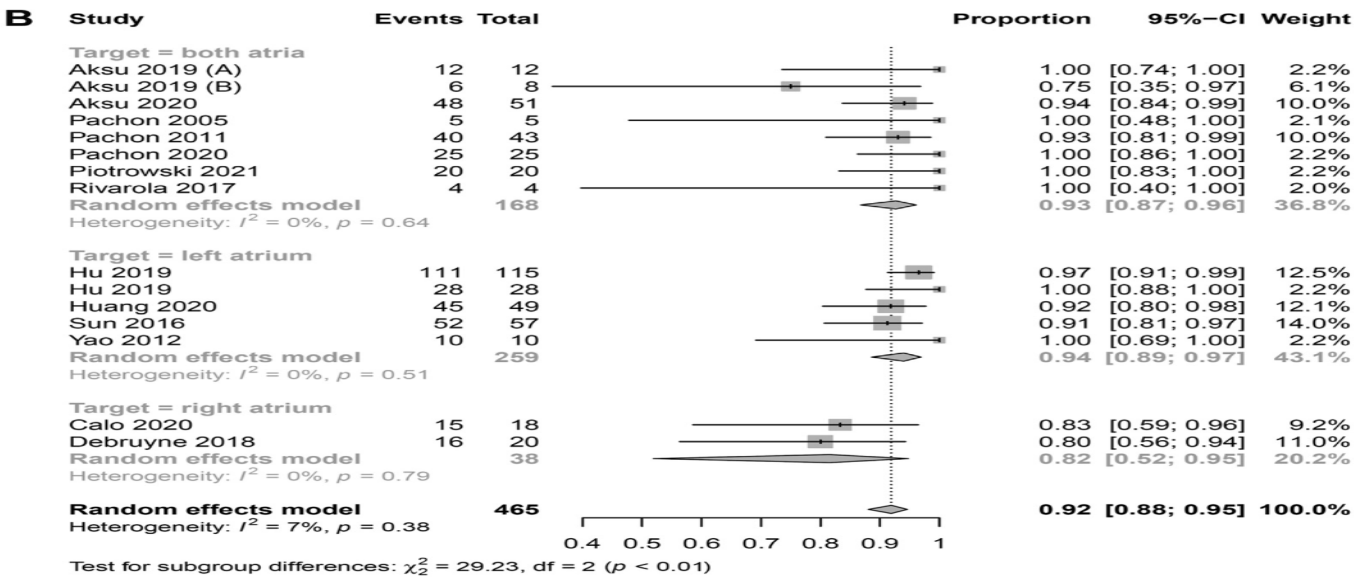
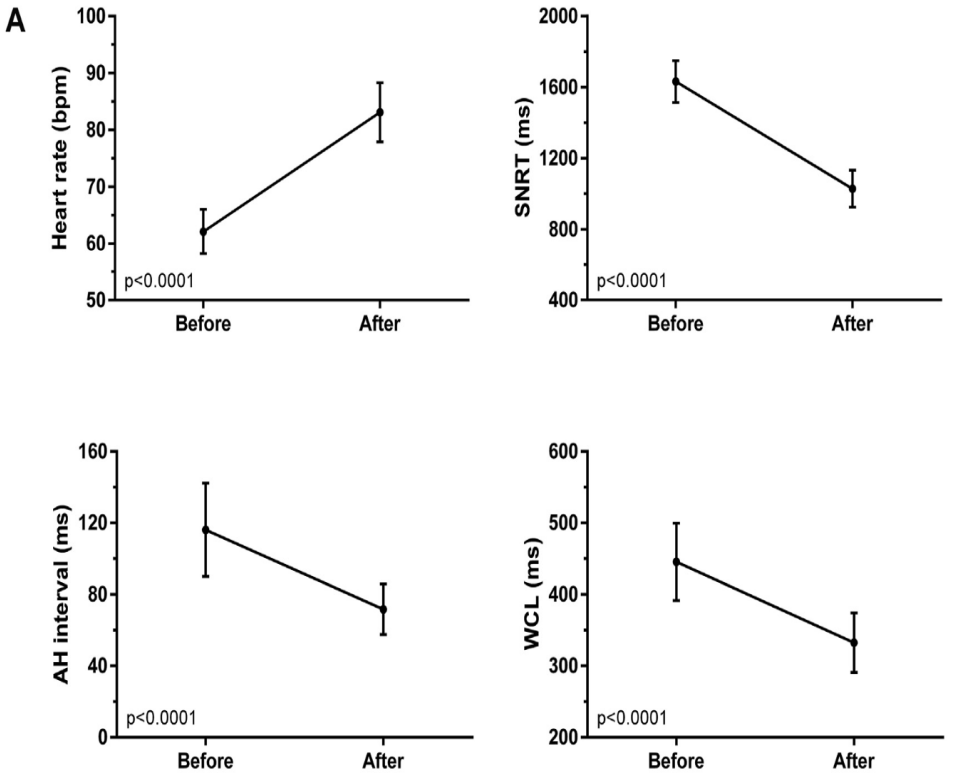


Table 2. Comparison Between the HFS– and Anatomically Guided Ablation Groups

	HFS-Guided Ablation (n=10)	Anatomically Guided Ablation (n=47)	*P* Value
Procedure time, min	50.2±3.8	43.7±6.1	0.002
Fluoroscopy time, min	11.2±1.7	6.1±2.9	<0.001
RF applications, n	9.1±1.4	34.6±5.4	<0.001
LSGP	6.3±0.9	11.0±3.2	<0.001
LLGP	—	6.2±1.7	—
LIGP	1.5±2.0	5.9±1.6	<0.001
RAGP	1.3±1.4	6.1±1.6	<0.001
RIGP	0	5.4±0.9	<0.001
RF delivery time, s	345.0±121.9	622.8±210.3	<0.001
LSGP	242.0±73.3	275.1±117.7	0.398
LLGP	—	97.2±68.5	—
LIGP	54.0±75.9	88.1±61.7	0.134
RAGP	49.0±56.1	93.4±59.1	0.034
RIGP	0	68.9±40.6	<0.001
Positive vagal response observed at each GP			
LSGP	10/10	42/47	0.574
LLGP	—	19/47	—
LIGP	3/10	15/47	1.000
RAGP	5/10	22/47	1.000
RIGP	0/10	11/47	0.183

GP indicates ganglionated plexus; HFS, high-frequency stimulation; LIGP, left inferior ganglionated plexus; LLGP, left lateral ganglionated plexus; LSGP, left superior ganglionated plexus; RAGP, right anterior ganglionated plexus; RF, radiofrequency; RIGP, right inferior ganglionated plexus.

Subgroup analysis for ablation target.



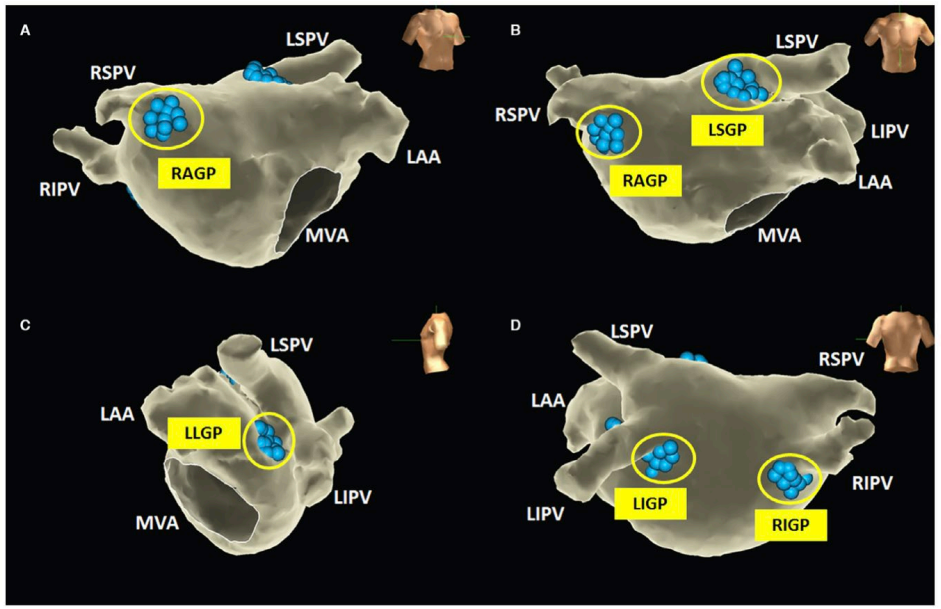
Overall freedom from syncope rate of 92% for CNA

Heart Rhythm 2022 Nov;19(11):1804-1812

Catheter Ablation as a Treatment for Vasovagal Syncope: Long-Term Outcome of Endocardial Autonomic Modification of the Left Atrium

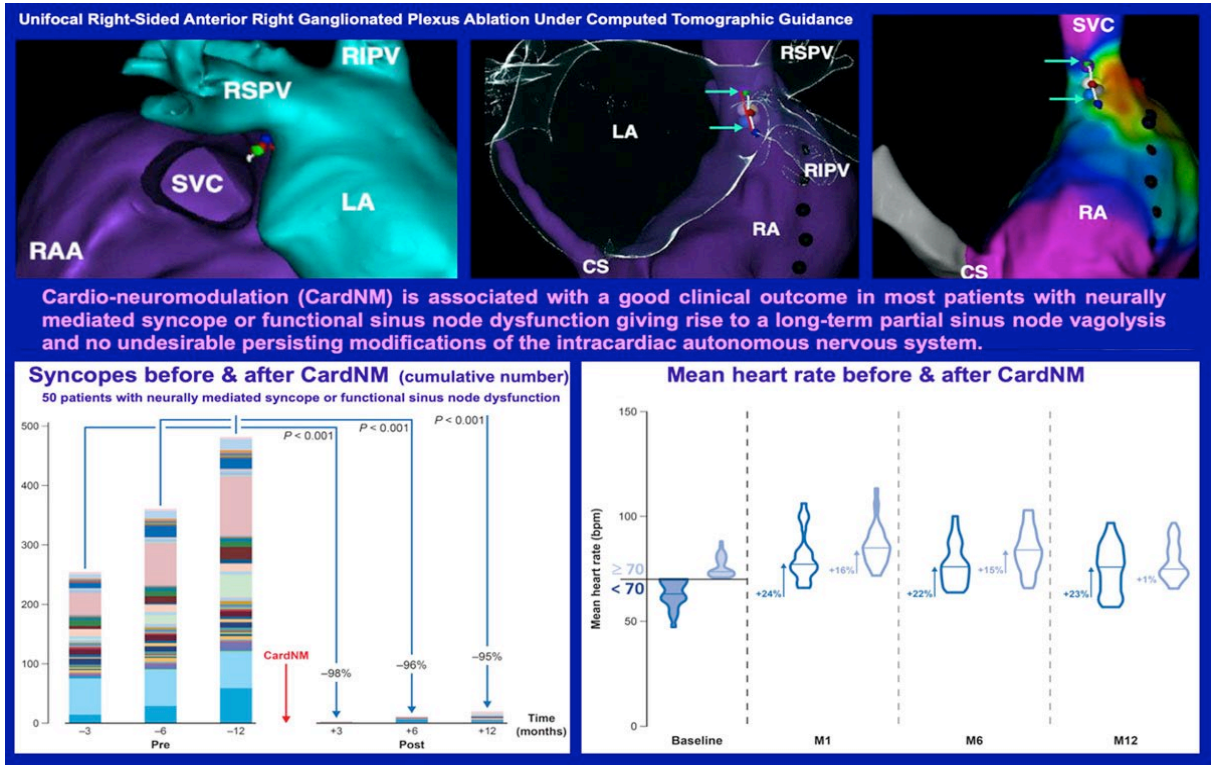
- 57 consecutive patients (aged 43.2 ± 13.4 years; 35 women)
- Refractory vasovagal syncope
- Follow-up of 36.4 ± 22.2 months (range 12–102 months)
- 52 patients (91.2%) remained free from syncope.
- Prodromes recurred in 16 patients.

- No statistical differences were found between the high-frequency stimulation and anatomically guided ablation groups in either freedom from syncope (100% versus 89.4%, P=0.348) or recurrent prodromes (50% versus 76.6%, P=0.167).



Wei Sun et al J Am Heart Assoc. 2016;5:e003471

Durable Physiological Changes and Decreased Syncope Burden 12 Months After Unifocal Right-Sided Ablation Under Computed Tomographic Guidance in Patients With Neurally Mediated Syncope or Functional Sinus Node Dysfunction



- Target RAGP via right approach only
- CT guided anatomical approach
- General anesthesia
- Ablation index 800
- Endpoint – Increase in HR
- Follow-up – Holter monitoring and clinical outcomes

- Lower rate of syncope (–95%) and presyncope (–95%) at 12 months versus baseline (*P*<0.001).
- 37 pts. remained entirely free of syncope at 12 months
- The syncope-free survival curve remained stable between the 12- and 30-month follow-up.

Philippe Debruyne. Circulation: Arrhythmia and Electrophysiology. 2021, Volume: 14, Issue: 6,

RECRUITING

Efficacy of a Right-sided Ablation of the Anterior Ganglionated Plexus for Neurally Mediated Syncope (CardNMH3)

ClinicalTrials.gov ID NCT04755101

Sponsor Imelda Hospital, Bonheiden

Information provided by Philippe Debruyne, Imelda Hospital, Bonheiden (Responsible Party)

Last Update Posted 2023-04-04

The primary goal of the study is to determine whether a CT-guided, right-sided ablation of the anterior ganglionated plexus safely reduces the risk of recurrent episodes of syncope in patients with a history of recurrent NMS.

Two-third of the patients will be randomized to the active arm and one-third to the control arm (sham).

Cardioneuroablation for Reflex Syncope: Efficacy and Effects on Autonomic Cardiac Regulation – ROMAN 1 trial

- The first prospective randomized trial
- CNA versus optimal nonpharmacologic therapy in patients with cardioinhibitory VVS.
- Documented symptomatic cardioinhibitory or mixed VVS and positive atropine test.
- LA+ RA GP ablation
- ICE guided
- GPs – Paraseptal GP from left atrial approach → Left sided RAGP (anterior right PV line) → right paraseptal GP → right sided RAGP
- Ablation index 400
- Follow-up lasted 2 years.
- Primary endpoint was **time to first syncope recurrence.**
- Secondary endpoints included changes in sinus rhythm and heart rate variability measured in holter ECG (3, 12, 24 months) + QOL and baseline and completion of F/U.

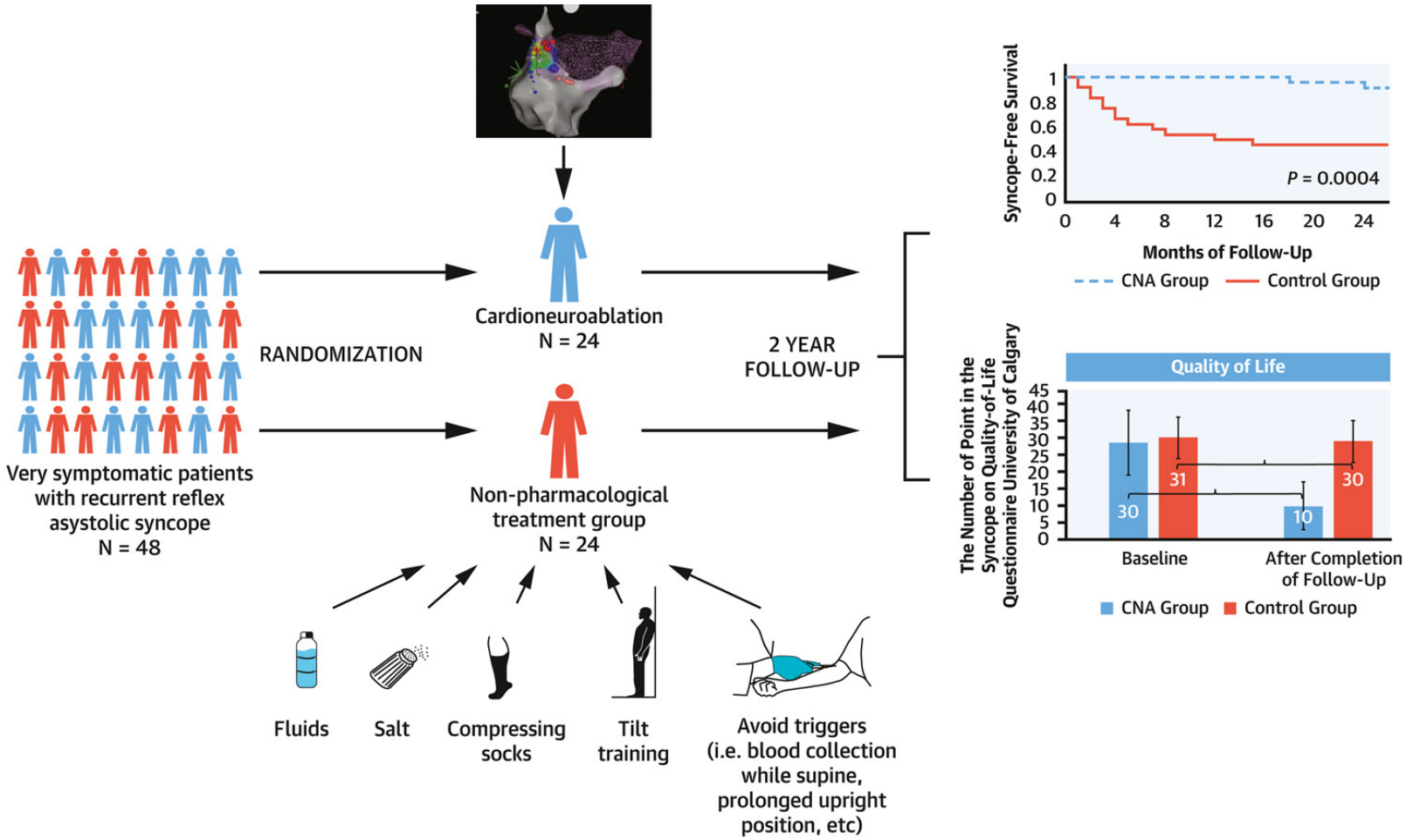
Piowtrowski et al. JACC: Clinical Electrophysiology, 2023-01-01, Volume 9, Issue 1, Pages 85-95

Cardioneuroablation for Reflex Syncope: Efficacy and Effects on Autonomic Cardiac Regulation – ROMAN 1 trial

- 48 patients (24 in CNA group ,24 in control group)
  - 17 male
  - mean age 38 ± 10 years

- The primary endpoint occurred in:
  - 2 patients (8%) from the CNA group
  - 13 control patients (54%) (*P* = 0.0004).

- QOL
  - Significantly improved in the CNA group (30±10 vs 10±7 points; *P* = 0.0001)
  - Remained stable in control patients (31±10 vs 30±10 points; *P* = 0.5501).



