Sistema Socio Sanitario

Regione Lombardia

Fondazione IRCCS Policlinico San Matteo

ASST Pavia

ATS Pavia

UNIVERSITÀ DI PAVIA

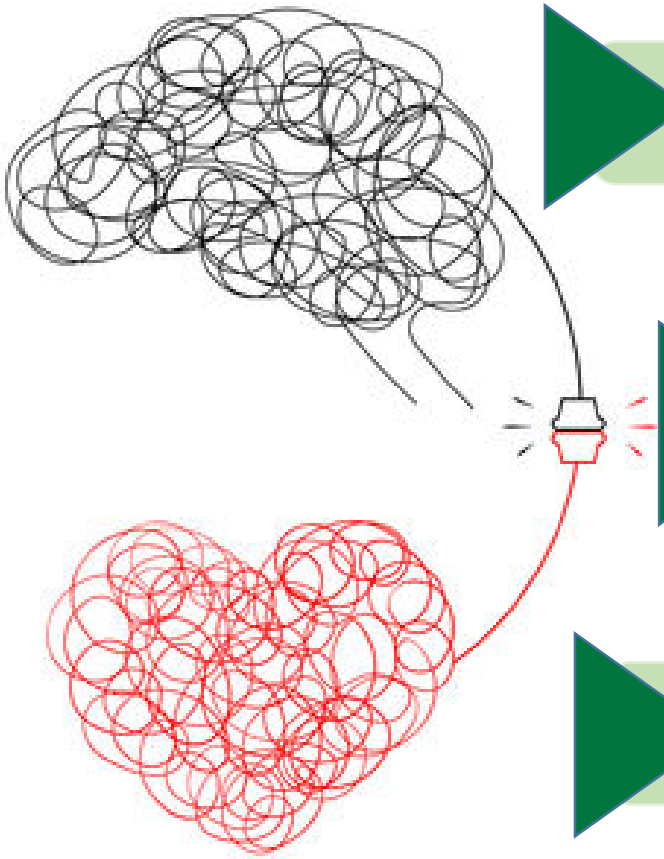
GRAND ROUNDS CLINICI DEL MERCOLEDÌ

con il Policlinico San Matteo

Aula Magna "C. Golgi" & WEBINAR

Nuove frontiere nella gestione delle aritmie ventricolari refrattarie: focus sulla neuromodulazione.

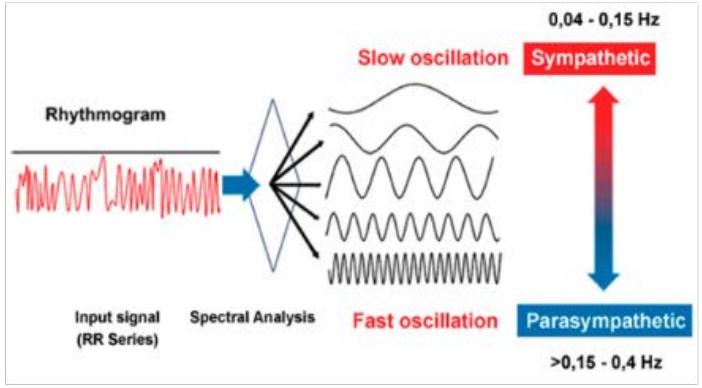
Dott. S.Savastano, Dott. R.Rordorf
UOC Cardiologia 1
Fondazione IRCCS Policlinico San Matteo.

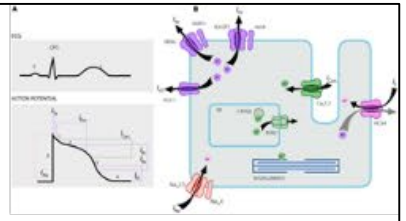


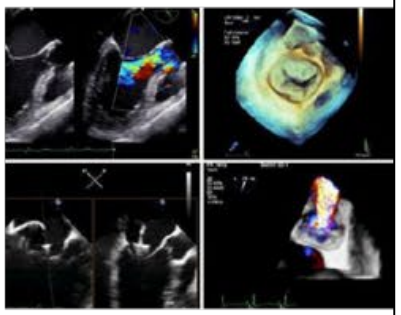
Sistema nervoso simpatico e aritmie

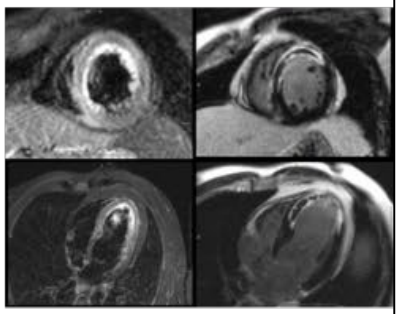
Ruolo della neuromudalazione acuta per il trattamento dello storm aritmico

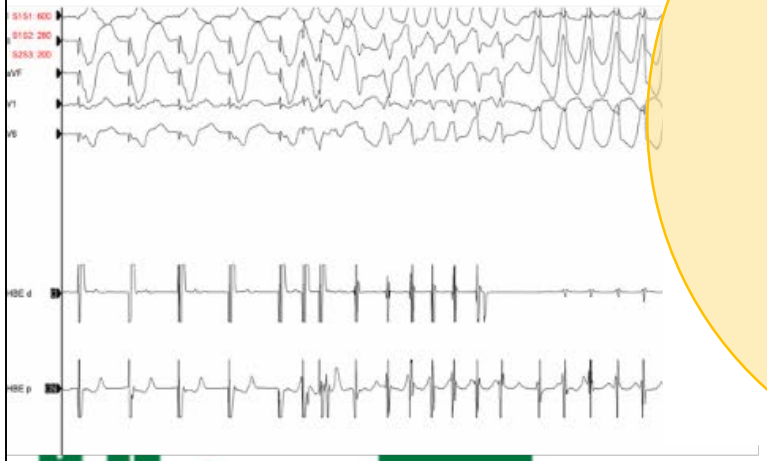
Ruolo della neuromudalazione per la prevenzione delle recidive







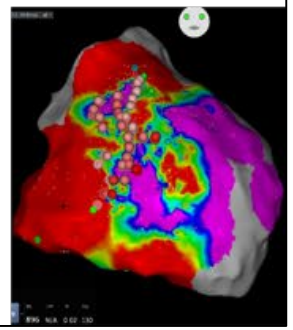




Fattori Modulanti
Sistema autonomico

Trigger

Substrate



tratta da Simone Savastano: «Il blocco percutaneo del ganglio stellato a scopo antiaritmico Una guida pratica». Il Pensiero Scientifico Editore

Il sistema nervoso autonomico e il cuore

L’attivazione del sistema simpatico:

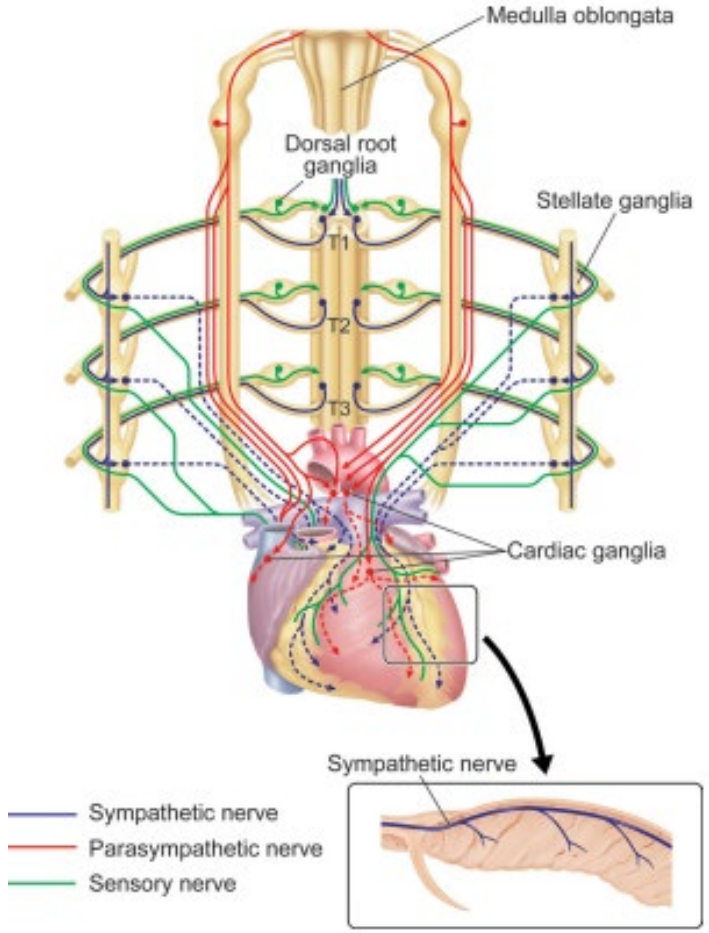
1- aumenta la frequenza cardiaca

2- aumenta l’automatismo

2- riduce la soglia di fibrillazione ventricolare

3- riduce la refrattarietà

4- aumenta la velocità di conduzione



Circ Res. 2012;110:325-336.