Piowtrowski et al. JACC: Clinical Electrophysiology, 2023-01-01, Volume 9, Issue 1, Pages 85-95

CardioneuROablation: coMparison of acute effects of right versus left atrial Approach in patients with reflex syncope – ROMAN 2 study

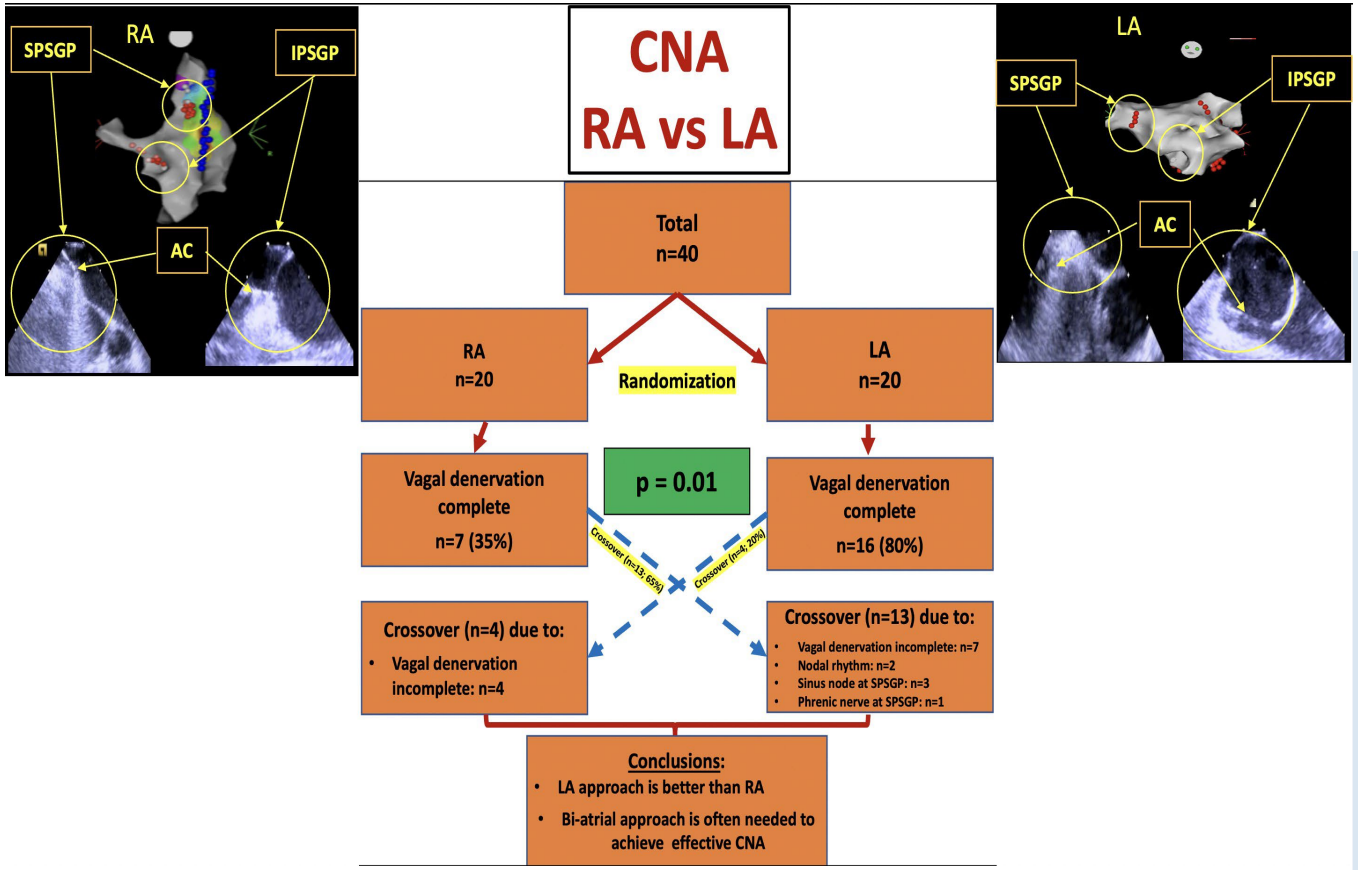


Table 1 Demographic, clinical, and procedural parameters in the whole study group and comparison between the RA and LA groups

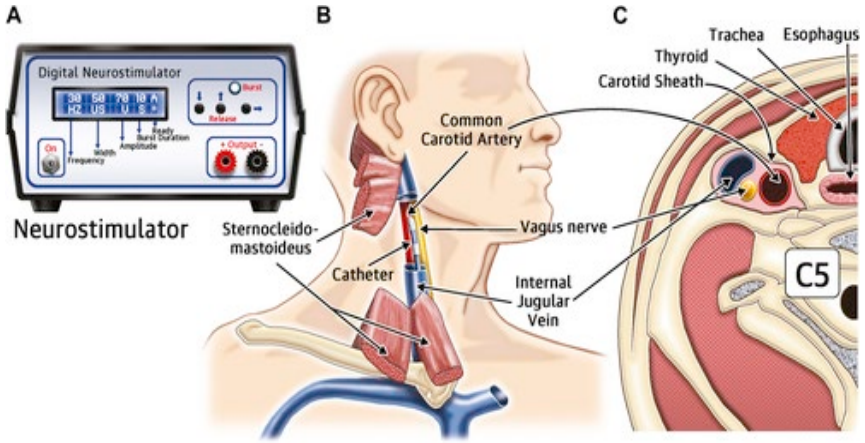
Parameter	Total ($n = 40$)	RA group ($n = 20$)	LA group ($n = 20$)	P
Age (years)	40 ± 12	37 ± 11	44 ± 13	0.1668
Female gender	24 (60%)	12 (60%)	12 (60%)	1.000
Total no. of syncopal episodes in the past	5 ± 5	5 ± 6	6 ± 5	0.3999
No. of syncopes associated with injury	5 (12.5%)	1 (5%)	4 (20%)	0.3416
No. of syncopal episodes during 1 year preceding the study	2 ± 2	2 ± 3	2 ± 1	0.8402
Concomitant diseases				
Hypertension	9 (23%)	3 (15%)	6 (30%)	0.4505
Hyperlipidaemia	5 (13%)	2 (10%)	3 (15%)	1.000
Type of VVS				
Cardioinhibition	38	18	20	0.6153
Mixed	2	2	0	0.6153
Asystole > 3 s				
Only spontaneous ECG (no. of pts)	7	5	2	0.4074
Only tilt induced (no. of pts)	26	11	15	0.3202
Both (no. of pts)	7	4	3	1.000
Mean asystole duration (s)				
Mean asystole duration due to SA (s)	11 ± 10	11 ± 12	11 ± 6	0.8388
Mean asystole duration due to AVB (s)	9 ± 7	8 ± 7	10 ± 7	0.6671
Mechanism of asystole				
Asystole due to SA	29	16	13	0.4801
Asystole due to AVB	11	4	7	0.4801
Procedural parameters				
Procedure duration (min)		107 ± 22	102 ± 26	0.6165
Fluoroscopy time (s)		308 ± 119	330 ± 155	0.6353
Total dose X-ray (mGy)		12.7 ± 8.0	19.6 ± 25.8	0.2642
Total dose X-ray ($Gycm^2$)		1.28 ± 0.83	3.91 ± 6.12	0.0841

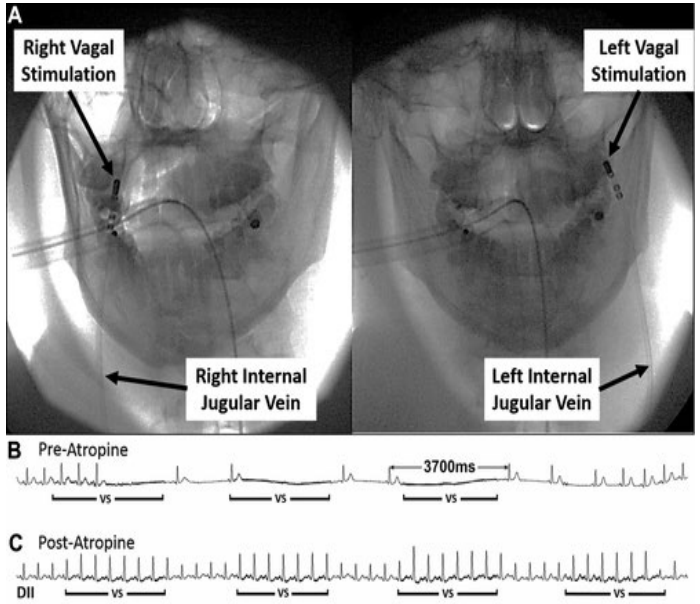
AVB, atrioventricular block; ECG, electrocardiogram; SA, sinus arrest; VVS, vaso-vagal syncope.

EP Europace, Feb 2024;, euae042.

CardioneuROablation: coMparison of acute effects of right versus left atrial Approach in patients with reflex syncope – ROMAN 2 study

- After including 40 patients, the study was stopped because total vagal denervation was achieved in significantly less patients from the RA vs. LA group.
- Of the RA group, in 13 (65%) patients, the primary endpoint was not achieved, and crossover to LA was necessary due to the inability to achieve full vagal denervation (n = 7, AVB in all patients)
- Of the LA group, crossover was needed in 4 (20%) patients due to the inability to achieve full vagal denervation (AVB in all patients; P = 0.0095, RA vs. LA group).
- LA or BiA approach resulted in a better mid-term outcome than the RA approach only.





Jose C. Pachon M. et al. *J Am Coll Cardiol EP* 2015; 1:451-460.

EP Europace, Feb 2024;, euae042.

Cardioneuroablation for reflex asystolic syncope: Mid-term safety, efficacy, and patient's acceptance

- Prospective observational single-center study
- 115 consecutive patients
- Between 2016 and 2022
- At least 1-year follow-up.

Table 1 Baseline demographic and clinical characteristics (n = 115)

Age (y)	39 ± 13
Female	67 (58)
ECG documentation of sinus pause or AVB	
Spontaneous	35 (30)
Tilt-induced	60 (52)
Both spontaneous and tilt-induced	20 (17)
ECG phenotype	
Functional sinus arrest >3 s or sinus bradycardia	80 (70)
Functional AVB	21 (18)
Both	14 (12)
Asystole (sinus arrest or AVB) duration (s)	10 (3–60)
Total no. of syncopal episodes before CNA	5 (1–150) [3–5]
No. of syncopal episodes before CNA over period equal to follow-up	3 (1–110) [2–10]
No. of syncopal episodes in the 1 year before CNA	2 (1–56) [1–4]
Injury associated with syncope	18 (16)
Previous treatment	
Nonpharmacologic	115 (100)
Beta-blockers	2 (2)
Midodrine	4 (3)
Fludrocortisone	2 (2)
PM implanted in the past	10 (9)
Previous qualification for PM but implantation not performed	59 (51)

Piotr Kulakowski et al. Heart Rhythm, Vol 21, No 3, March 2024

Cardioneuroablation for reflex asystolic syncope: Mid-term safety, efficacy, and patient's acceptance

- Prospective observational single-center study
- 115 consecutive patients
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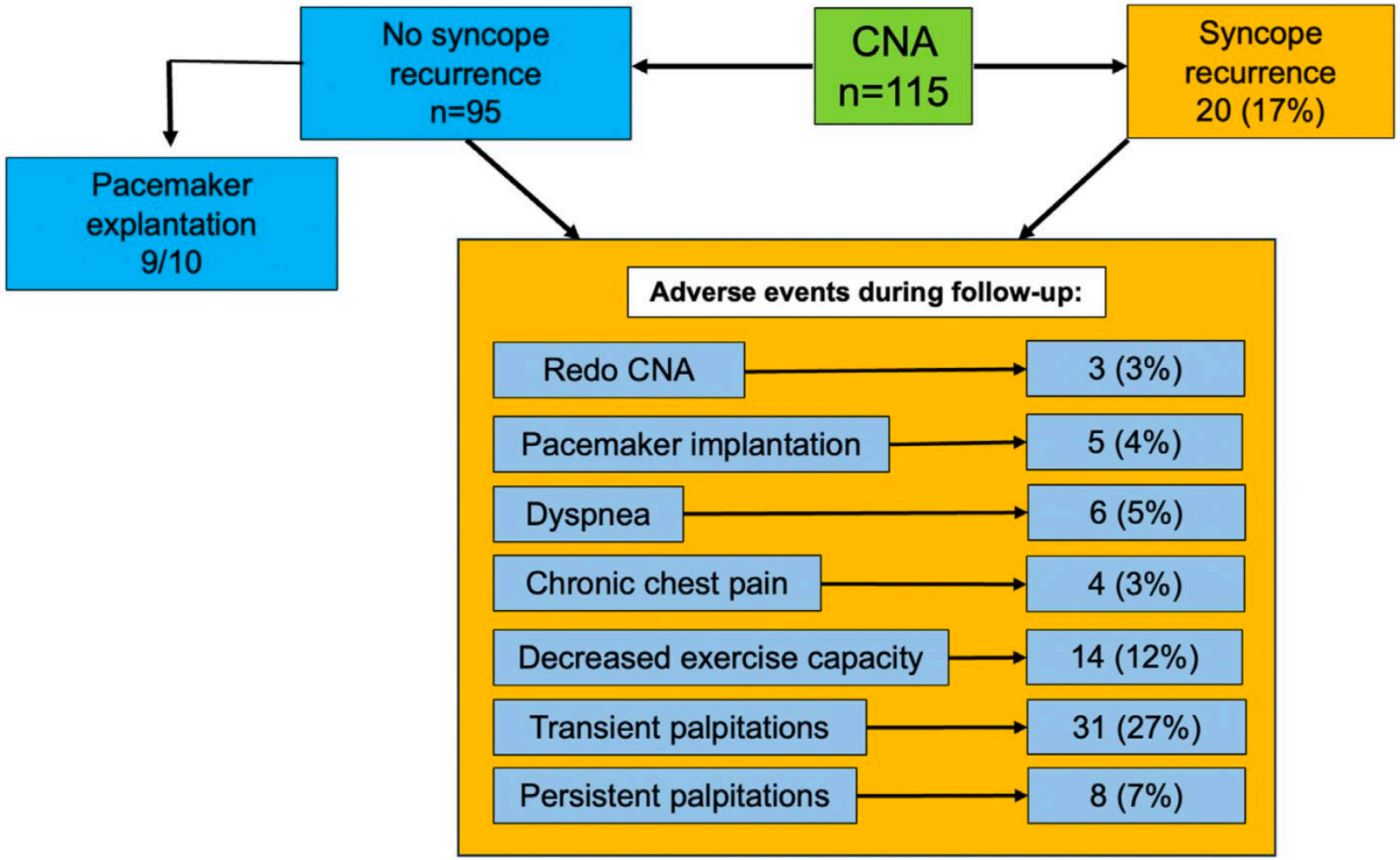


Piotr Kulakowski et al. Heart Rhythm, Vol 21, No 3, March 2024

Cardioneuroablation for Treatment of Atrioventricular Block

Tolga Aksu ✉, Rakesh Gopinathannair, Serdar Bozyel, Kivanc Yalin and Dhiraj Gupta

Originally published 1 Sep 2021 | https://doi.org/10.1161/CIRCEP.121.010018 | Circulation: Arrhythmia and Electrophysiology. 2021;14

A stepwise protocol in 241 consecutive patients
Symptomatic AVB to identify 31 (12.9%) patients with functional AVB
All patients had episode(s) of syncope in previous 12 months
AVB was persistent in 17 (54.8%) patients.

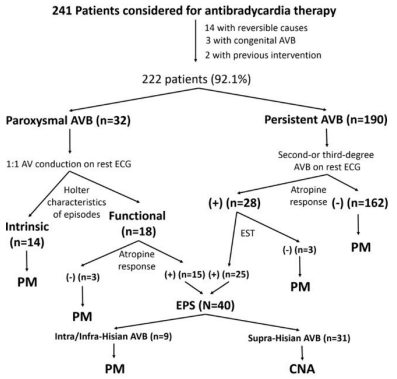
Results:
28 pts. received biatrial or left-sided cardioneuroablation
3 pts. received only right-sided cardioneuroablation because of structural factors

acute reversal of AVB and complete abolition of atropine response - in 30 (96.7%) cases
the remaining patient received a pacemaker.

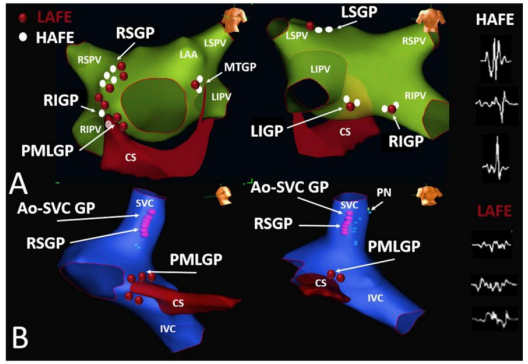
mean follow-up of 19.3±15 months
AVB episodes were observed in 2 (6.7%) of 30 cases
3 (9.6%) patients required pacemaker implantation during follow-up.

Conclusions:
Functional AVB can be identified in a minority of patients presenting with high-grade AVB. Cardioneuroablation for these patients results in encouraging medium-term outcomes.

Selection of patients

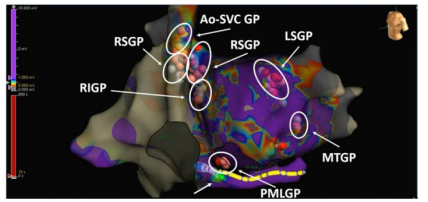


Schematic view of ganglionated plexi distribution based on electrogram characteristics

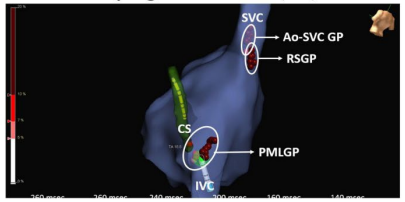


Patients underwent two different CNA approaches based on the risk of transseptal puncture

Bi-atrial or left-sided CNA (n:28)



Only right-sided CNA (n:3)



Endpoints

Endpoint of RF lesion is unknown

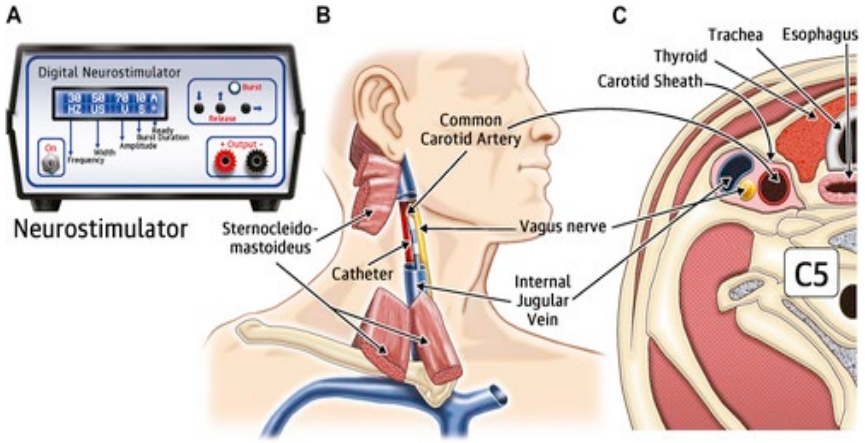
- increase HR
- SNRT
- Wenckebach point
- eliminaiton of electrograms
- if fAVB – shortening of AH interval

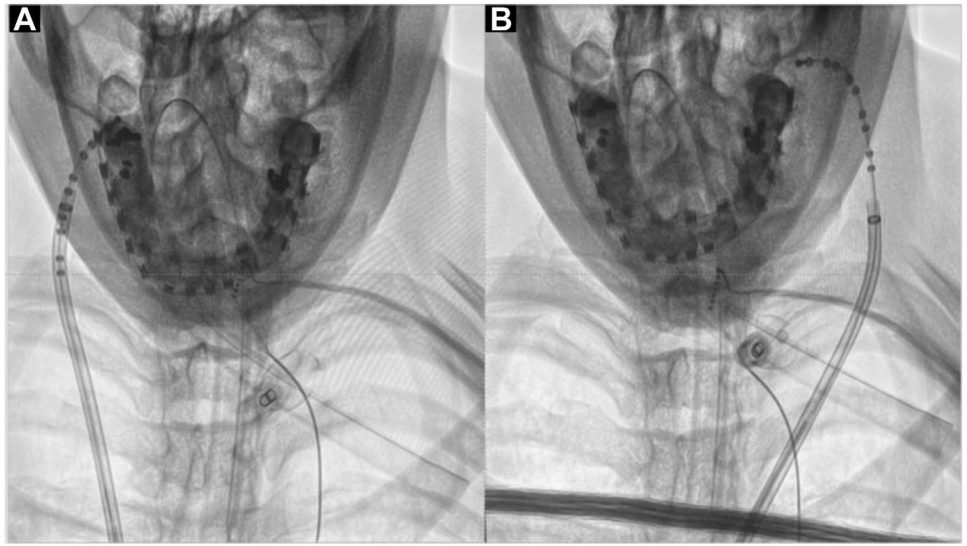
**** Potential esophageal and phrenic nerve injury
**** RF lesion should be intramural to reach affectively to the GP
**** loss of vagal protective effect
**** Arrythmogenesis

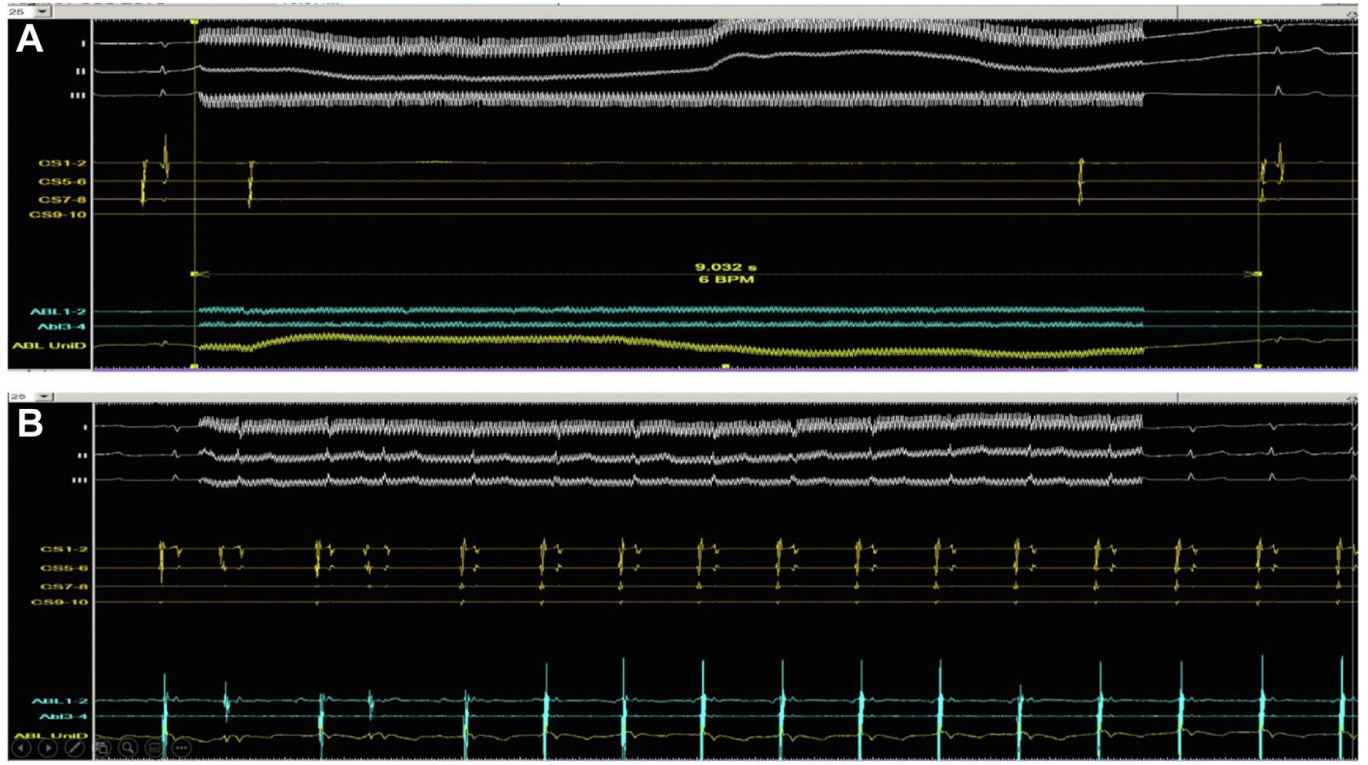
Extra Cardial vagal Stimulation (ECVS)

No FDA/ CE mark approval

Need for general anesthesia







Heart Rhythm 2022;19:1247–1252

Long term safety of CNA???
The protective effects of vagal activity

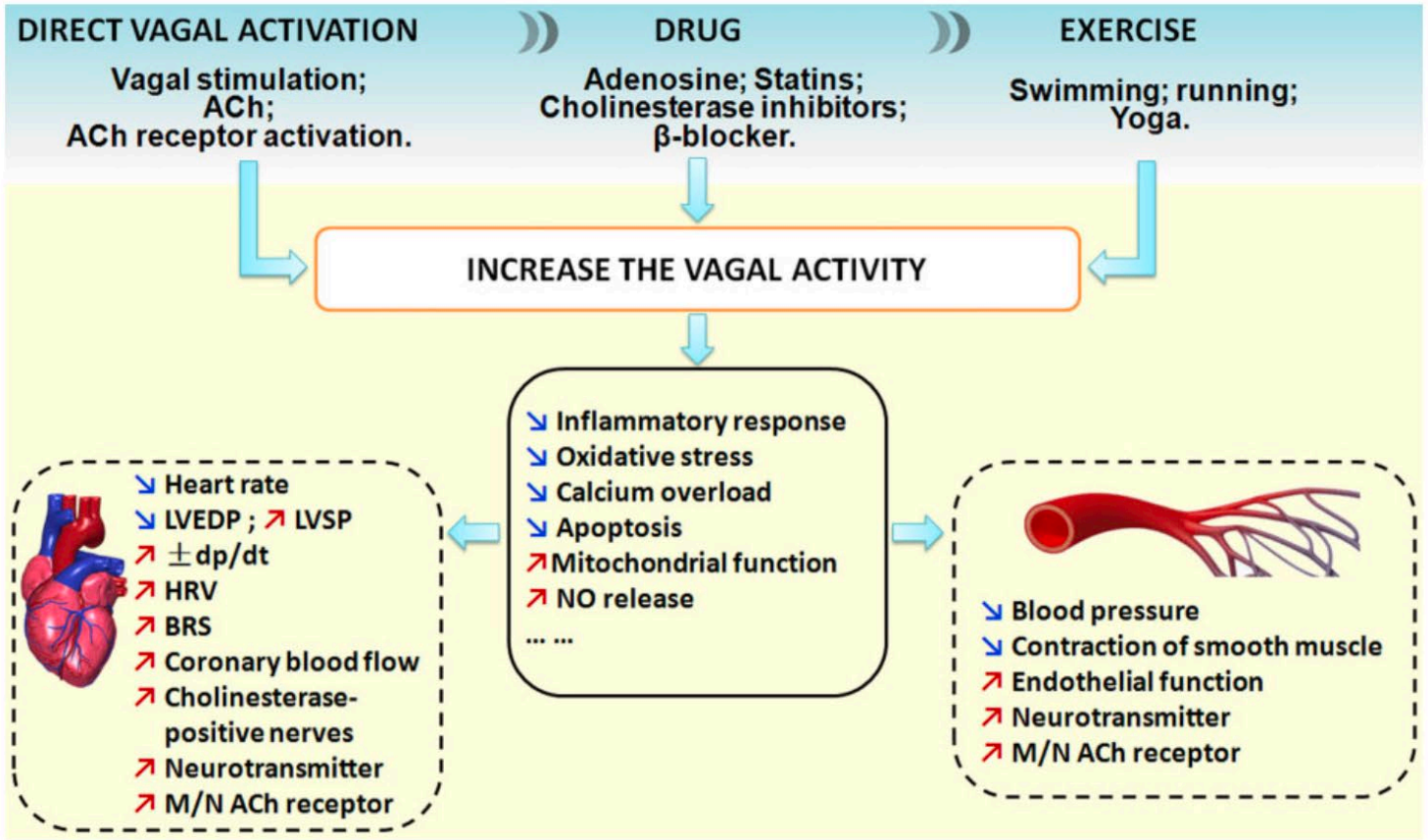
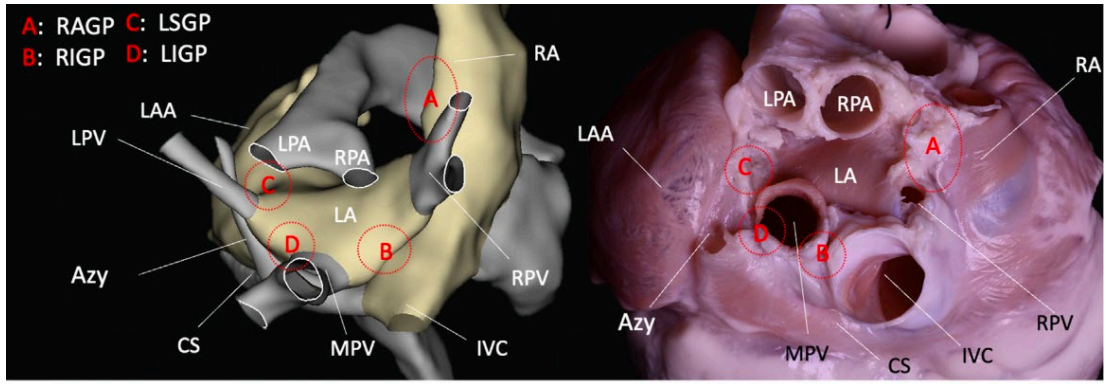


Figure 2

Beneficial effects on cardiac and vascular function are provided by the modulation of vagal activity, including direct vagal activation (vagal stimulation, ACh administration and ACh receptor activation), pharmacological modulation (adenosine, cholinesterase inhibitors, statins) and exercise training.

British Journal of Pharmacology (2015) **172** 5489–5500

Is CNA pro-arrhythmic??



Pigs model

8 RA+LA CNA vs 8 Sham control

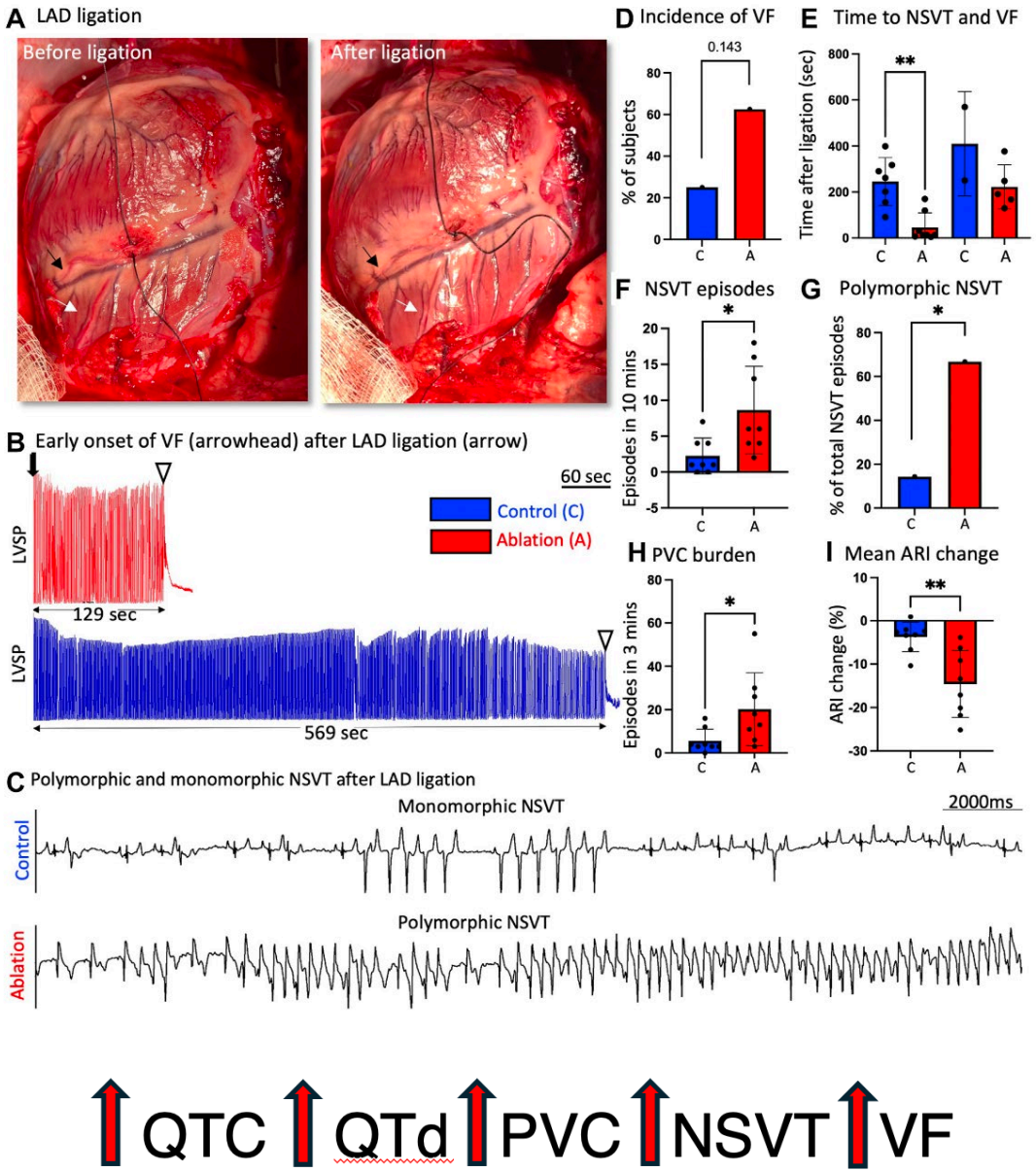
After 6 weeks - hemodynamic studies, Sym and ParaSym studies

+ proarrhythmic potential after LAD ligation.

Conclusions:

Cardiac vagal denervation is maintained long-term after CNA in a porcine model.

chronic CNA was associated with cardiovascular dysreflexia, diminished cardioprotective effects of cardiac vagal tone, and increased susceptibility to VT/VF in ischemia.



↑QTC ↑QTd ↑PVC ↑NSVT ↑VF

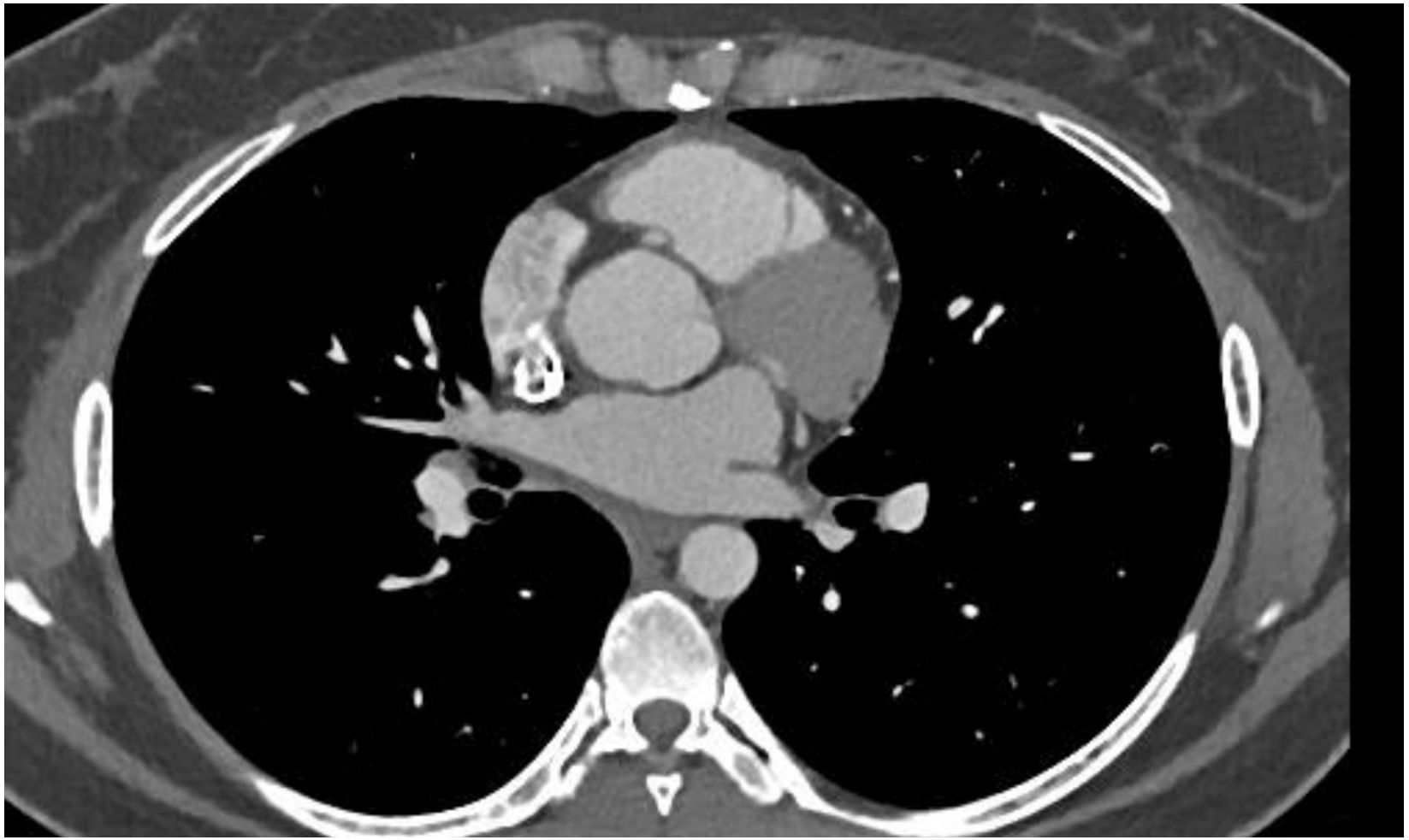
Heart Rhythm, Vol 20, No 11, November 2023

דוגמא 1 – ספטמבר 2020

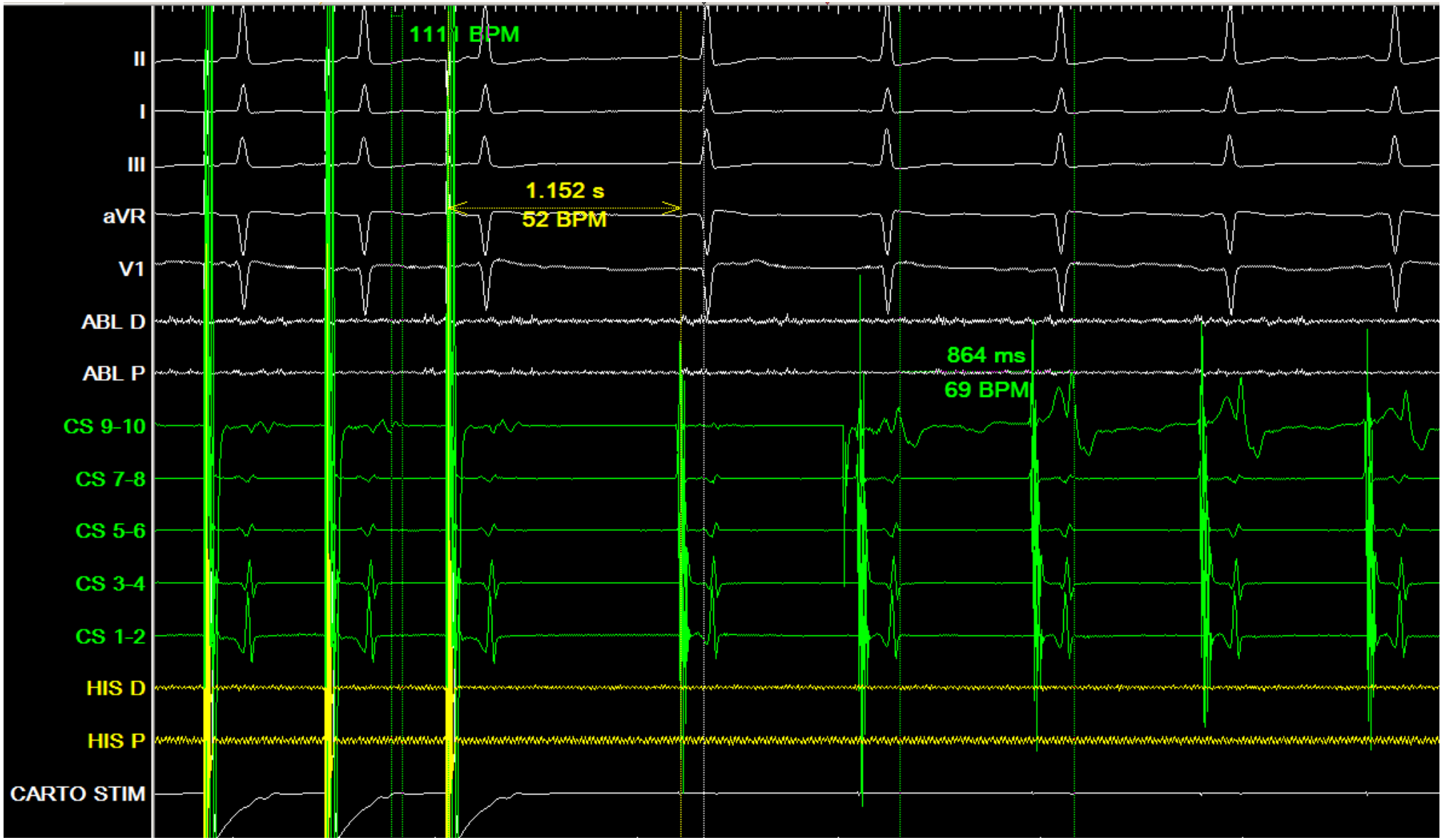
- א.ש.
- בת 32, עשרות אירועי סינקופה מרובים עם מאפיינים וואגלים.
- 4-5 התקפים בשנה עם אירועי סינקופה במקבצים.
- EEG, CT מח, MRI מח תקינים.
- TILT TEST חיובי - Sinus arrest 14 שניות.
- ניסיון טיפול במידודרין (אלפא אגוניסט) ופלודרוקורטיזון ללא הטבה.