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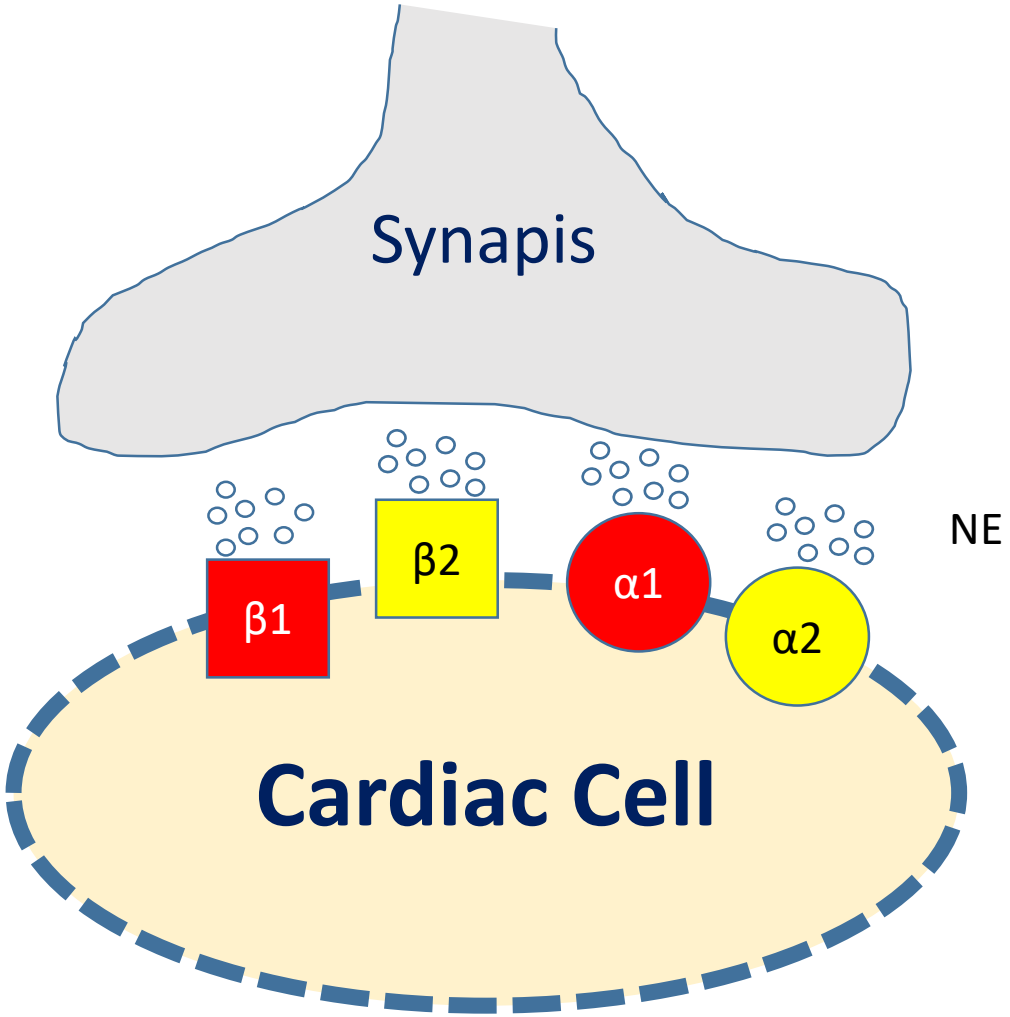
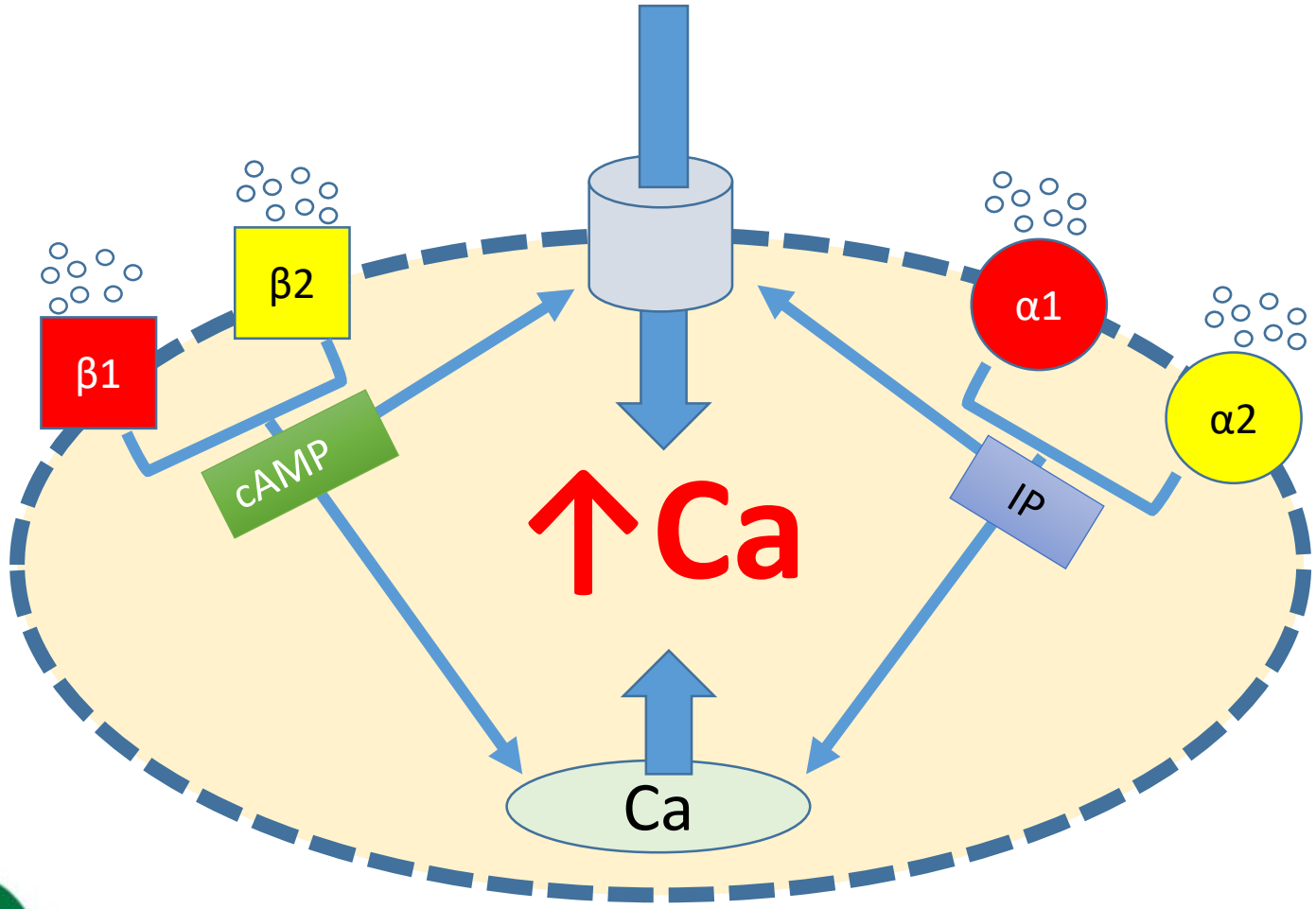
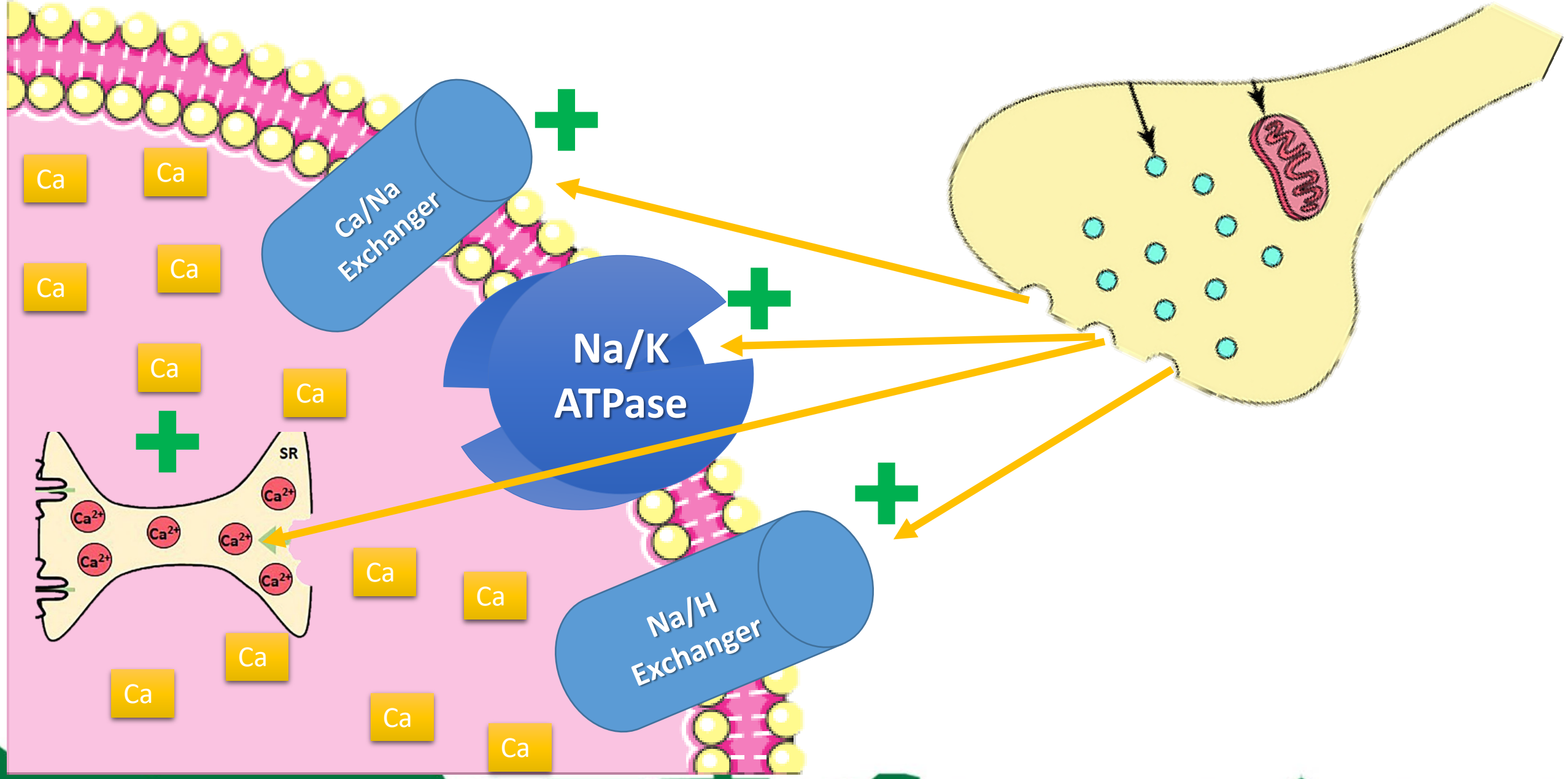

Synapis
β1
β2
α1
α2
NE
Cardiac Cell


β2
β1
α1
α2
cAMP
IP
↑Ca
Ca



Delayed Afterdepolarizations Elicited In Vivo by Left Stellate Ganglion Stimulation

Silvia G. Priori, MD, Massimo Mantica, BS, and Peter J. Schwartz, MD

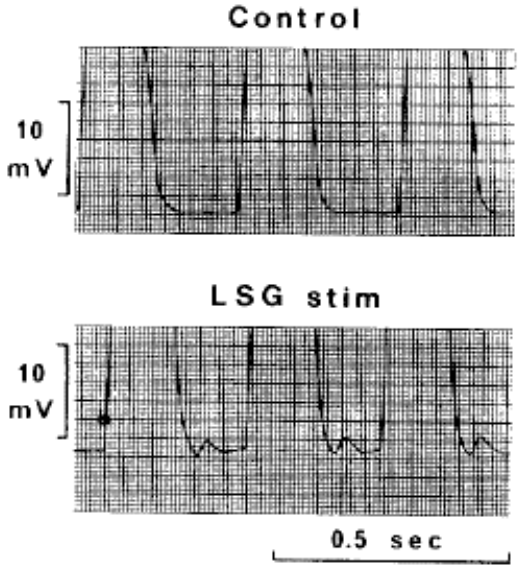
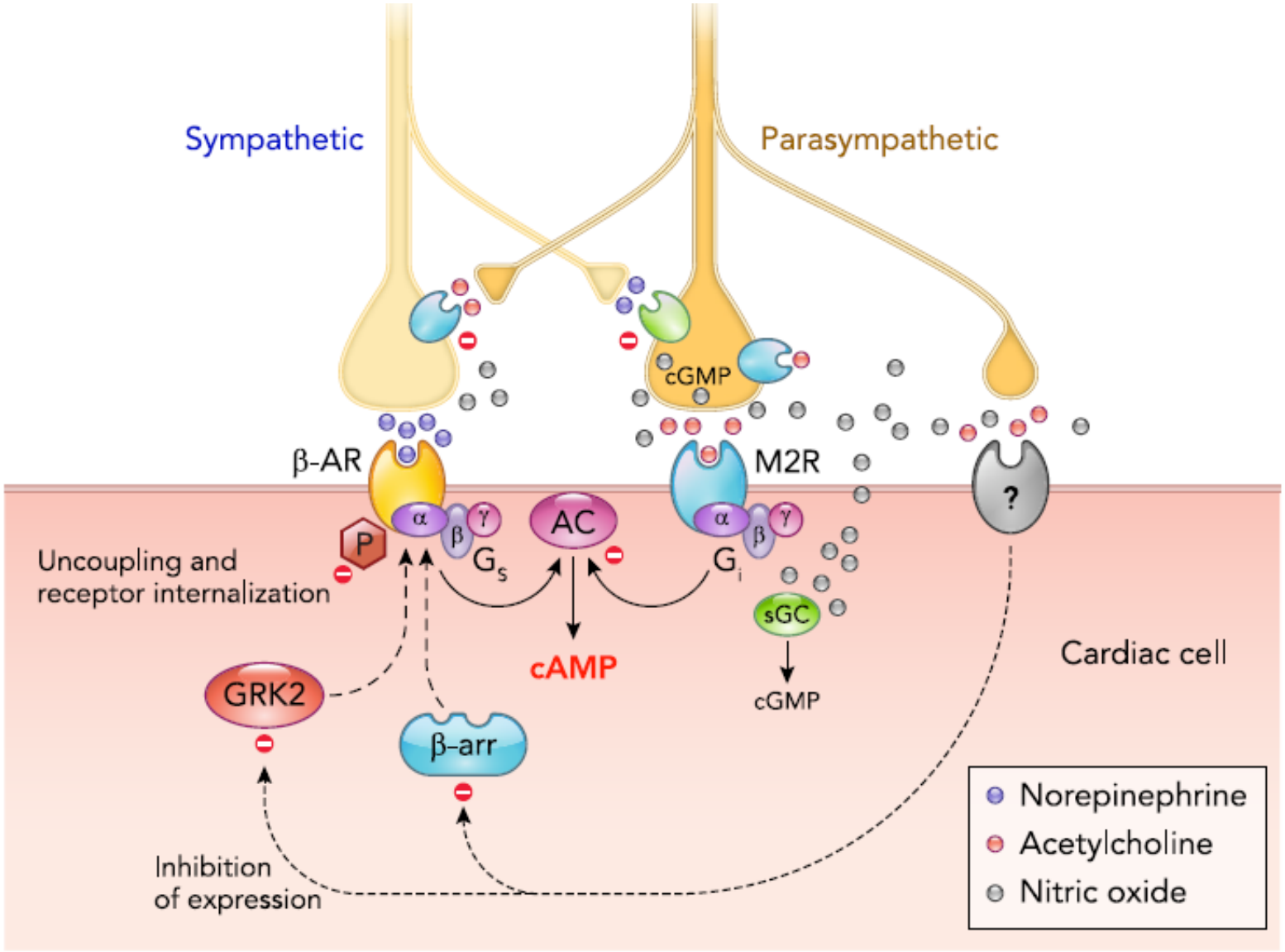
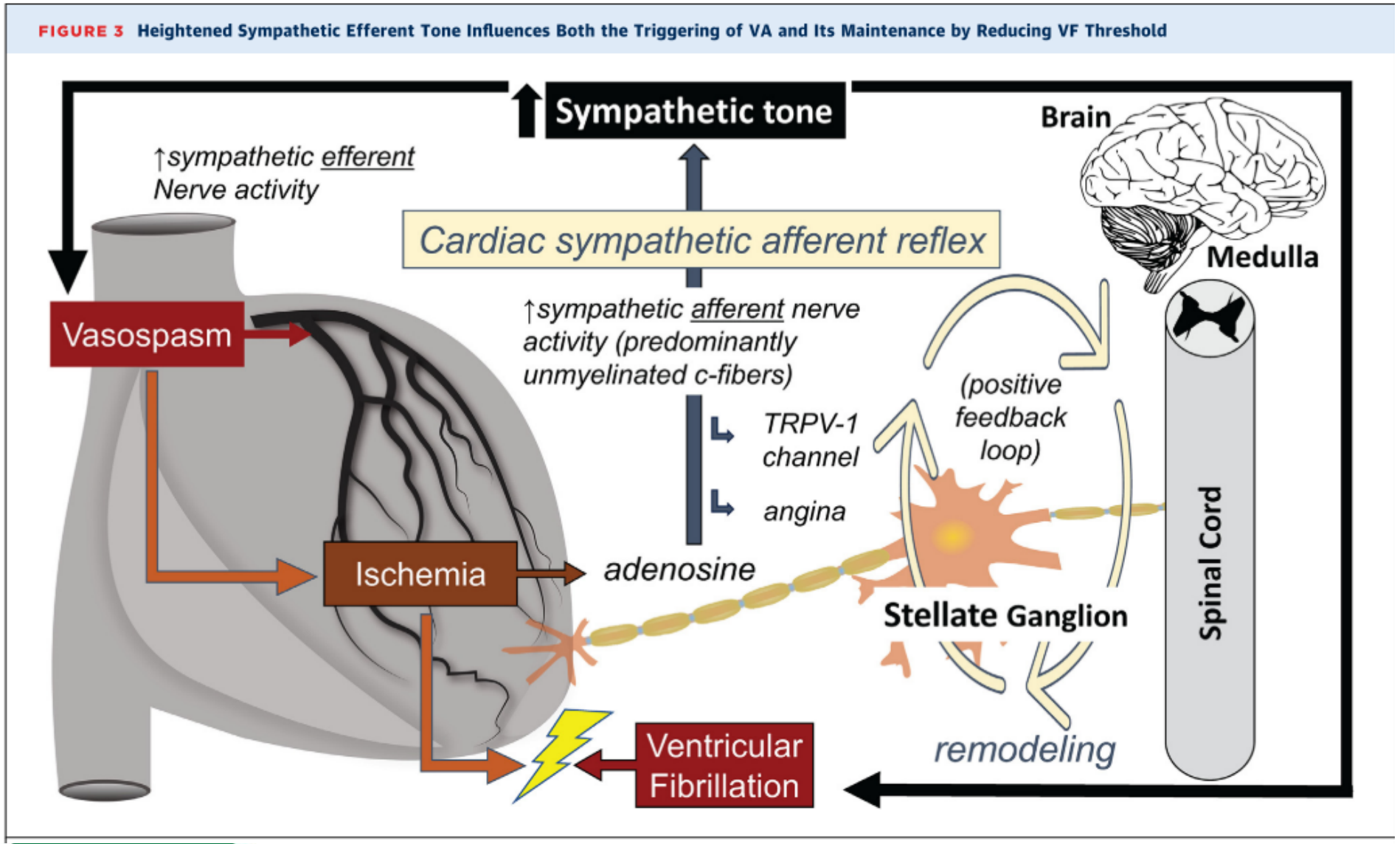