- אק"ג בסיסי סינוס תקין 75 לדקה, PR-QRS-QT תקינים.
- אקו לב תקין.
- מספר בדיקות הולטר לב ומבחני מאמץ – תקינים.

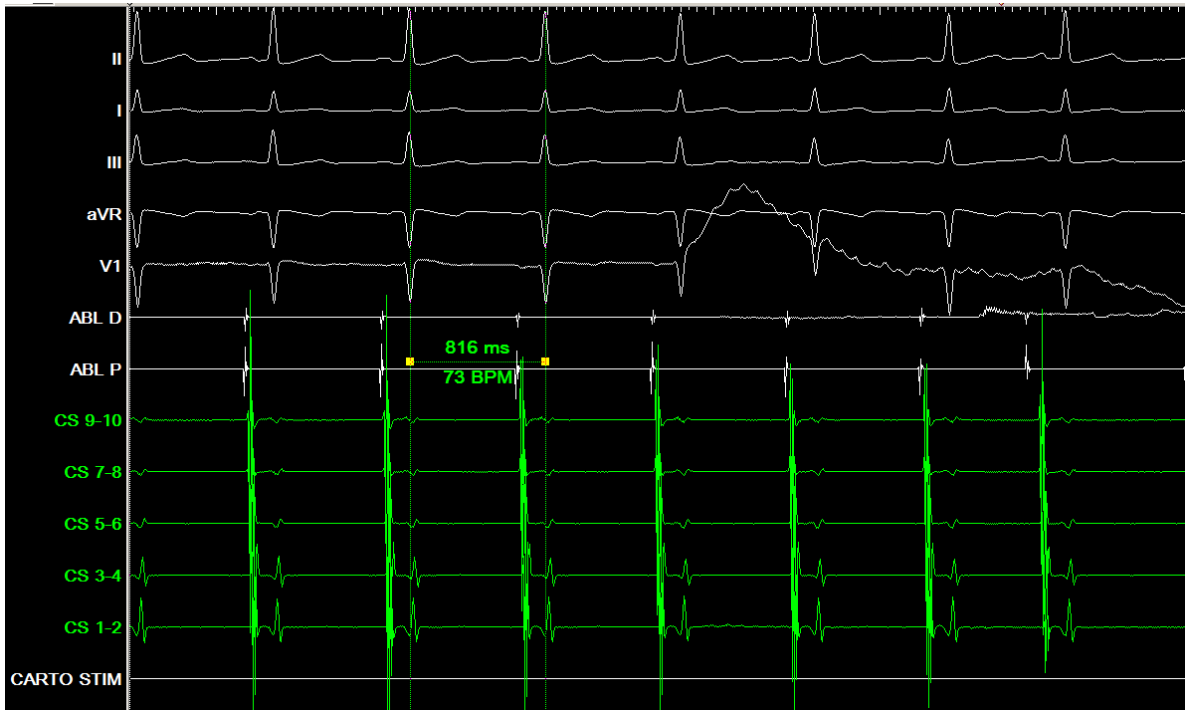
- בדיקת אטרופין בסיסי – דופק בסיסי סינוס 55 לדקה והעלאת דופק ל112 לאחר 2 מנות אטרופין 1 מ"ג במשך 6 דקות.



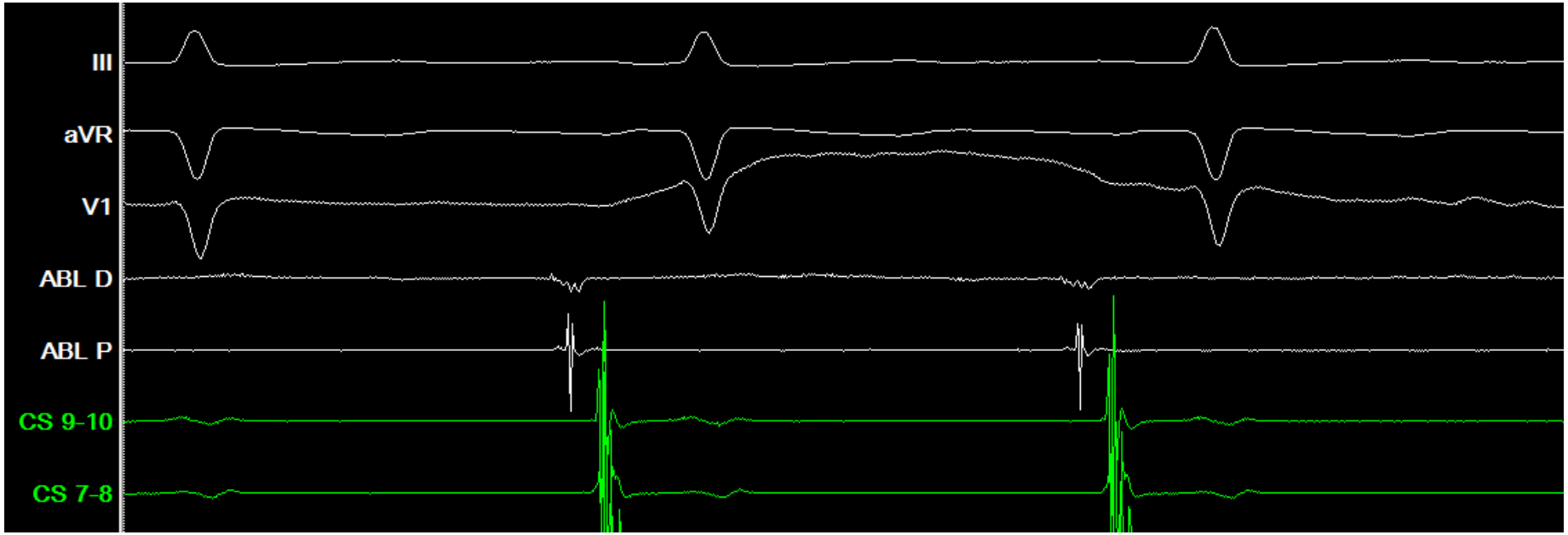
Normal SNRT


111 I BPM
II
I
III
aVR
V1
ABL D
ABL P
CS 9-10
CS 7-8
CS 5-6
CS 3-4
CS 1-2
HIS D
HIS P
CARTO STIM
1.152 s
52 BPM
864 ms
69 BPM

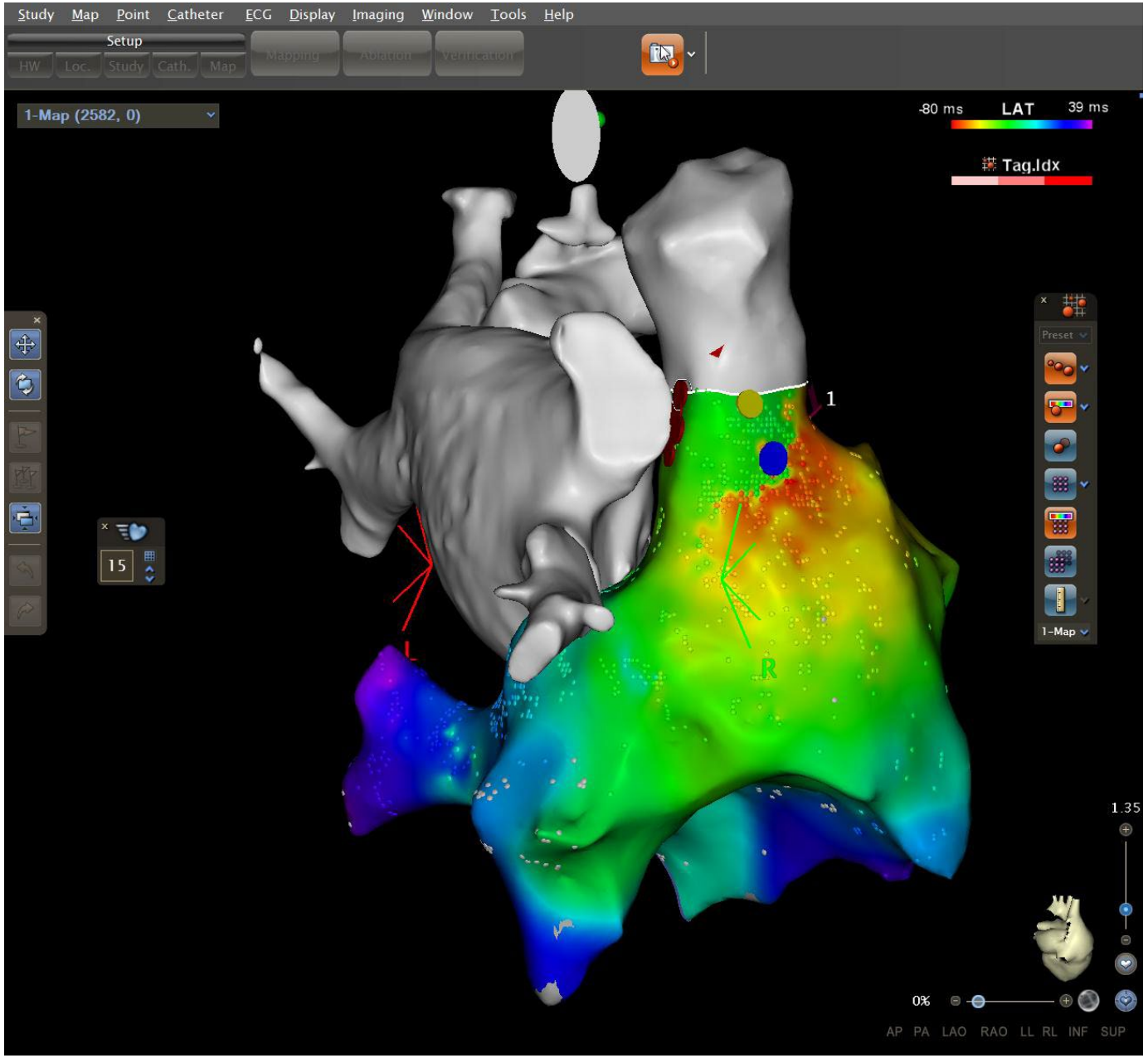
Pre-RF



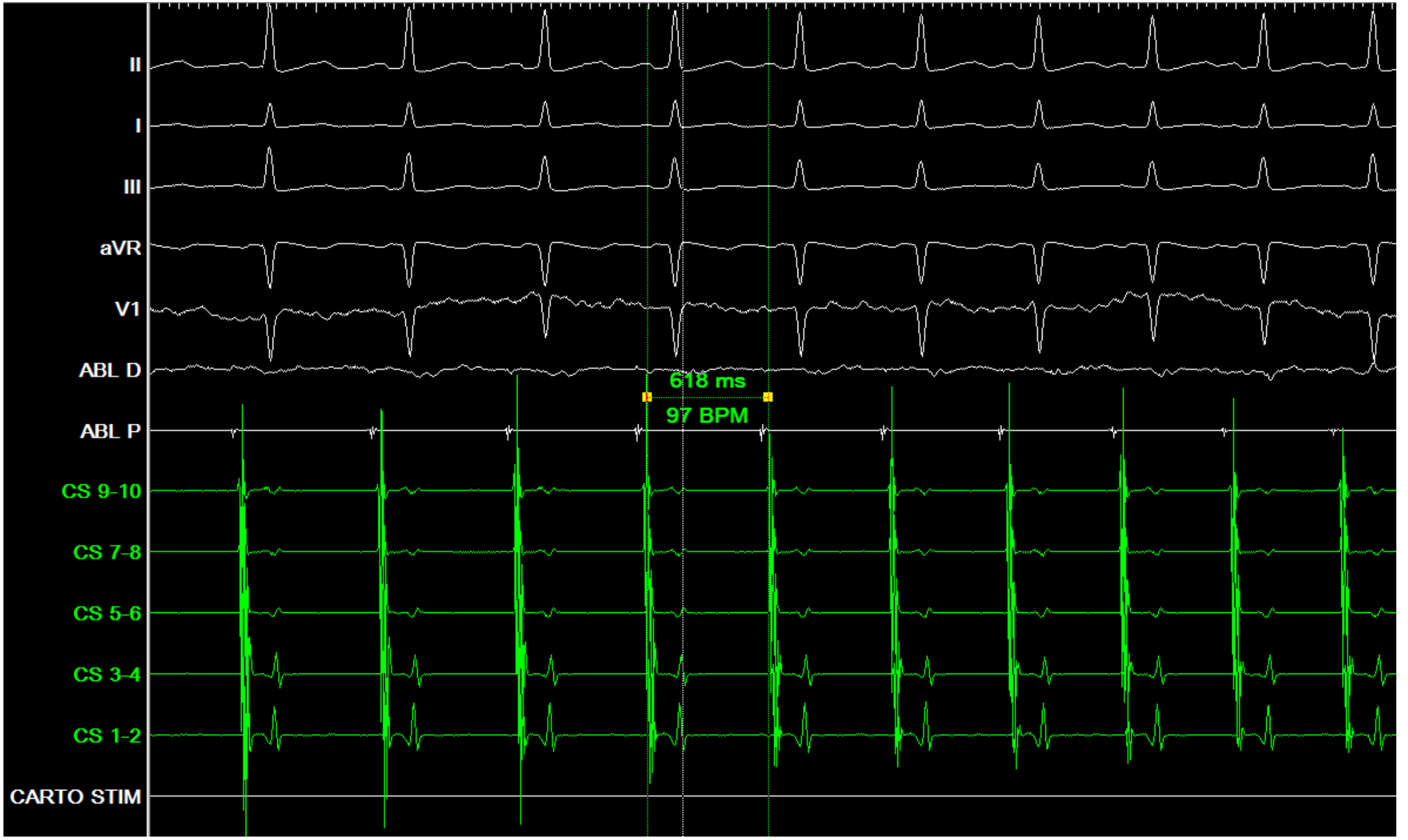
Fractionated signal ??
on ABL pre-RF



עליית דופק מיידית ל95 והתייצבות קצב לב 85 לדקה



Post RF – IV Atropine 1mg+1 mg (6 minutes)



במעקב:

בדיקת אטרופין חוזרת לאחר 6 שבועות

סינוס 70 לדקה ולאחר אטרופין 85 לדקה.

מבחן הטיה ללא עדות להיפוטנסיה אורטוסטטית. תגובה של דופק לעמידה תקינה ללא סימנים פתולוגיים.

ללא אירועי סינקופה חוזרים במעקב של 3.5 שנים.

פודרומים בלבד של התקפי בחילה וחולשה חולפים תוך שניות

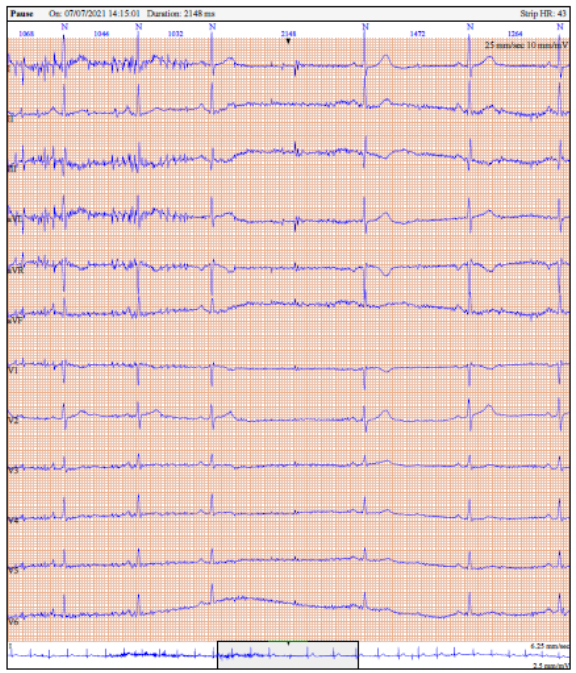
דוגמא 2

- א.מ.
- בן 58, ברקע בעברו פנאומוטורקס ספונטי. עישון כבד בעבר. ללא כותרת של COPD
- היסטוריה של רצפי אירועי פרה-עלפון ועלפון חשודים לואגליים.
- שבועיים טרם קבלתו רצף אירועים ואגליים עם פרה-סינקופה וסינקופה קצר. אירוע סינקופה קשה עם חבלת ראש ושבר באף. עבר עיסויים על ידי בן משפחה.
- בהולטר לב באשפוז פאוזה בת 10 שניות
- אק"ג בסיסי – סינוס 60 לדקה, QT-QRS-PR תקינים
- אקו לב תקין

Patient: MIRZAYEV AVRAHAM
ID: 16785974
Age: 58 Gender: Male

Printed:08/07/2021 09:11
Recorded:07/07/2021 12:53

Selected Events



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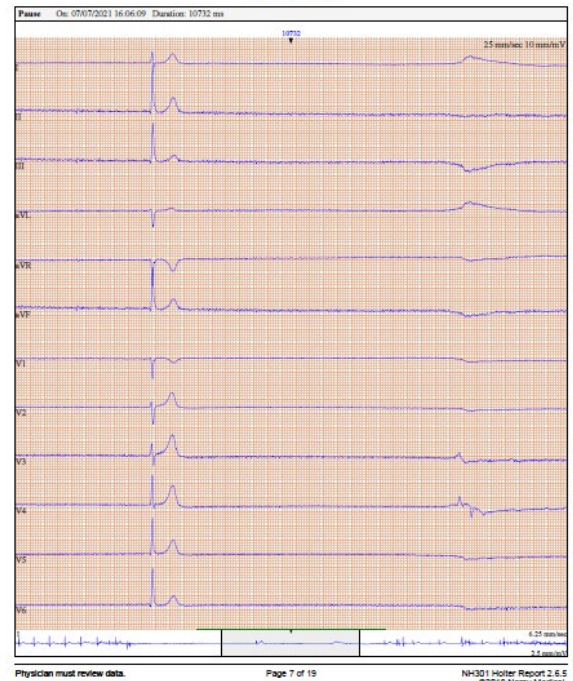

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General

	Recorded	Analyzed
Duration (hh:mm)	19:36	18:31
Start	07/07/2021 12:53	07/07/2021 13:00
Stop	08/07/2021 08:29	08/07/2021 07:32
Channels	I, II, III, aVL, aVR, aVF, V1, V2, V3, V4, V5, V6.	I, II, III, aVL, aVR, aVF, V1, V2, V3, V4, V5, V6.