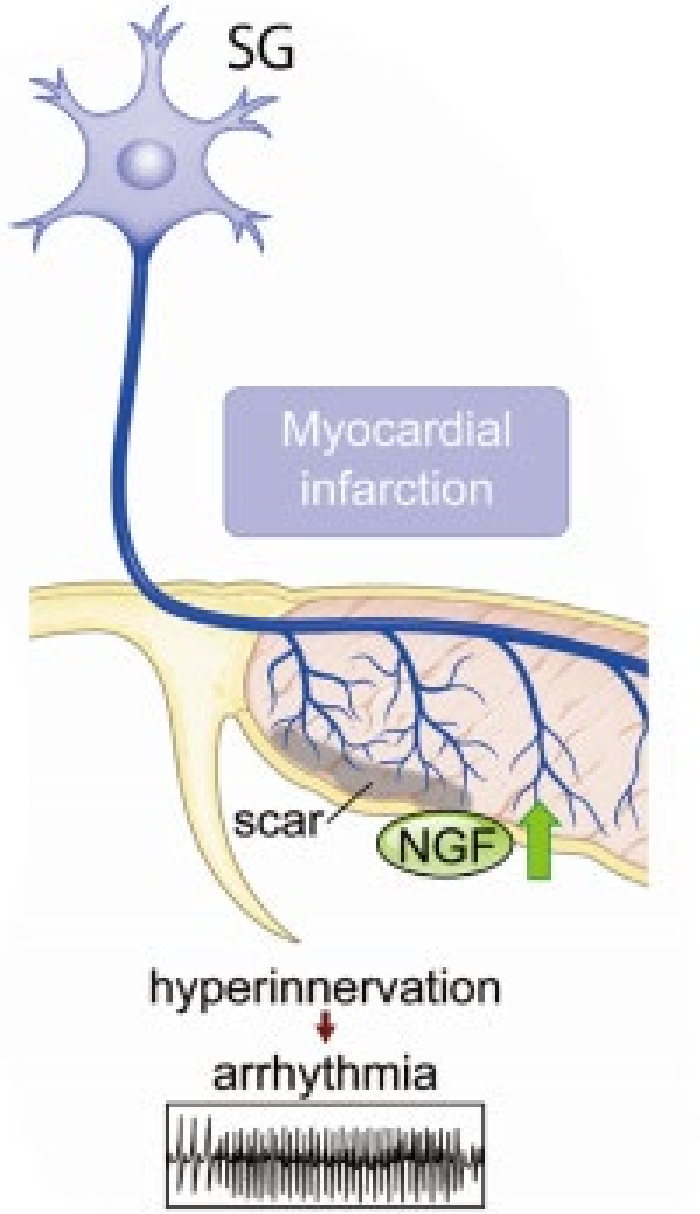
FIGURE 4. *Monophasic action potential recording at high amplification in control conditions and after left stellate ganglion stimulation (LSG stim) when delayed afterdepolarizations are present.*

Circulation. 1988 Jul;78(1):178-85

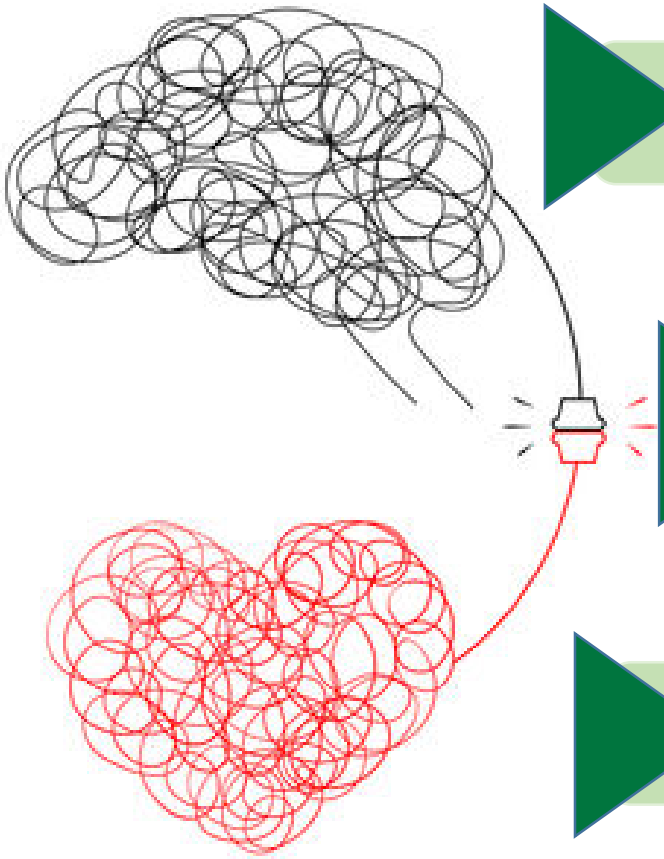

Sympathetic
Parasympathetic
cGMP
β-AR
M2R
?
α
β
γ
P
AC
G_s
G_i
Uncoupling and
receptor internalization
sGC
cAMP
cGMP
Cardiac cell
GRK2
β-arr
Inhibition
of expression
Norepinephrine
Acetylcholine
Nitric oxide



JACC Clinical Electrophysiology 2023



Circ Res. 2012;110:325-336.