Heart Rate Variability

Time Domain		Frequency Domain (ms²)	
SDNN (ms)	110.11	ULF[0-0.003Hz]	8205.99
SDANN (ms)	82.58	VLF[0.003-0.04Hz]	9897.06
RMSSD (ms)	65.48	LF[0.04-0.15Hz]	8569.23
HRV triang.index	27.43	HF[0.15-0.4Hz]	712.76

Ventricular Ectopy

	Total
Beats (% of total beats)	0 (0 %)
Isolated	0
Bigeminy	0
Trigeminy	0
Couplet	0
Triplet	0
V.Tachycardia	0
Fusion	0
Supraventricular Ectopy	4 (<0.1 %)
Isolated	4
Pair	0
Run (>=3)	0

Heart Rate

	Total	Time
Total Beats	73994	
Average HR	67	
Max HR	92	07/07/2021 21:18:40
Min HR	41	07/07/2021 16:06:20
Bradycardia (< 60 bpm)	83	
Longest		08/07/2021 04:21:19
Tachycardia (> 100 bpm)	0	
Longest		
Pause (> 2000 ms)	10	
Min RR (ms)	380	08/07/2021 06:45:40
Max RR (ms)	10732	07/07/2021 16:06:20
Atrial Fibrillation	0	0 % of analysed time
Longest		

Relative ST Analysis

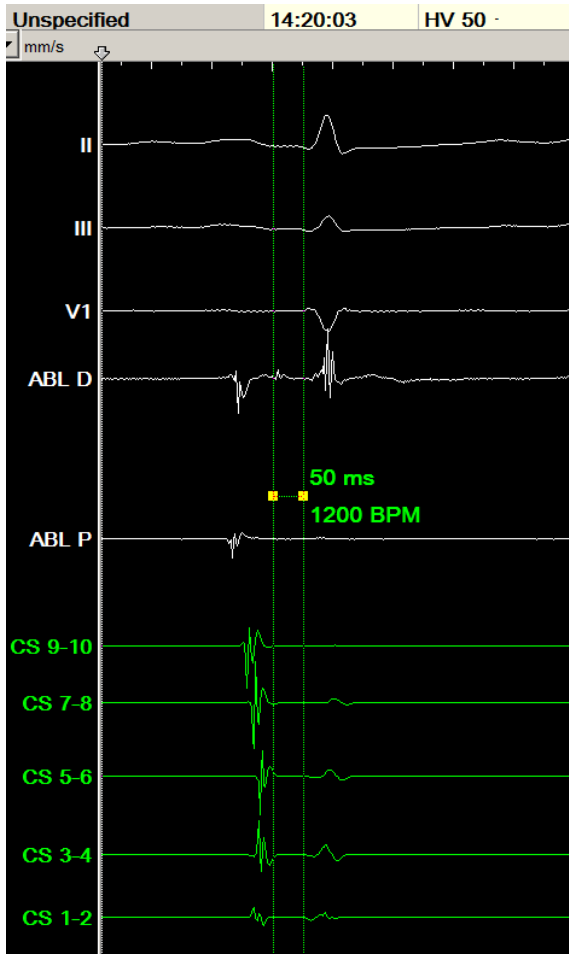
Max Elevation (> 1.00 mm)	0.00
Max Depression (> 1.00 mm)	0.00

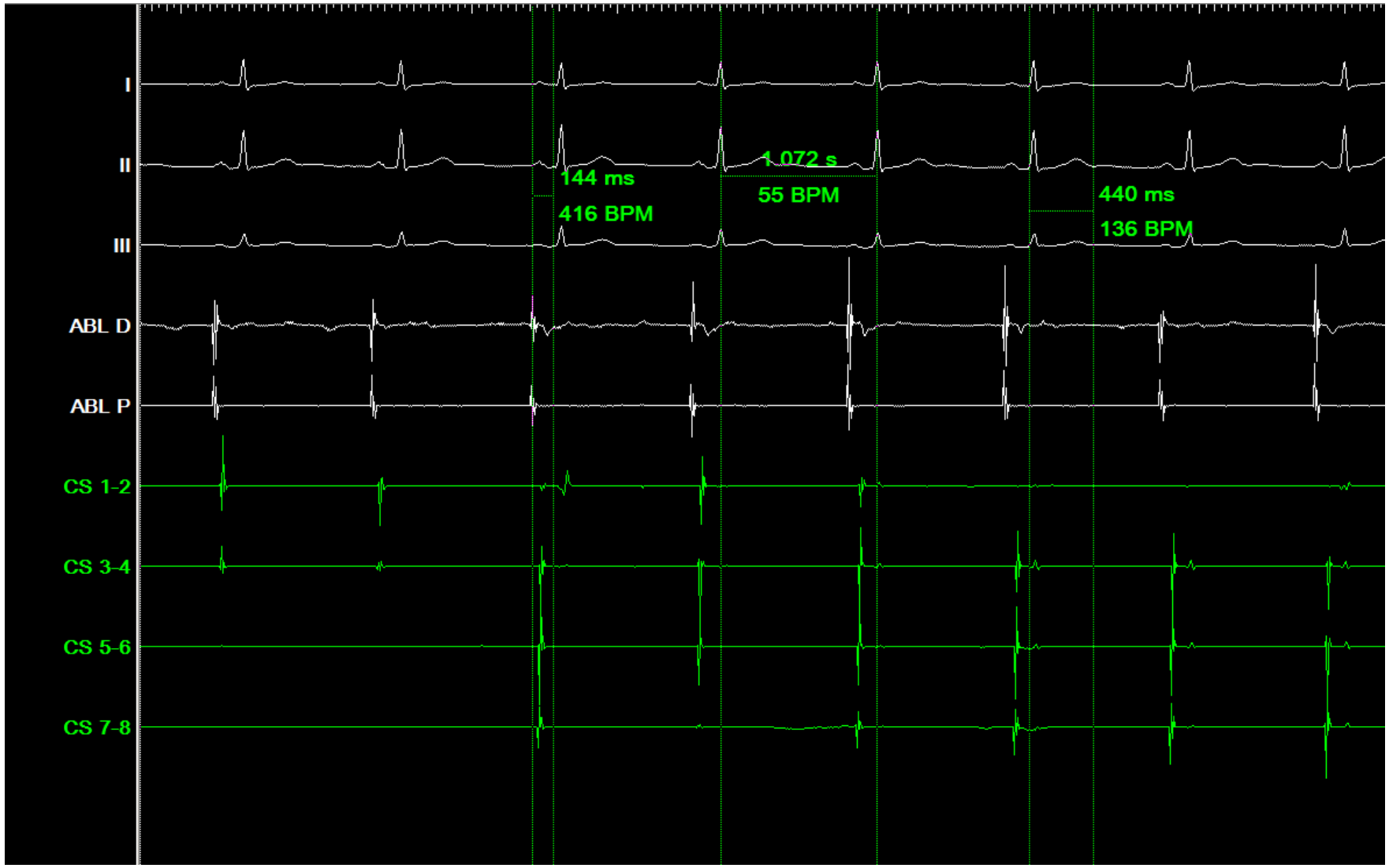
Reference ST: I 0.4 mm | II 0.2 mm | III -0.2 mm | aVL 0.3 mm | aVR -0.3 mm | aVF 0.0 mm | V1 0.1 mm | V2 0.8 mm | V3 0.4 mm | V4 0.4 mm | V5 0.2 mm | V6 0.1 mm

Holter Events

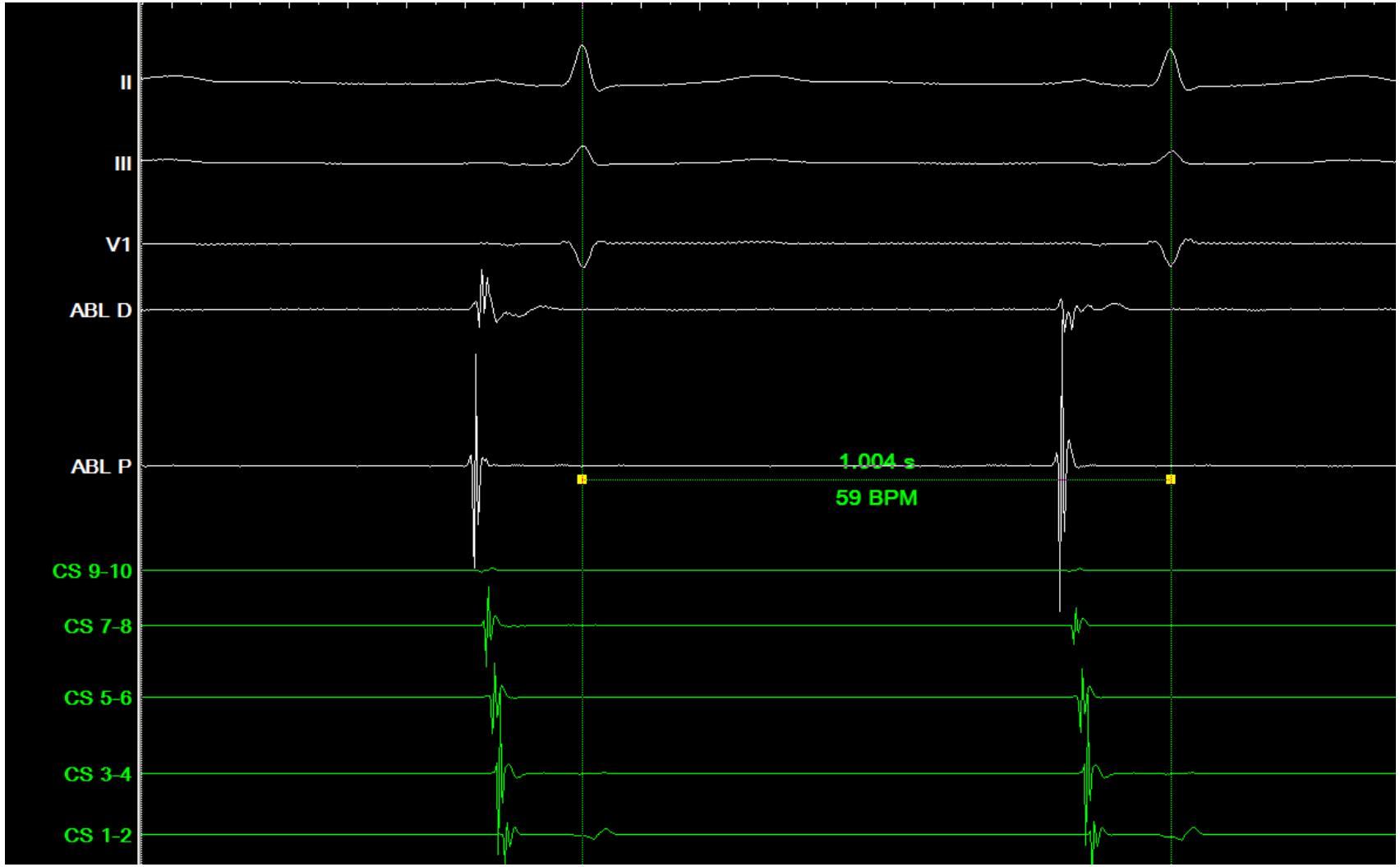
	Total
Pacer (Detection was On)	0
Symptoms Button	0

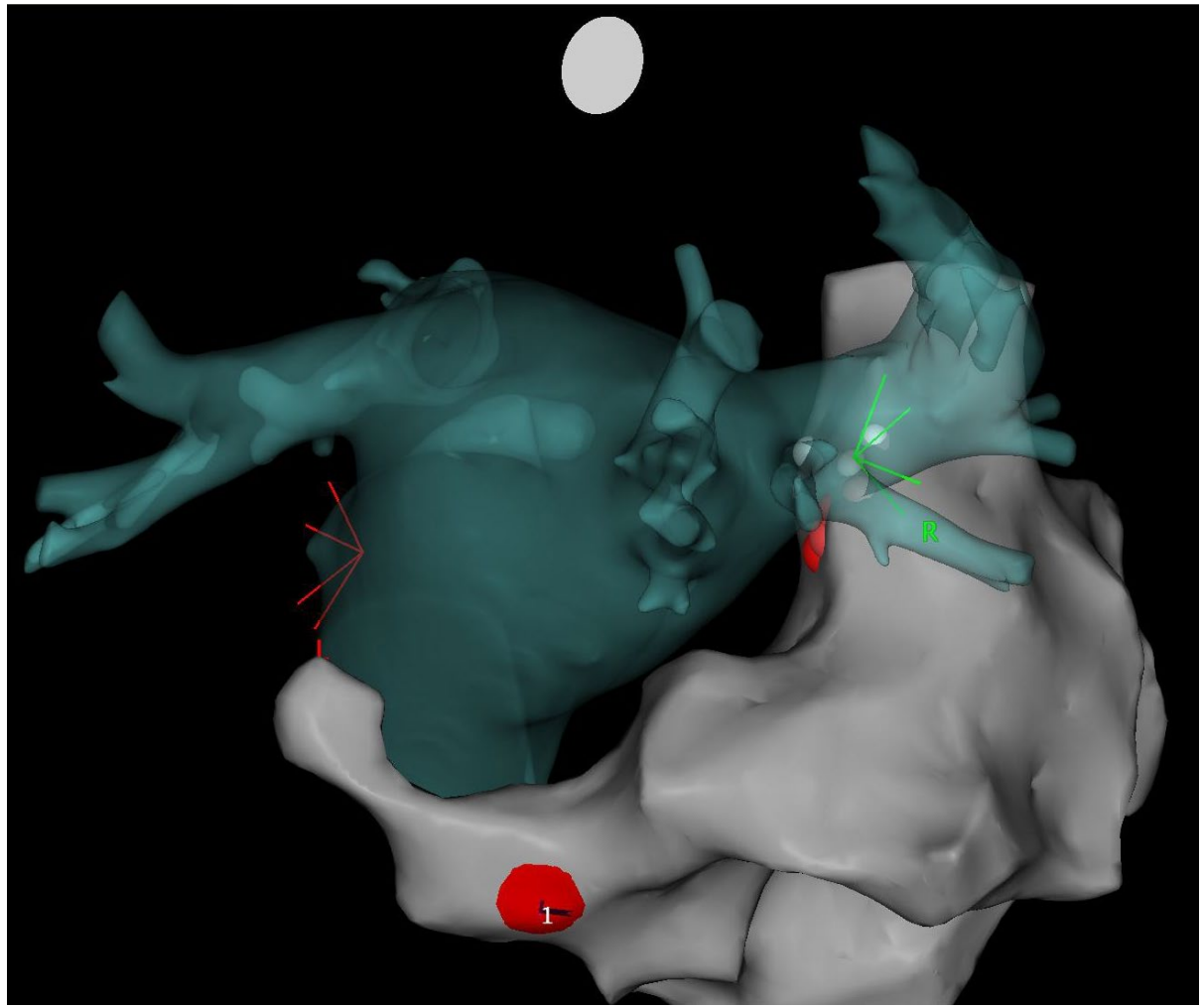
baseline

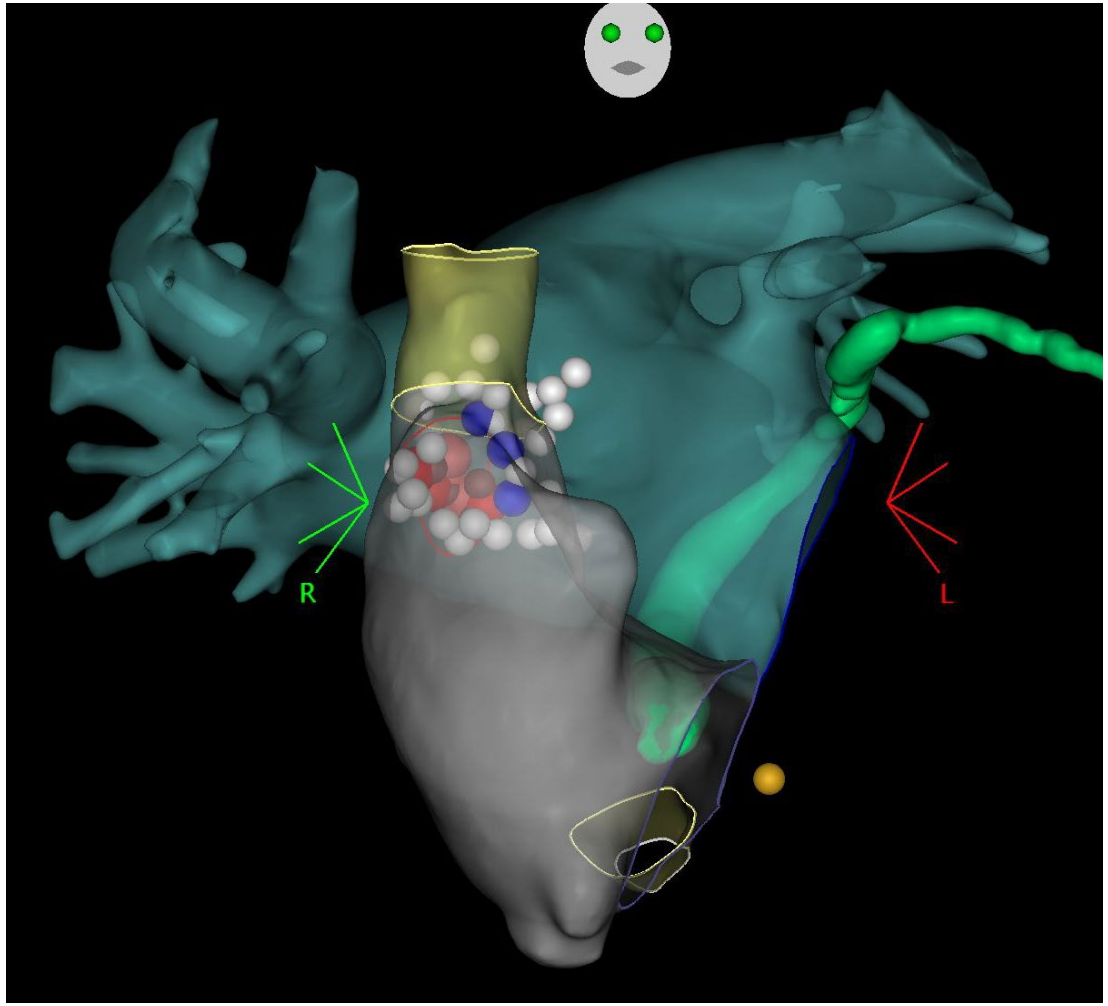

Unspecified
14:20:03
HV 50
mm/s
II
III
V1
ABL D
50 ms
1200 BPM
ABL P
CS 9-10
CS 7-8
CS 5-6
CS 3-4
CS 1-2


I
II
III
144 ms
416 BPM
1.072 s
55 BPM
440 ms
136 BPM
ABL D
ABL P
CS 1-2
CS 3-4
CS 5-6
CS 7-8

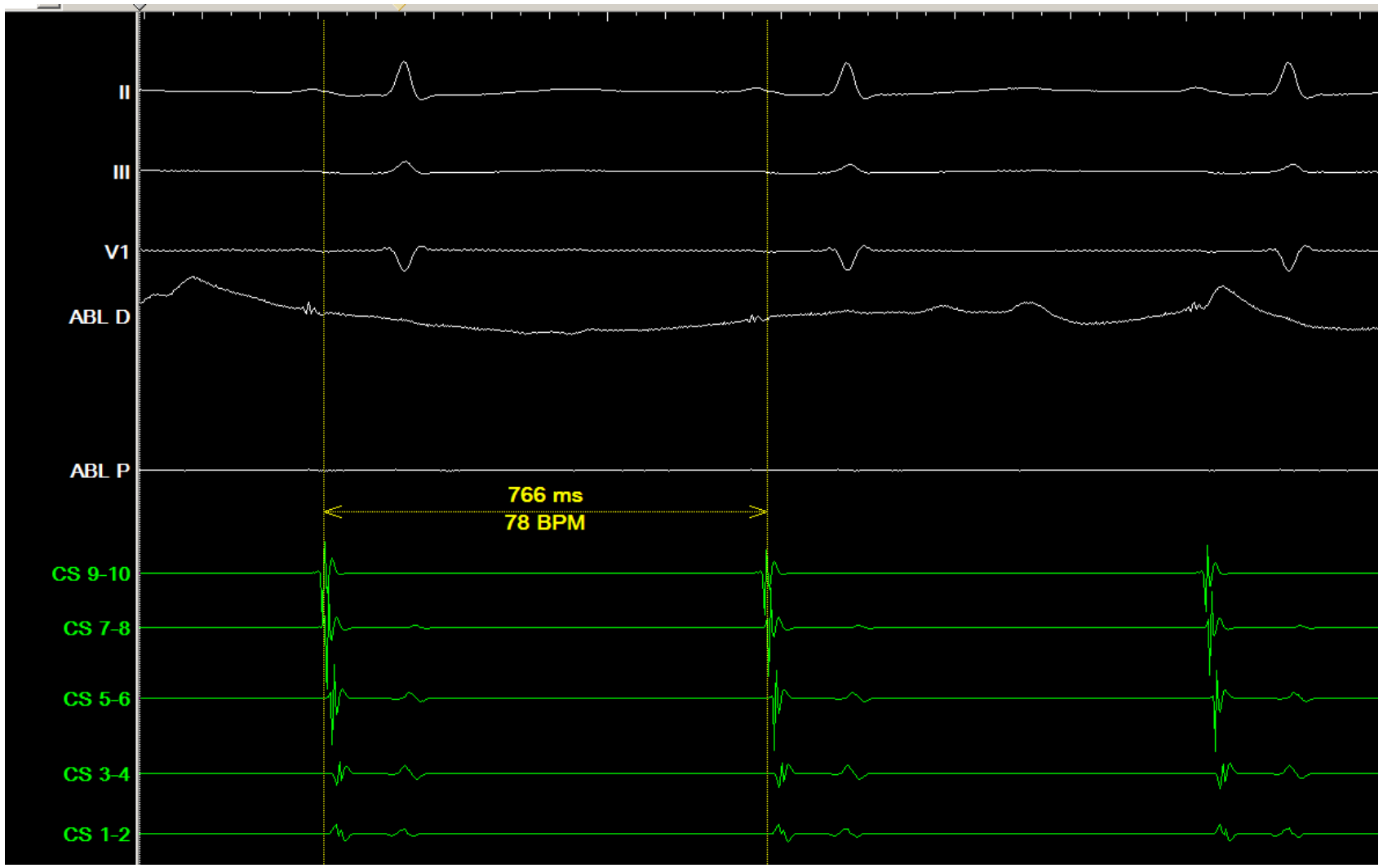
Fractionated signal on ABL pre-RF




R
1

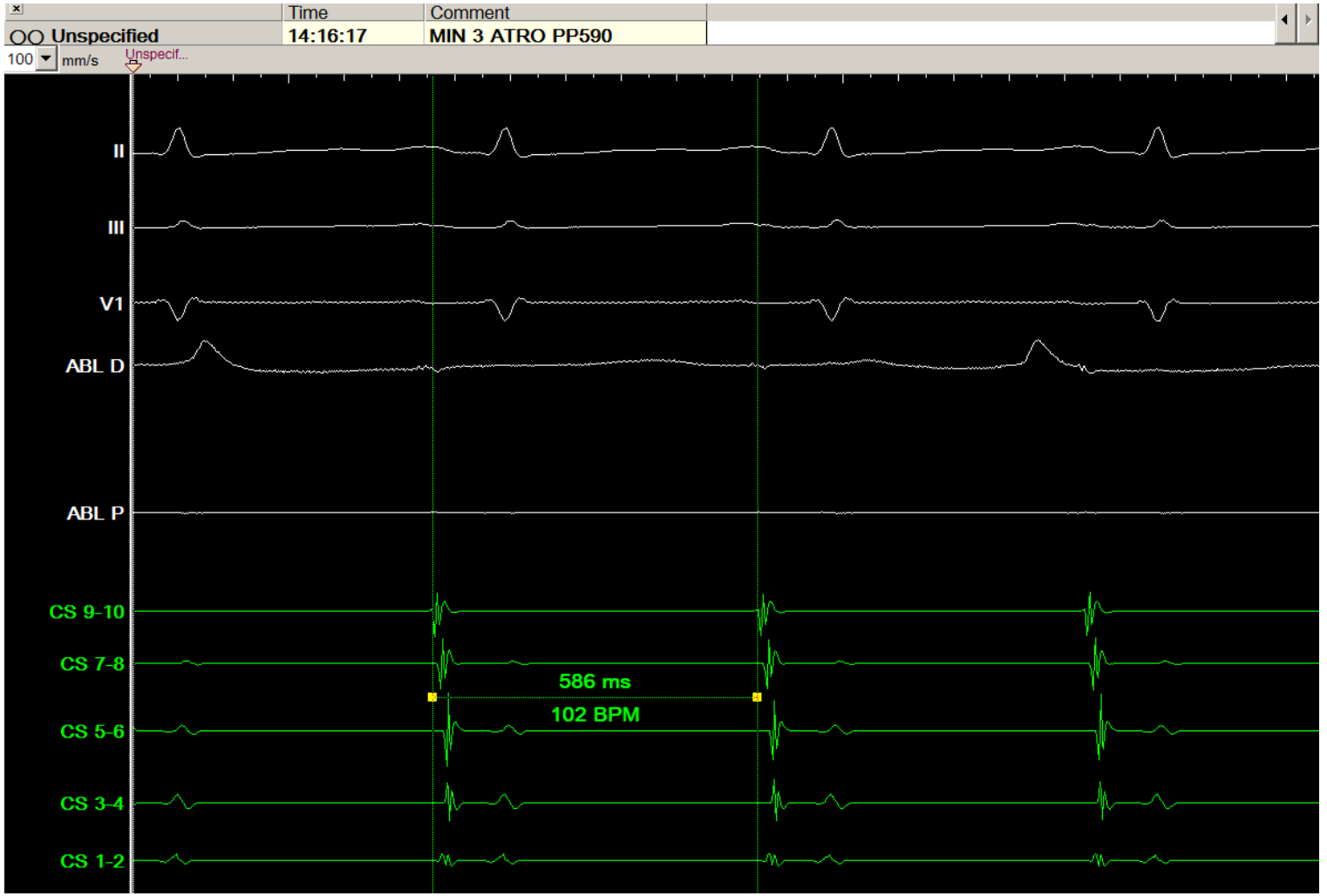

R
L

15 minutes post RF

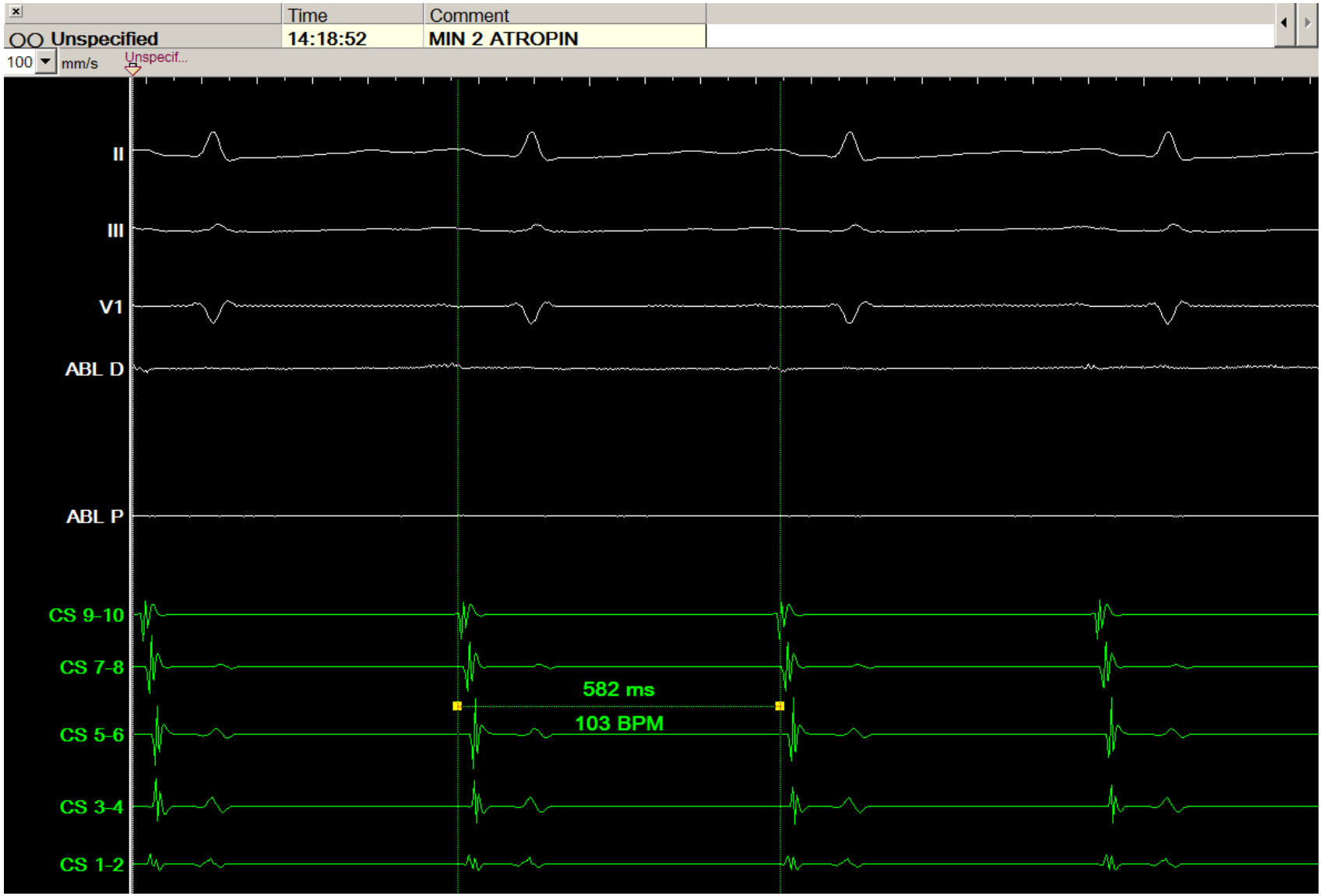


20 minutes post RF and baseline IV Atropine

IV Atropine 1 mg - post 3 minutes

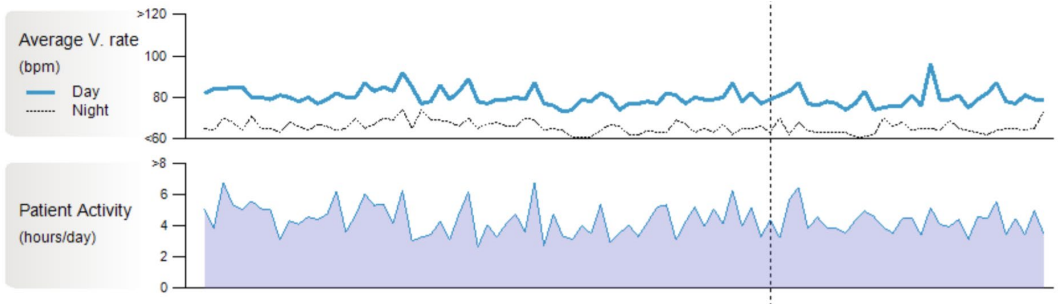


Second dose IV Atropine 1+ 1 mg - post 5 minutes

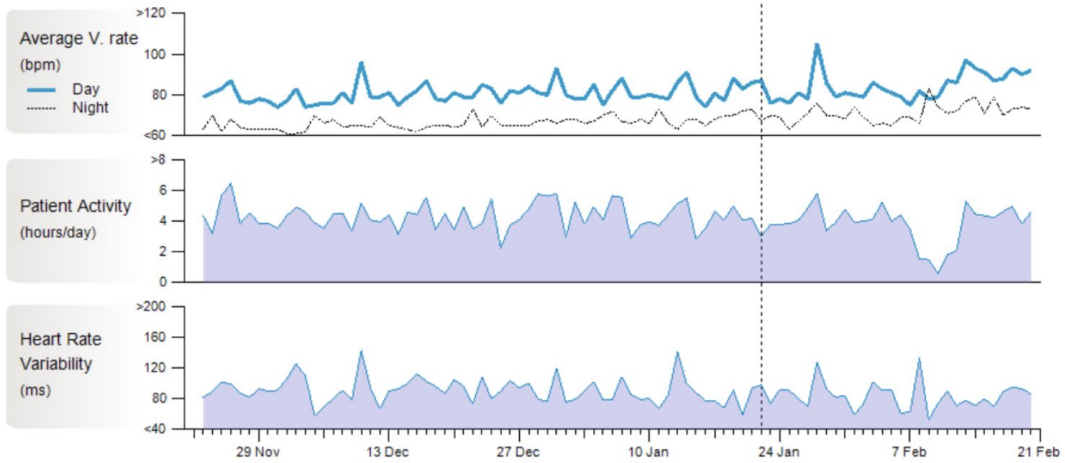


השתלת ILR – יולי 2021

10/2021



2/2022



תאריך:	04/07/2021	**תחילת בדיקה:**	15:03
סיום בדיקה:	13:00	**סה"כ שעות:**	22:13 0:0
		מהירות מינימלית:	53
מהירות מקסימאלית:	98	**מהירות ממוצעת:**	71
הפרעות קצב חדריות VPC'S:	לא נצפו.	**הפרעות קצב על חדריות APC'S:**	נצפו סה"כ 5 APC'S במשך הבדיקה.עמ' 6-7.
הפרעות הולכה:	נצפו אירועים של SINUS ARREST עם מרווחי R-R עד 2.9 שניות.עמ' 4-5.		
שינויים משמעותיים בקטע st:	לא נצפו.	**תלונות הנבדק:**	לא צוינו.
הערות/סיכום:	קצב סינוס. מהירות מינימלית - 53 פעימות לדקה, מהירות מקסימלית - 98 פעימות לדקה, מהירות ממוצעת - 71 פעימות לדקה. APC's בודדים קטעי SINUS ARREST מוגבלים כמצוין לעיל.		

סיכום:

חדר שמאל אינו מורחב; דפנותיו בעובי תקין; ההתכווצות הגלובלית והאזורית תקינה. מקטע פליטה מוערך 60%.
עליה שמאלית ברוחב תקין.
חללי הלב הימניים בגודל תקין.
שורש האאורטה ברוחב תקין.
אי ספיקה טריקוספידלית מזערית;
אין עדות ליתר לחץ דם ראתי; הלחץ הסיסטולי בעורק הראה מוערך ב -30 ממ"כ.
לא נמצא תפליט פריקרדיאלי.

תאריך:	19/09/2021	**תחילת בדיקה:**	08:48
סיום בדיקה:	07:20	**סה"כ שעות:**	22:31 0:0
		מהירות מינימלית:	53
מהירות מקסימאלית:	99	**מהירות ממוצעת:**	71
הפרעות קצב חדריות VPC'S:	נצפו סה"כ 58 VPB'S במשך הבדיקה.	**הפרעות קצב על חדריות APC'S:**	נצפו סה"כ 6 APC'S במשך הבדיקה.
הפרעות הולכה:	לא נצפו.		
שינויים משמעותיים בקטע st:	לא נצפו.	**תלונות הנבדק:**	לא צוינו.
הערות/סיכום:	קצב סינוס. מהירות מינימלית - 53 פעימות לדקה, מהירות מקסימלית - 99 פעימות לדקה, מהירות ממוצעת - 71 פעימות לדקה. VPB's מעטים. APC's בודדים.		

סיכום ודיון

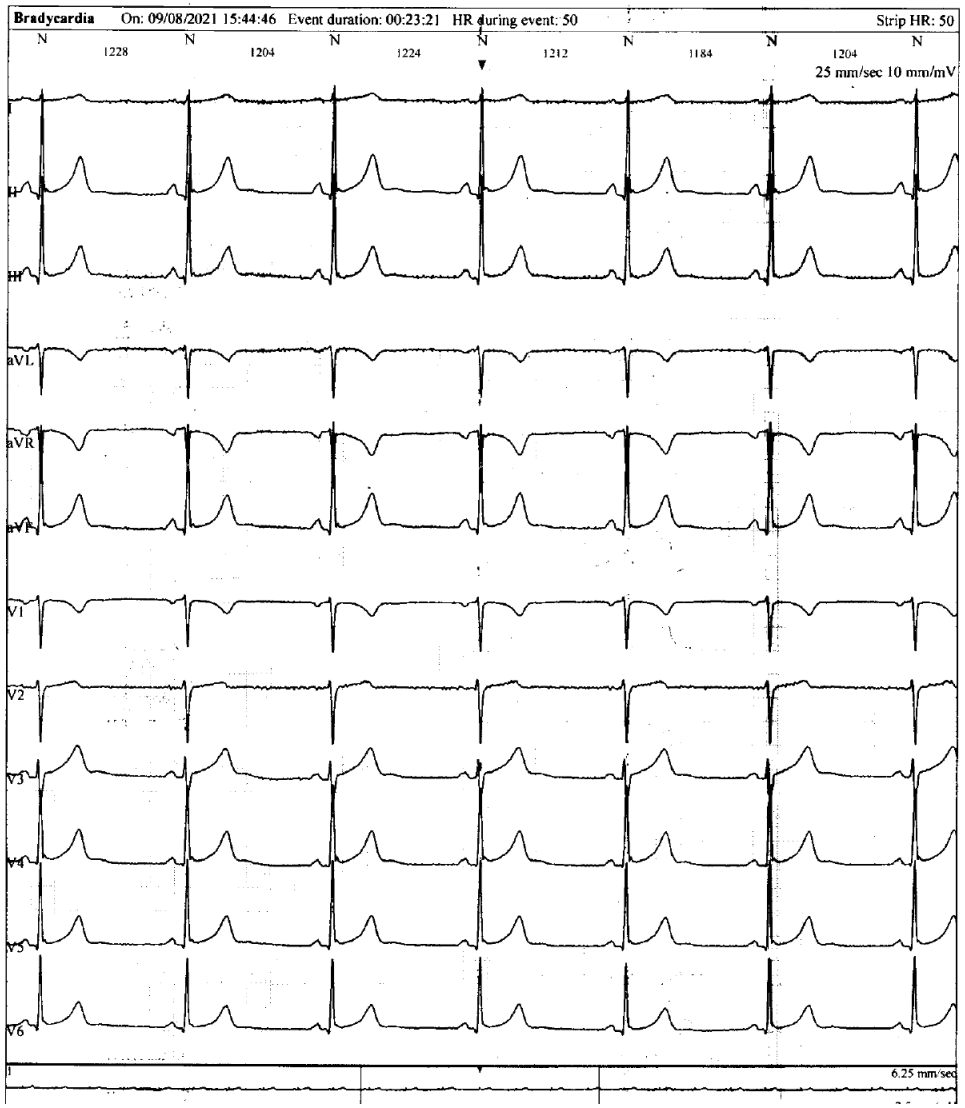
במבחן הטיה ממושך היום לא נצפתה עדות להיפוטנסיה אורתוסטטית.תגובה של דופק לעמידה תקינה..בדקה 10 של העמידה הרגיש כאבים ולחץ העורף,בדקה 30-הרגיש עייפות,שלא לוו בשינויים המודינמיים משמעותיים. בחזרה לשכיבה הדופק חזר לרמה הבסיסית ומצבו השתפר.
לא נצפתה עדות להיפוטנסיה אורתוסטטית או הפרעה קרדיו-סימפטטית אחרת היום בבדיקה.