Sistema nervoso simpatico e aritmie

Ruolo della neuromudalazione acuta pe ril trattamento dello storm aritmico

Ruolo della neuromudalazione per la prevenzione delle recidive

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Storm aritmico

Definizione

“ più di tre VT/VF nelle 24 h.”

JAm Coll Cardiol 1998;32:1909–1915.
Europace 2000;2:263–269.
Circulation 2001;103:2066–2071
European Heart Journal (2006) 27, 3027–3032
Circulation. 2016;133:672-676

Prevalenza

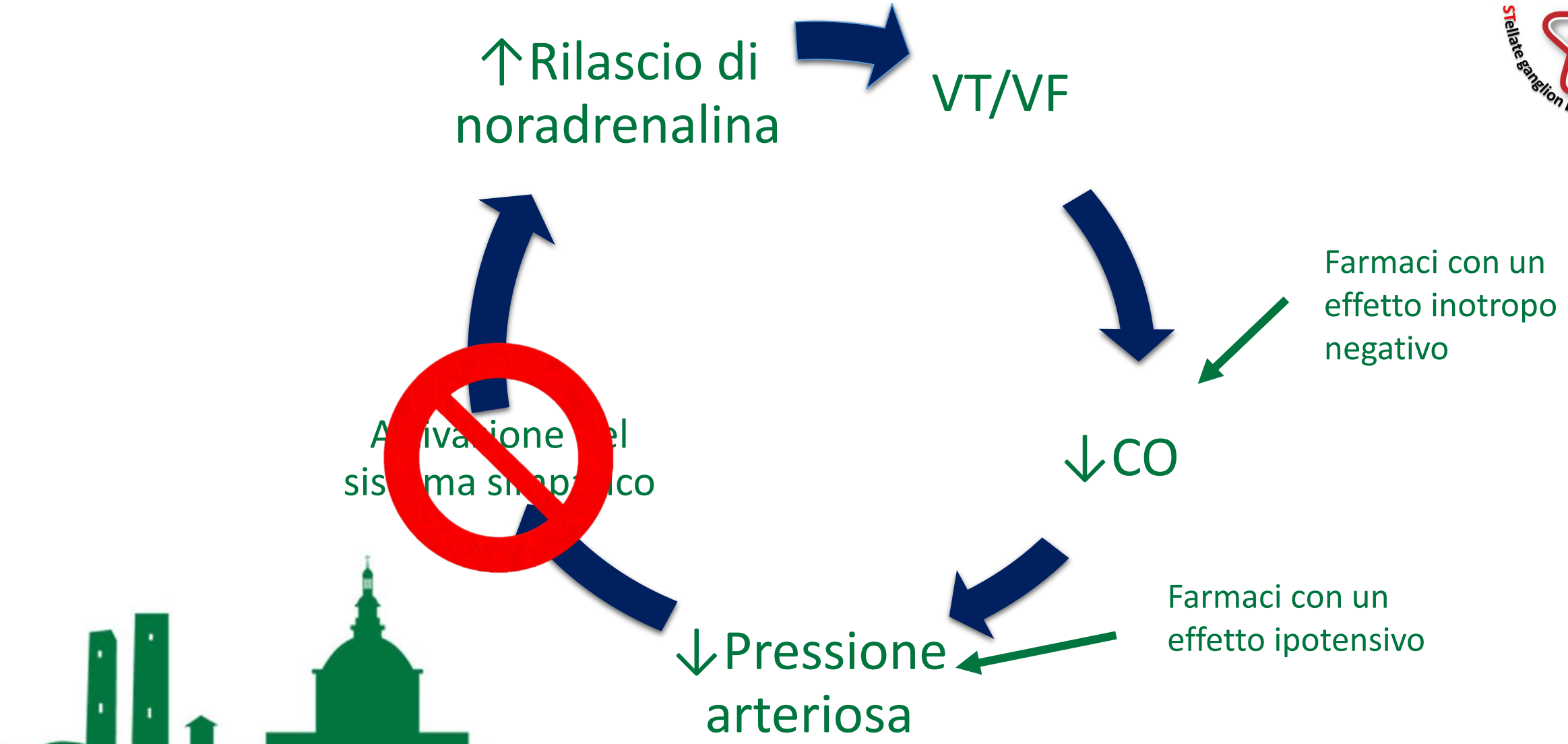
- **10-28%** in tre anni nei pazienti impiantati in prevenzione secondaria
- **4 %** in tre anni in pazienti impiantati in prevenzione primaria

J Am Coll Cardiol. 1998;32:1909
Circulation.2001;103:2066
J Am Coll Cardiol. 2000;36:566
Heart Rhythm. 2007;4:1395

Outcome

- Aumenta il rischio di mortalitò (RR 5)