ללא תסמינים או פאוזות בתקופת המעקב
שנתיים ו8 חודשים

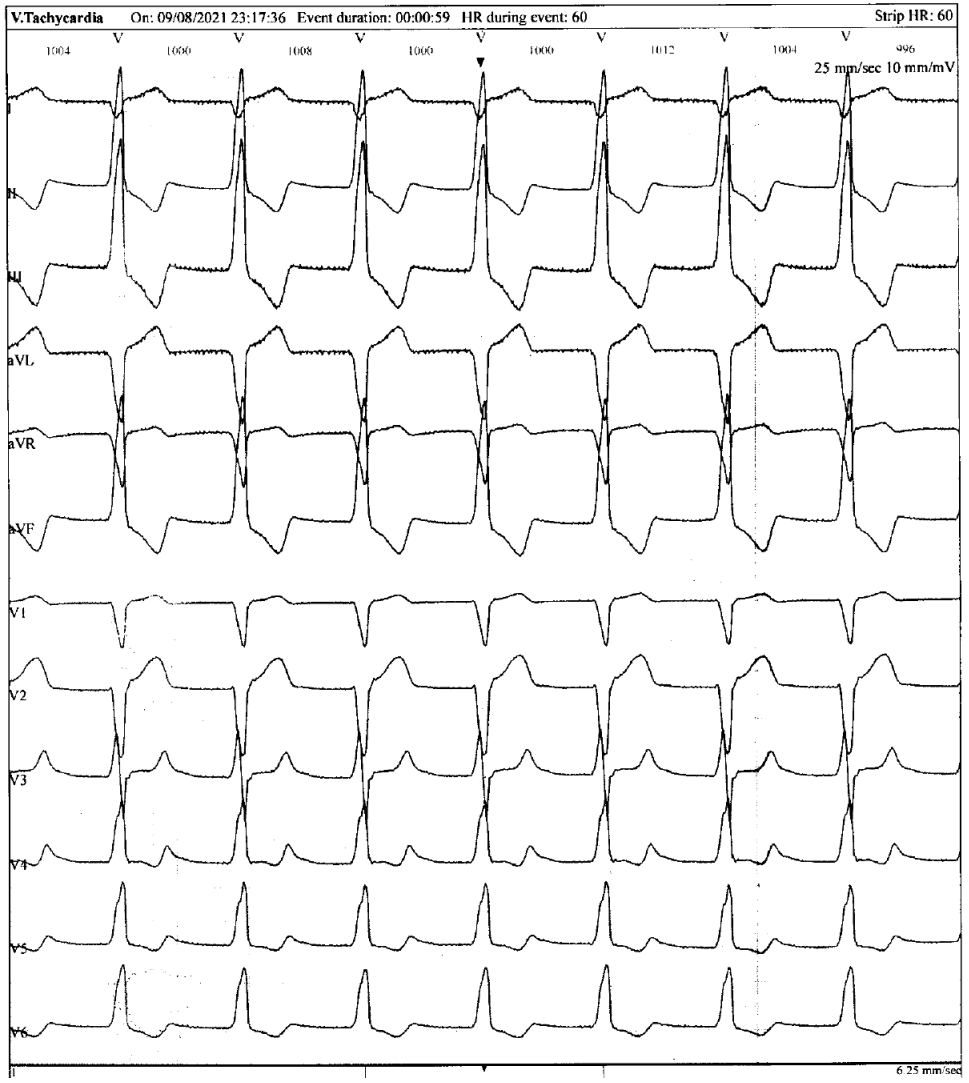
דוגמא 3

- בת 54 ברקע הפרעת חרדה ללא טיפול תרופתי.
- עישון כבד בעבר – הפסיקה לעשן לפני כ15 שנים.
- מזה שנים תחושת דופק איטי במנוחה, לעיתים סחרחורת במנוחה. חולשה מתמשכת.
- כל התלונות חולפות במאמץ. מחמיר לאחר פעילות גופנית מאומצת.
- אקו לב תקין.
- בהולטר לב סינוס 38-123 ומקטעי AIVR במנוחה. דופק 38 בזמן ערות במהלך היום.
- ארגומטריה עם תגובת דופק טובה למאמץ והגעה עד 90 אחוז דופק מקסימלי ללא סימפטומים.
- בבדיקת אטרופין – דופק בסיסי 50 לדקה ולאחר מתן של 1 מ"ג אטרופין בלבד עליה עד סינוס 110.
- אוגוסט 2021 – צריבה של גנגליון פלקסוס.

Selected Events



Selected Events



Holter Summary Report

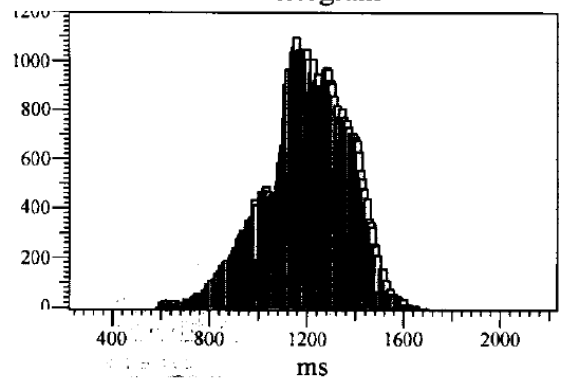
General	Recorded	Analyzed
Duration (hh:mm)	19:58	18:00
Start	09/08/2021 13:41	09/08/2021 14:18
Stop	10/08/2021 09:40	10/08/2021 08:19
Channels	I, II, III, aVL, aVR, aVF, V1, V2, V3, V4, V5, V6.	I, II, III, aVL, aVR, aVF, V1, V2, V3, V4, V5, V6.

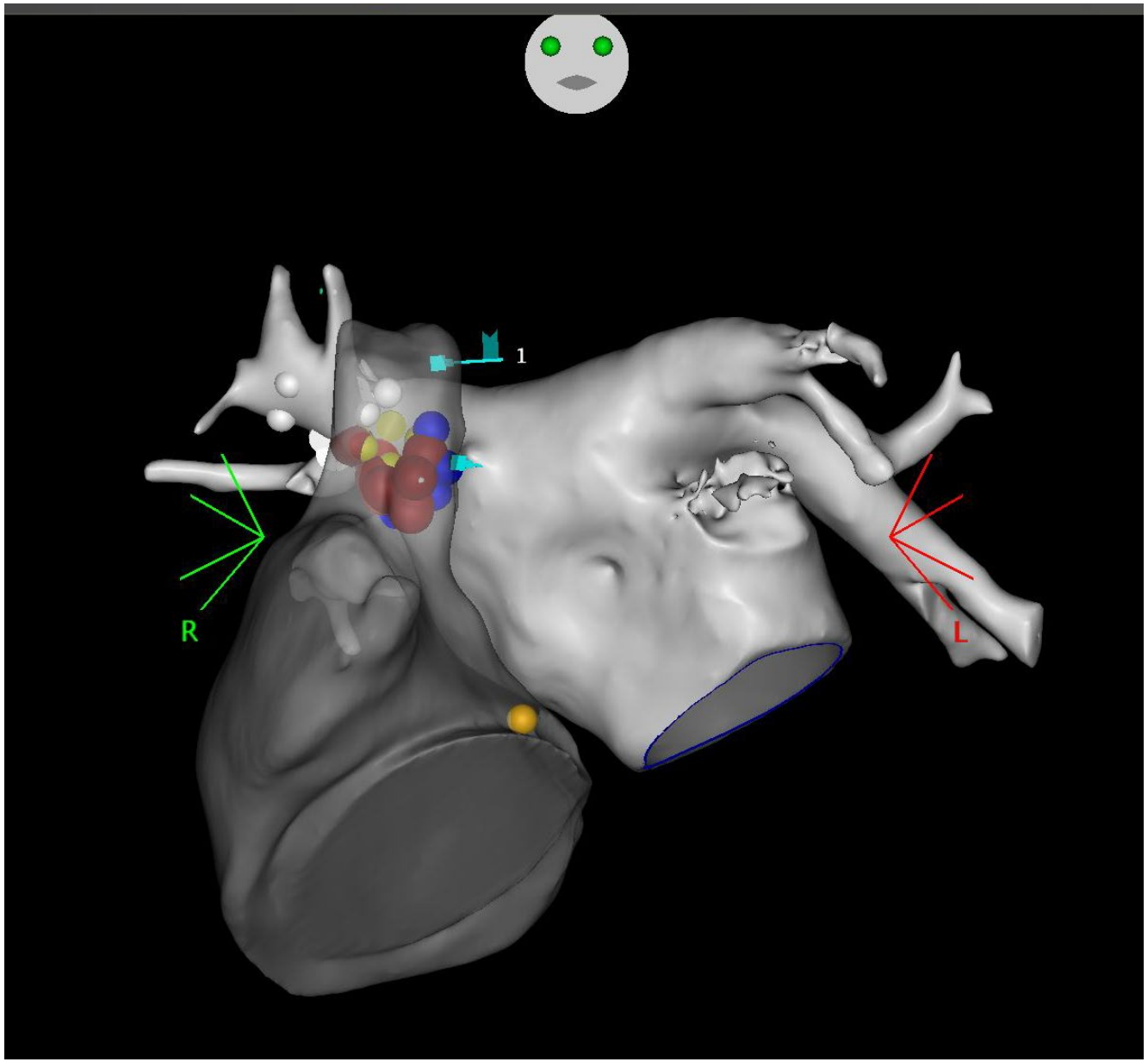
Heart Rate Variability			
Time Domain		Frequency Domain (ms²)	
SDNN (ms)	173.38	ULF[0-0.003Hz]	22758.09
SDANN (ms)	150.24	VLF[0.003-0.04Hz]	2674.02
RMSSD (ms)	50.04	LF[0.04-0.15Hz]	1217.56
HRV triang.index	48.51	HF[0.15-0.4Hz]	717.27

Ventricular Ectopy	Total
Beats (% of total beats)	561 (1.0 %)
Isolated	51
Bigeminy	0
Trigeminy	3
Couplet	8
Triplet	5
V.Tachycardia	30
Fusion	0
Supraventricular Ectopy	1 (<0.1 %)
Isolated	1
Pair	0
Run (>=3)	0

Heart Rate	Total	Time
Total Beats	54079	
Average HR	50	
Max HR	99	09/08/2021 14:19:40
Min HR	37	10/08/2021 04:10:30
Bradycardia (< 60 bpm)	47	
Longest		10/08/2021 00:38:52
Tachycardia (> 100 bpm)	0	
Longest		
Pause (> 2000 ms)	0	
Min RR (ms)	588	10/08/2021 07:44:33
Max RR (ms)	1712	10/08/2021 04:35:53
Atrial Fibrillation	0	0 % of analysed time
Longest		

HRV Histogram




1
R
L

- מבחן אטרופין יום לאחר הפעולה - דופק בסיס עלה ל- 65. לאחר שתי מנות אטרופין העלתה דופק עד 75 עם השטחה של התגובה הקודמת לאטרופין.

Holter Summary Report

General		
	Recorded	Analyzed
Duration (hh:mm)	20:55	19:50
Start	31/08/2021 12:15	31/08/2021 12:22
Stop	01/09/2021 09:11	01/09/2021 08:13
Channels	I, II, III, aVL, aVR, aVF, V1, V2, V3, V4, V5, V6	I, II, III, aVL, aVR, aVF, V1, V2, V3, V4, V5, V6

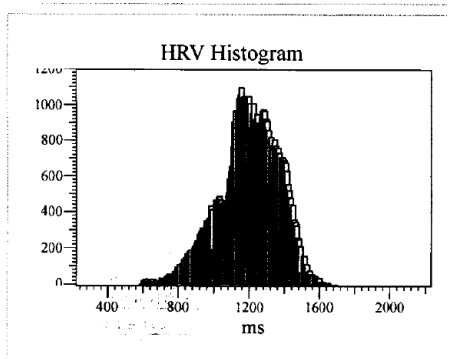
Heart Rate Variability			
Time Domain		Frequency Domain (ms²)	
SDNN (ms)	62.27	ULF[0-0.003Hz]	2691.26
SDANN (ms)	53.71	VLF[0.003-0.04Hz]	393.51
RMSSD (ms)	37.79	LF[0.04-0.15Hz]	640.65
HRV triang.index	13.19	HF[0.15-0.4Hz]	501.17

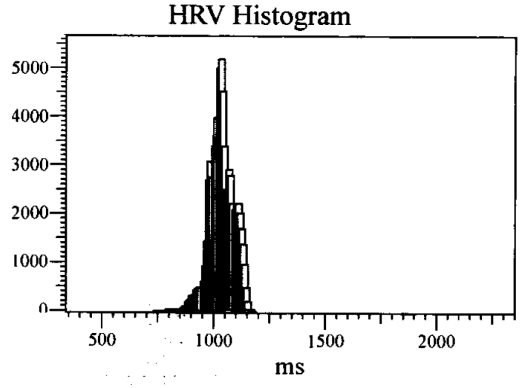
Ventricular Ectopy	
	Total
Beats (% of total beats)	0 (0 %)
Isolated	0
Bigeminy	0
Trigeminy	0
Couplet	0
Triplet	0
V.Tachycardia	0
Fusion	0
Supraventricular Ectopy	18 (<0.1 %)
Isolated	16
Pair	1
Run (>=3)	0

Heart Rate		
	Total	Time
Total Beats	68885	
Average HR	58	
Max HR	85	01/09/2021 07:21:55
Min HR	51	01/09/2021 01:03:30
Bradycardia (< 60 bpm)	10	
Longest		31/08/2021 22:33:48
Tachycardia (> 100 bpm)	0	
Longest		
Pause (> 2000 ms)	0	
Min RR (ms)	685	01/09/2021 07:21:51
Max RR (ms)	1262	01/09/2021 03:37:48
Atrial Fibrillation	0	0 % of analysed time
Longest		

Relative ST Analysis	
Max Elevation (> 1.00 mm)	0.00
Max Depression (> 1.00 mm)	0.00
Reference ST: I 0.1 mm | II 0.6 mm | III 0.5 mm | aVL -0.2 mm | aVR -0.4 mm | aVF 0.5 mm | V1 0.1 mm | V2 0.9 mm | V3 1.1 mm | V4 0.5 mm | V5 0.5 mm | V6 0.3 mm	

Holter Events	
	Total
Pacer (Detection was On)	0
Symptoms Button	0





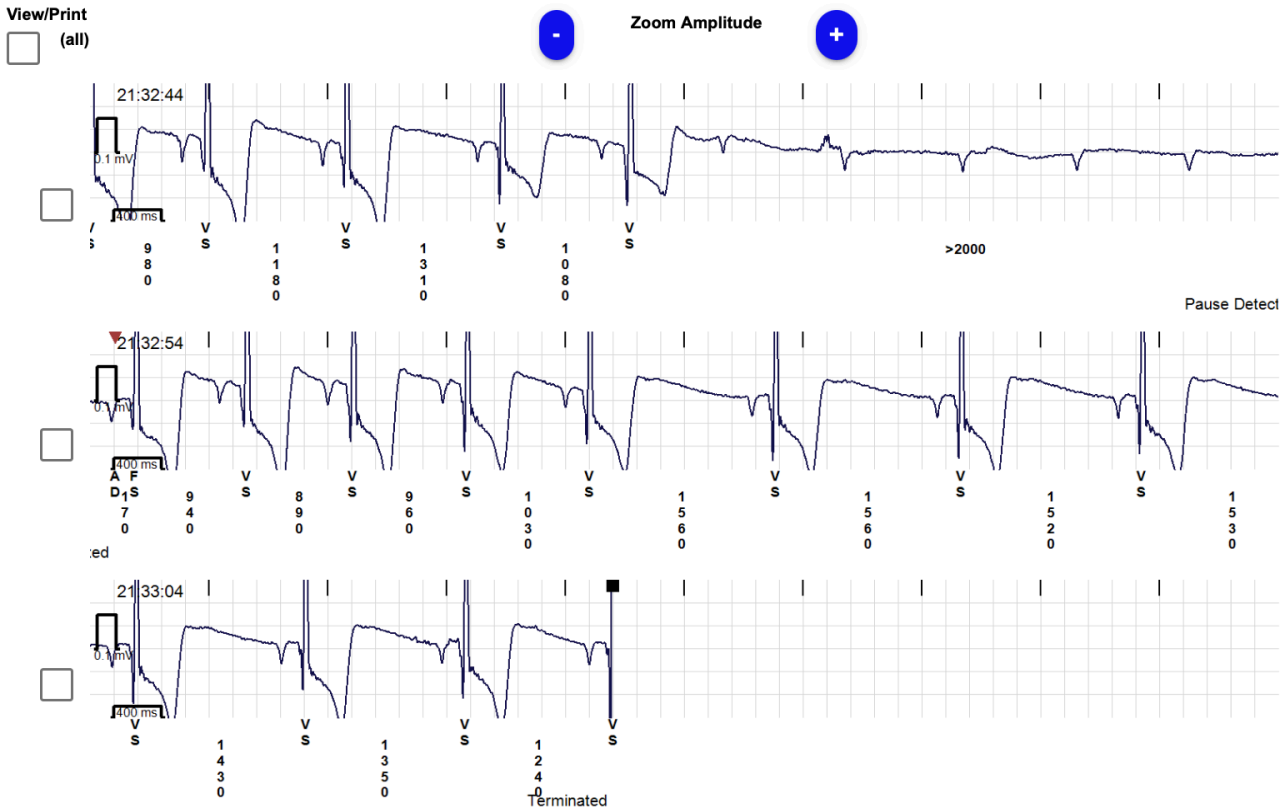
סיכום ודיון

במבחן הטיה ממושך היום לא נצפתה עדות להיפוטנסיה אורתוסטטית.תגובה של דופק לעמידה תקינה..בדקה 10 של העמידה הרגיש כאבים ולחץ העורף,בדקה 30-הרגיש עייפות,שלא לוו בשינויים המודינמיים משמעותיים. בחזרה לשכיבה הדופק חזר לרמה הבסיסית ומצבו השתפר.