Europace (2014) 16, 347–353



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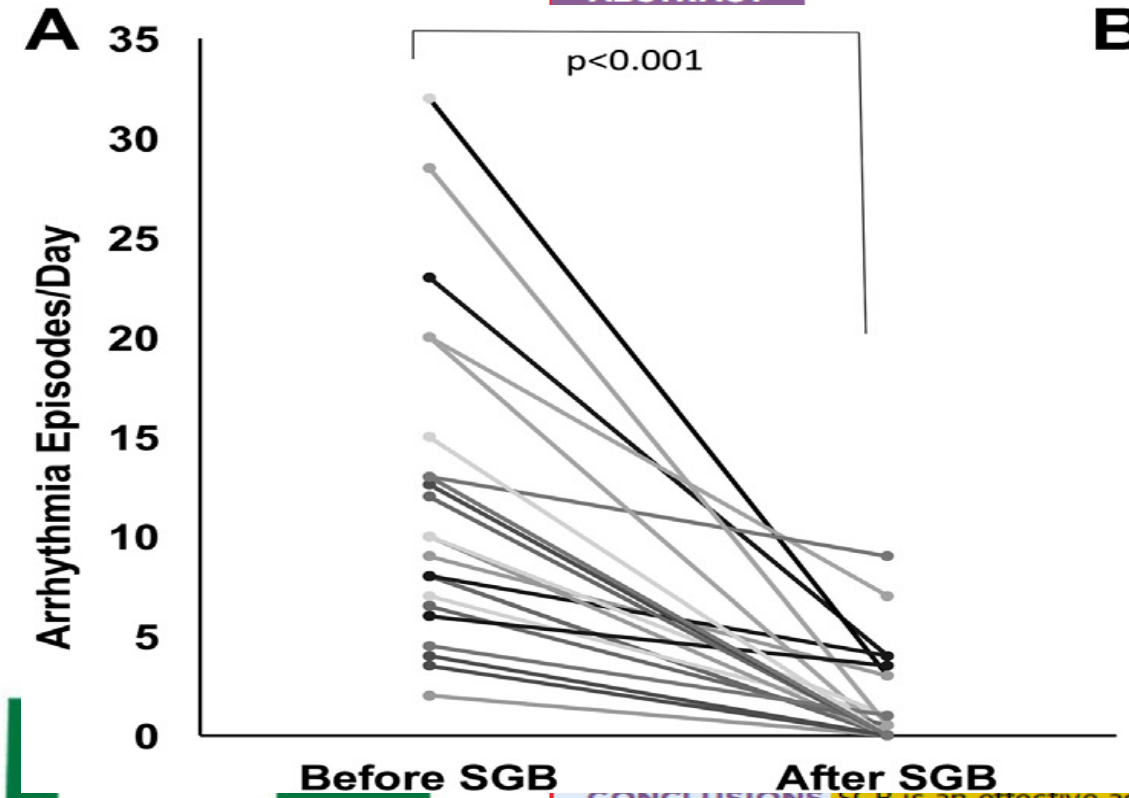
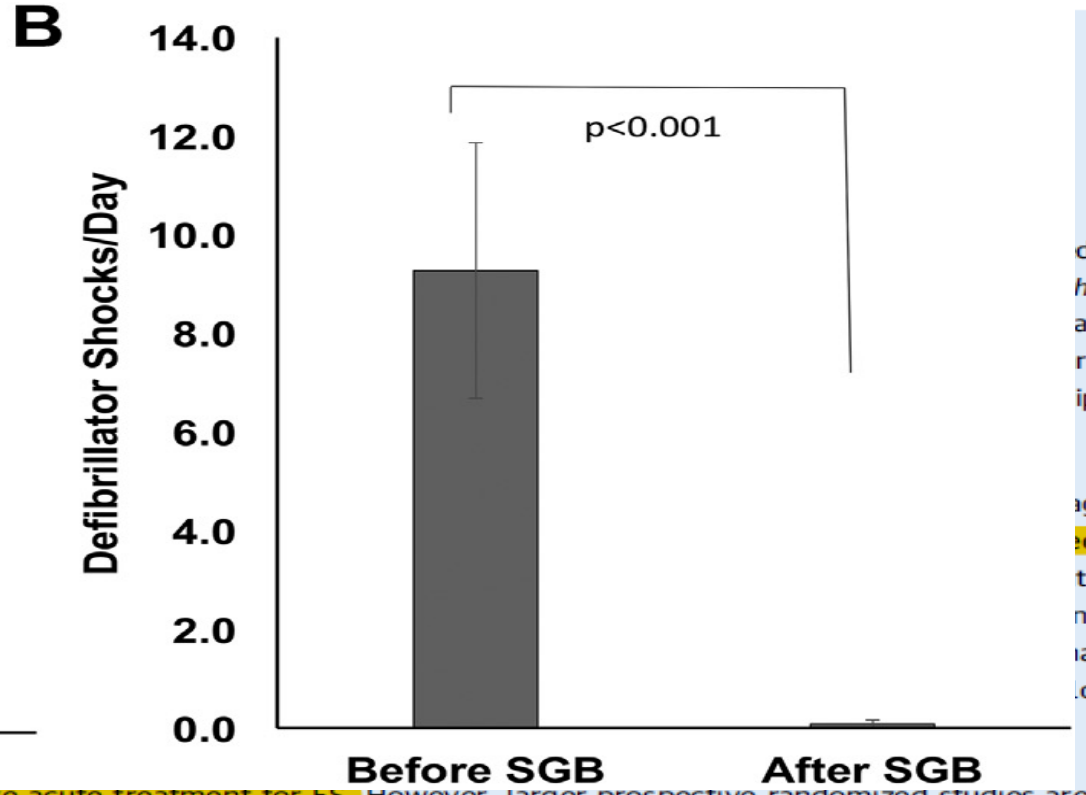
Efficacy of Stellate Ganglion Blockade in Managing Electrical Storm

A Systematic Review

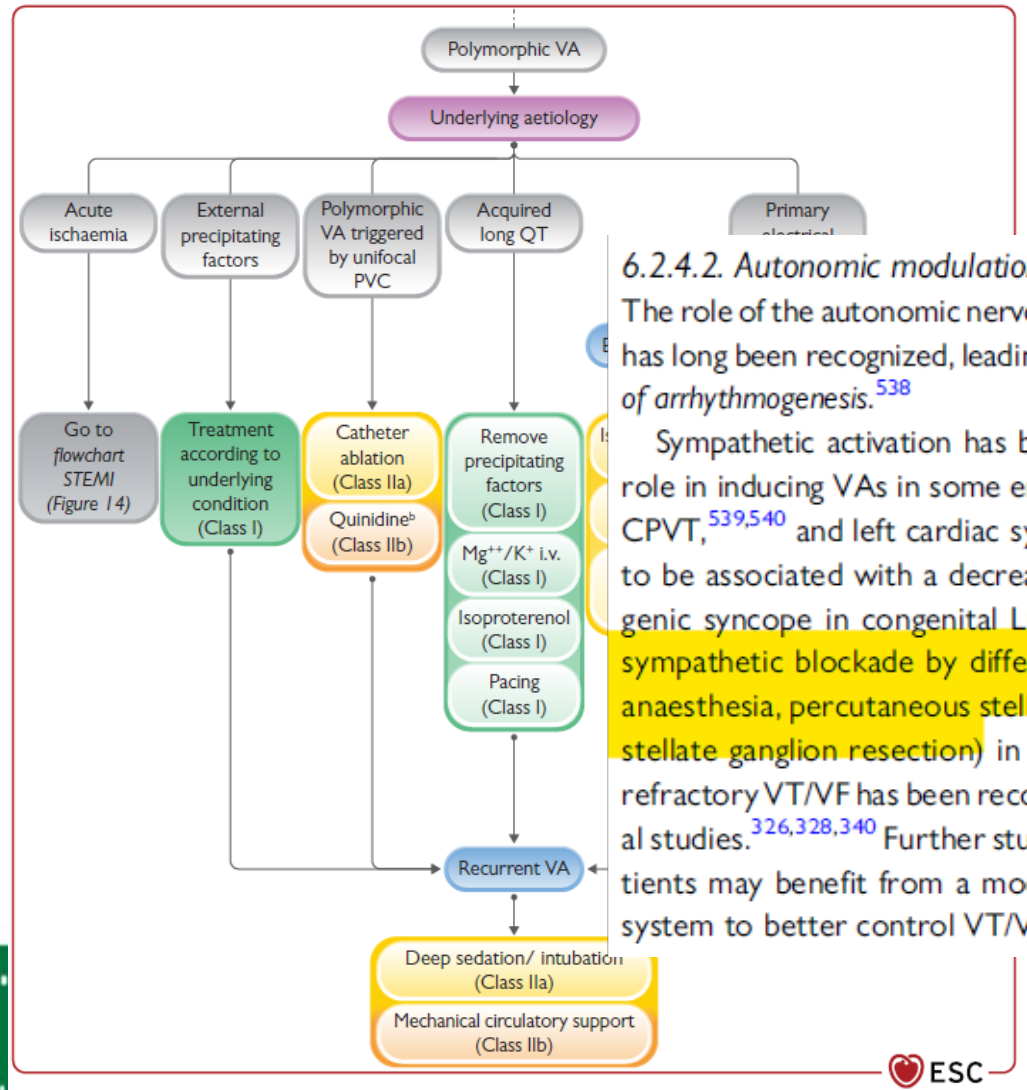
Lingjin Meng, MD,[a] Chi-Hong Tseng, PhD