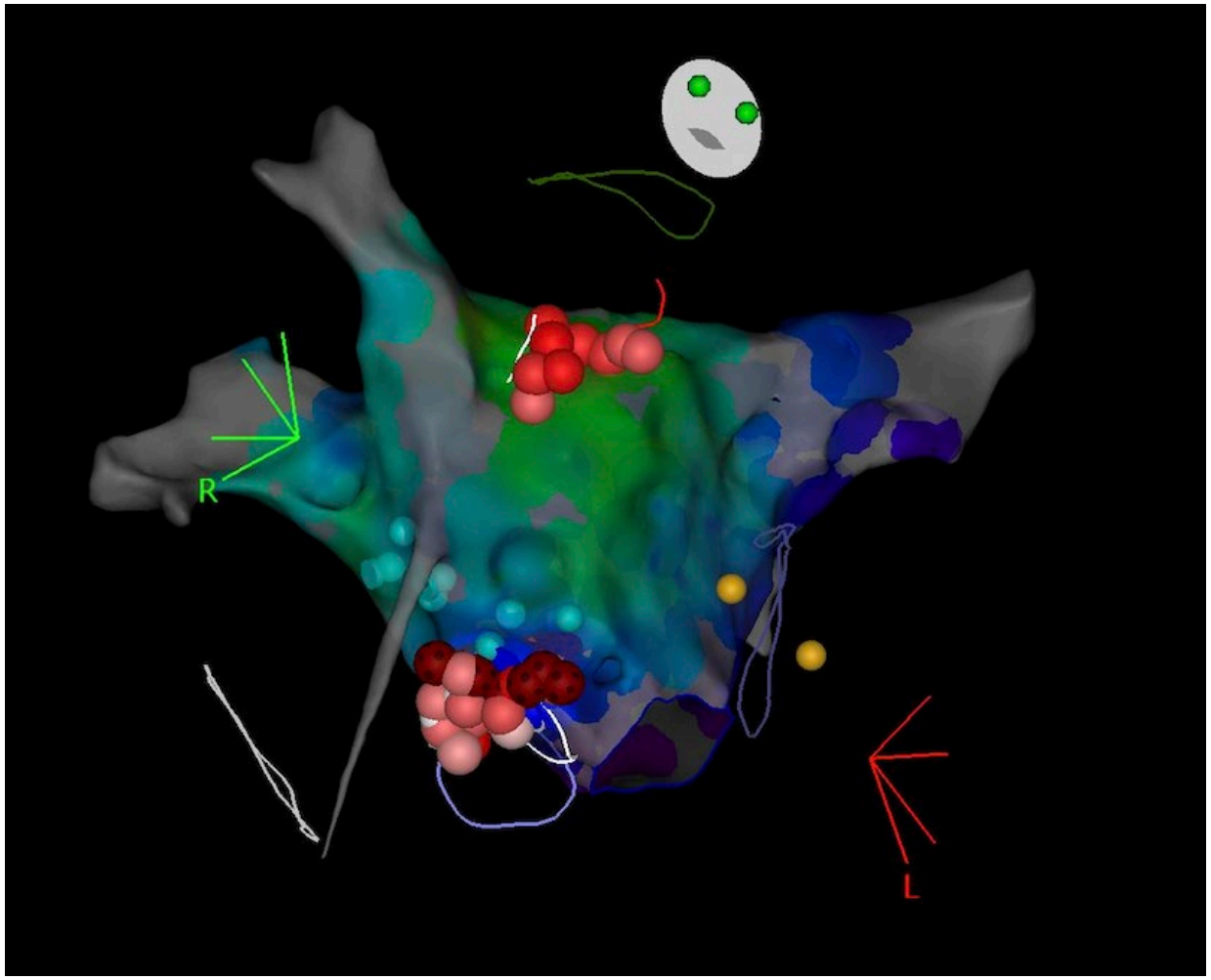
לא נצפתה עדות להיפוטנסיה אורתוסטטית או הפרעה קרדיו-סימפטטית אחרת היום בבדיקה.

דוגמא 4

ILR



- בן 38, אצן חובב, אירועי סינקופה חוזרים בעלי מאפיינים ואגליים. מתאשפז לאחר אירוע נוסף.
- אק"ג – סינוס ברדיקרדיה 45 לדקה, PR-QRS-QT תקינים.
- הולטר לב – Transient functional AVBבשעות עירות.
- ארגומטריה תקינה.
- אקו לב – תפקוד לבבי תקין, הפרעה באפקס חדר ימין עם טרבקולציות.
- CMR - חדר ימין מבנה ותפקוד תקין. נפח סוף דיאסטולי בטווח תקין/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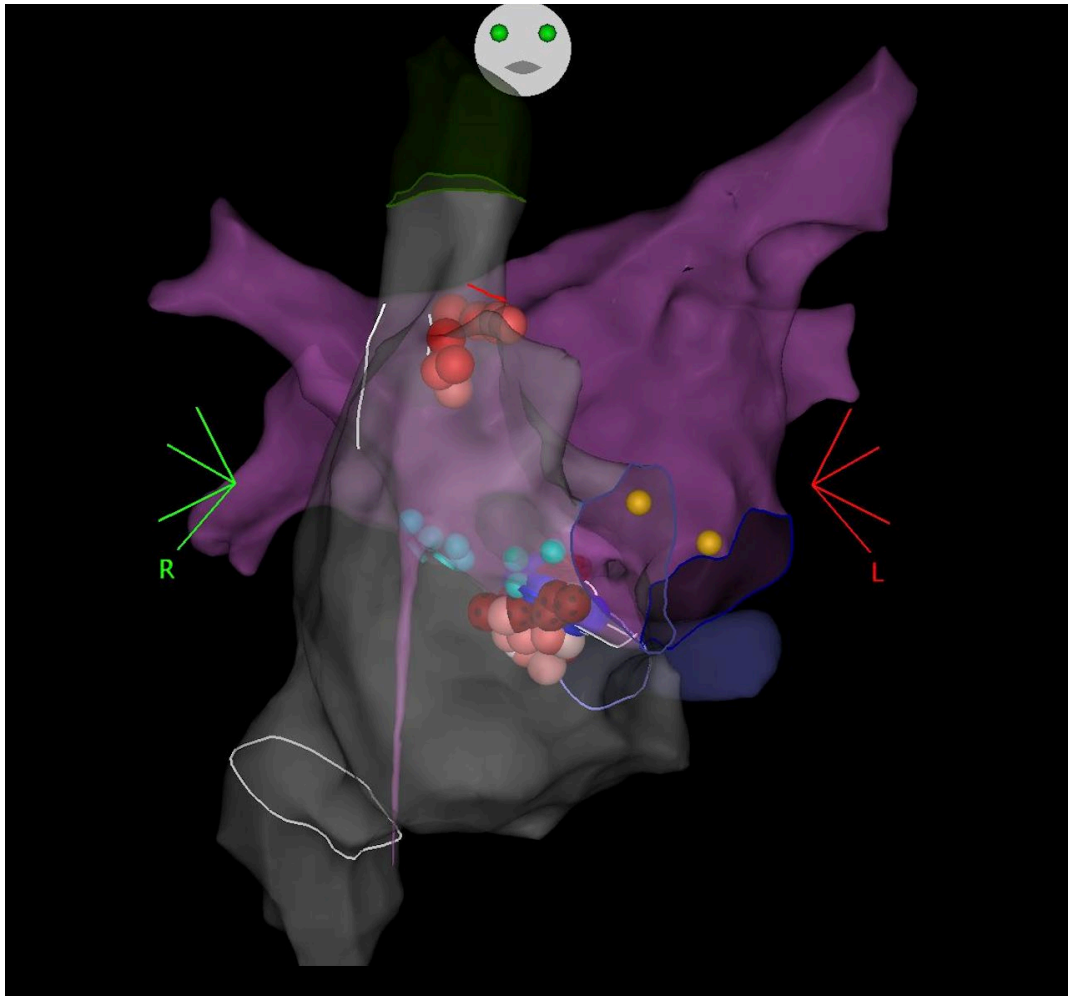
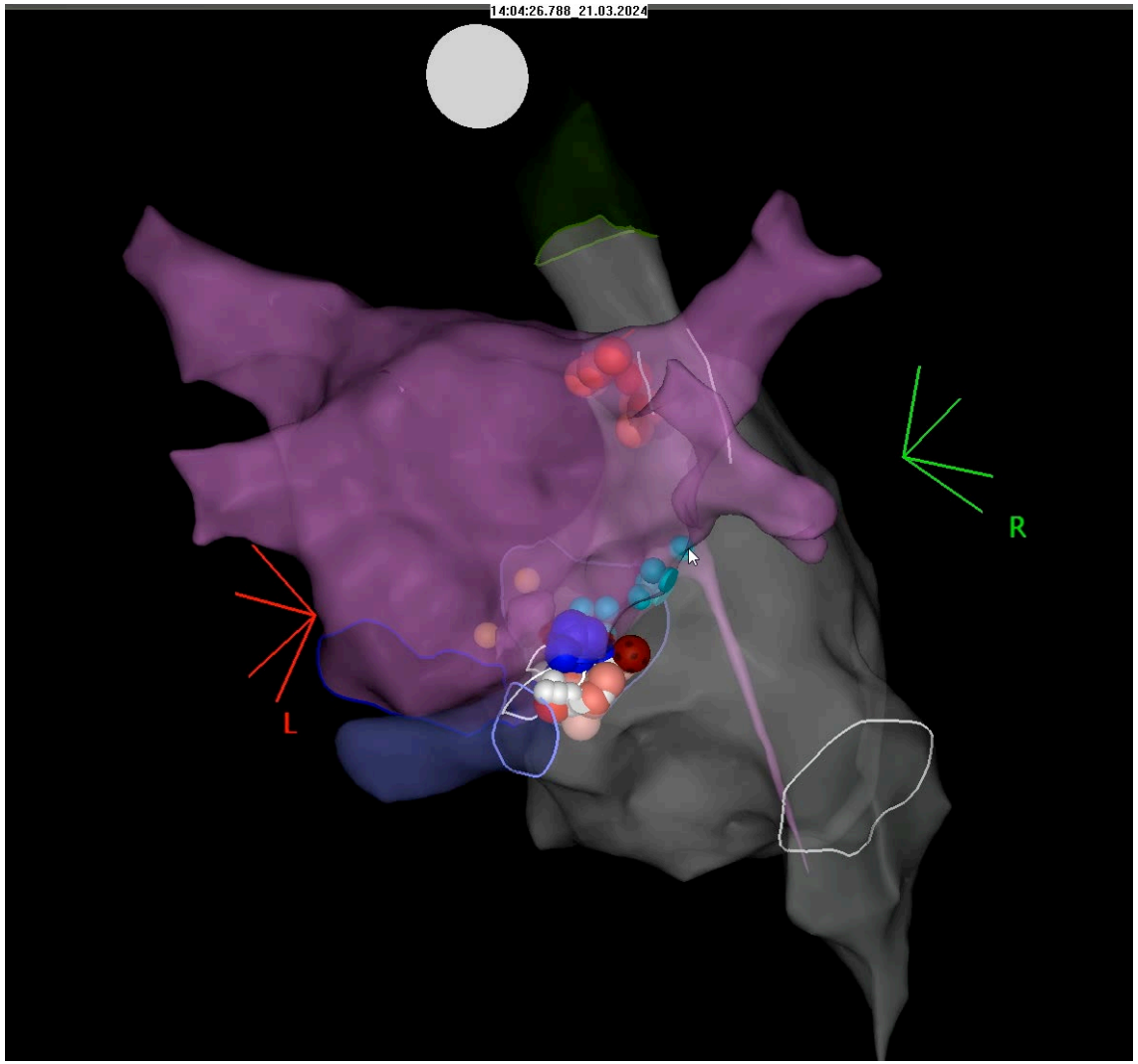
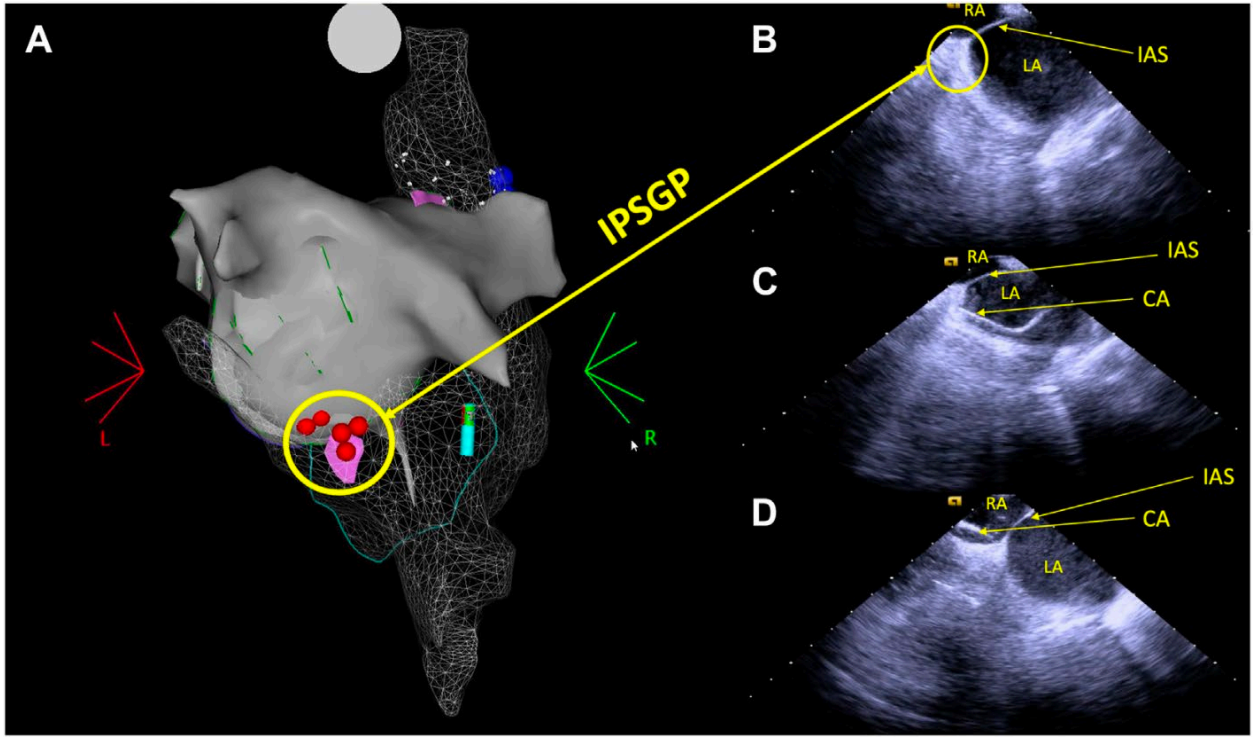

R
L

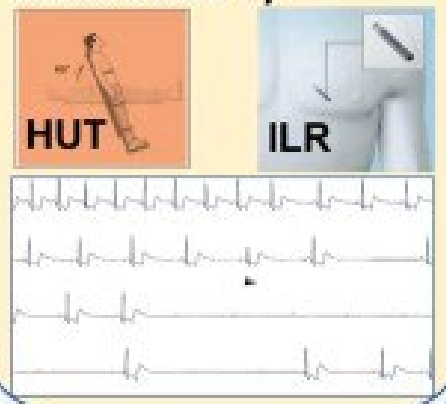
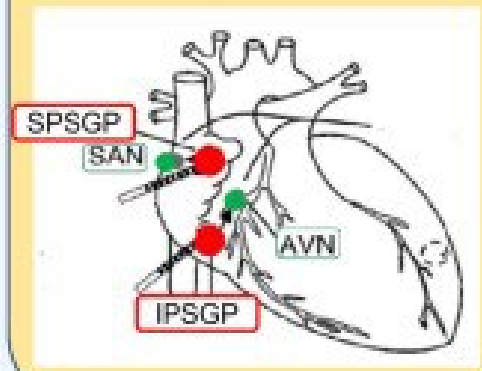

14:04:26.788 21.03.2024
R
L


A
IPSGP
L
R
B
RA
IAS
LA
C
RA
IAS
LA
CA
D
IAS
RA
CA
LA

ID#	Assessment Type	Date	Detected hh:mm	Duration hh:mm:ss	Max V. Rate	Median V. Rate	Episode Details
*	**Additional episodes may be available. Request a remote interrogation to fill in additional information.**						
10	Pause	11-Aug-2020	06:23	00:00:13		52 bpm	ECG
246	Pause	10-Dec-2022	05:09	00:00:06		55 bpm	ECG
216	Pause	16-Nov-2022	21:32	00:00:06		51 bpm	ECG
312	Pause	11-Apr-2023	09:16	00:00:06		57 bpm	ECG
140	Pause	03-Mar-2022	18:55	00:00:05		56 bpm	ECG
108	Pause	24-Jan-2021	10:56	00:00:05		48 bpm	ECG
123	Pause	04-May-2021	11:27	00:00:05		50 bpm	ECG
117	Pause	27-Mar-2021	20:16	00:00:05		54 bpm	ECG
323	Pause	26-Apr-2023	14:03	00:00:05		64 bpm	ECG
135	Pause	12-Feb-2022	11:42	00:00:05		50 bpm	ECG
264	Pause	17-Jan-2023	14:01	00:00:05		63 bpm	ECG
228	Pause	27-Nov-2022	07:49	00:00:05		79 bpm	ECG
334	Pause	16-May-2023	10:41	00:00:05		43 bpm	ECG
232	Pause	30-Nov-2022	23:22	00:00:04		58 bpm	ECG
257	Pause	21-Dec-2022	00:10	00:00:04		39 bpm	ECG
93	Pause	23-Dec-2020	06:03	00:00:04		54 bpm	ECG
214	Pause	31-Oct-2022	14:21	00:00:04		63 bpm	ECG

No significant pauses since CNA - June 2023

Cardioneuroblation for reflex syncope

	IDENTIFY the proper candidate	ABLATE the proper ganglia	VERIFY the effect of ablation	PROVE the efficacy of therapy
What is known	Asystolic reflex syncope documented by: 	*Target*: SPSGP - IPSGP 	*At 2 years:* ↓ Syncope recurrence ↓ Heart rate variability ↑ Heart rate 	• Need for large RCTs • Need for longer follow-up
What is not known	*Less suitable in:* • Mixed forms • Non-syncopal extrinsic SND/AVB *Do not perform in:* • VD forms • Intrinsic SND/AVB	• SPSGP only or SPSGP+IPSGP • RA vs LA vs RA+LA • Optimal ablation technique • Assessment of acute procedural success	• Long-term efficacy (reinnervation) • Patient's expectation effect • Physician's expectation effect • Subgroup efficacy	• Non-inferiority of CNA vs pacemaker in pts >40 yrs • Superiority of CNA vs conventional therapy in pts <60 years • Superiority of CNA vs sham CNA • Potential harm of long-term vagal denervation

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Randomized studies reporting the impact of different treatment strategies on quality of life in vasovagal syncope

Study	Treatment	No. of patients	Follow-up	QoL measurement tool	Headline results
Sharma et al. [14] (LIVE-Yoga)	Yoga practice	55	12 months	WHO-QOL-BREF and SF-30	QoL at 12 months showed significant improvement of all Syncope Functional Status Questionnaire scores and 2 domains of WHO QOL-BREF scores ($P < 0.05$)
Perez-Lugones et al. [15]	Fluoxetine vs. bisoprolol	96	6 months	General evaluation of QOL from 1 (very good) to 5 (very bad)	Patients' well-being was improved only in the fluoxetine-group (13.4 ± 0.7 vs. 15.4 ± 0.9 before treatment, $P < 0.01$)
Piotrowski et al. [8]	CNA	48	3, 12, 24 months	QOL questionnaire University of Calgary	QOL improved substantially in patients who underwent CNA whereas QOL in the control group remained the same during follow-up
Baron-Esquivias et al. [3]	Cardiac pacing	54	24 months	SF-36	Mean SF-36 scores were higher in the DDD-CLS group vs. the DDI group for the eight subdomains. DDD-CLS benefited both MCS and PCS components with significant differences in PCS when compared with the DDI group

QOL quality of life, *CNA* cardioneuroablation, *CLS* closed-loop stimulation, *MCS* mental component score, *PCS* physical component score

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