ABSTRACT





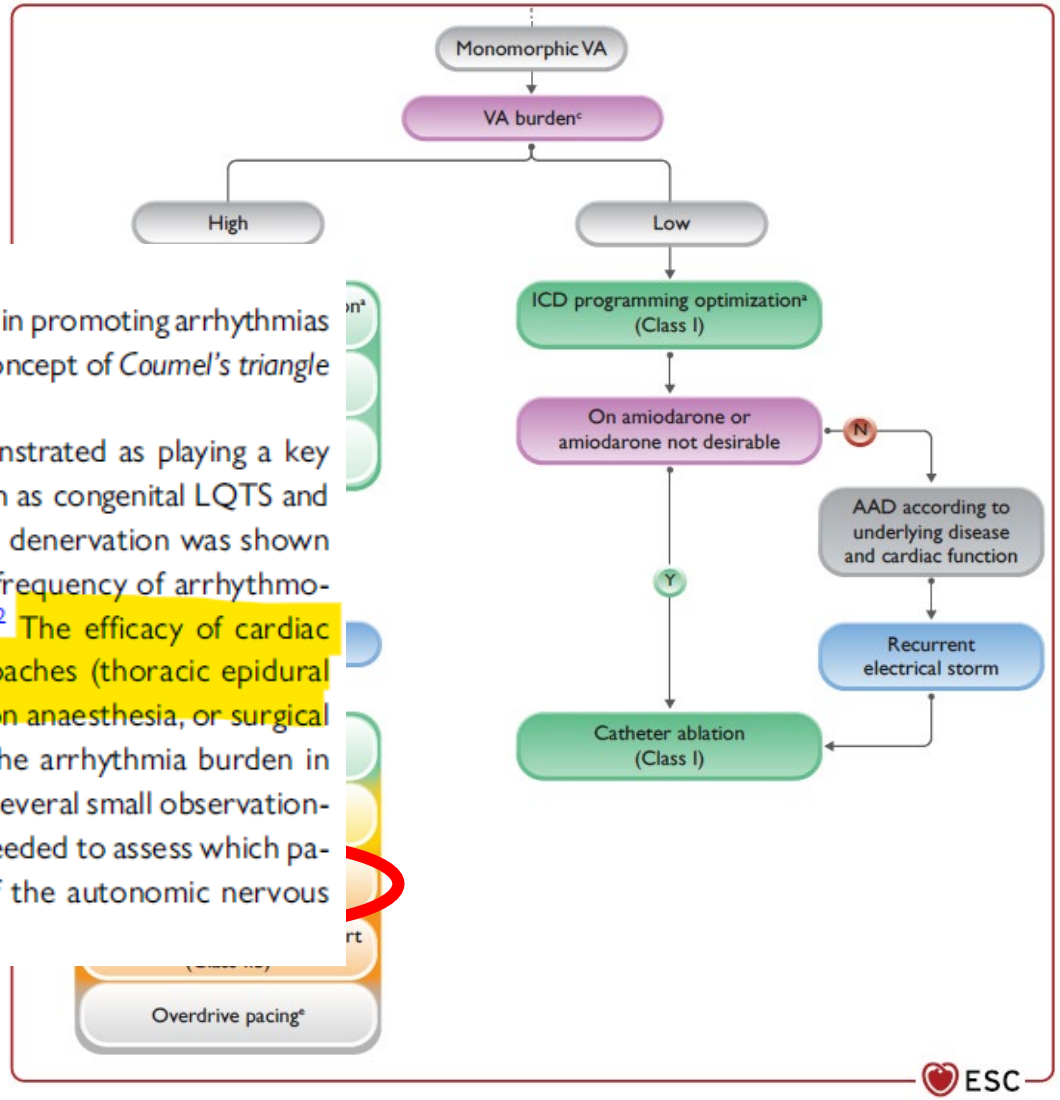
CONCLUSIONS SGB is an effective acute treatment for ES. However, larger prospective randomized studies are needed to better understand the role of SGB in ES and other VAs. (J Am Coll Cardiol EP 2017;3:942–9)



6.2.4.2. *Autonomic modulation*

The role of the autonomic nervous system in promoting arrhythmias has long been recognized, leading to the concept of *Coumel's triangle of arrhythmogenesis.*[538]

Sympathetic activation has been demonstrated as playing a key role in inducing VAs in some entities, such as congenital LQTS and CPVT,[539,540] and left cardiac sympathetic denervation was shown to be associated with a decrease in the frequency of arrhythmogenic syncope in congenital LQTS.[541,542] The efficacy of cardiac sympathetic blockade by different approaches (thoracic epidural anaesthesia, percutaneous stellate ganglion anaesthesia, or surgical stellate ganglion resection) in reducing the arrhythmia burden in refractory VT/VF has been recognized in several small observational studies.[326,328,340] Further studies are needed to assess which patients may benefit from a modulation of the autonomic nervous system to better control VT/VF.



European Heart Journal (2022) 00, 1–130

ESC European Society of Cardiology
Europace (2023) **25**, 1–3
https://doi.org/10.1093/europace/euad314

Neuronal sympathetic block for ventricular arrhythmias: one size may not fit all

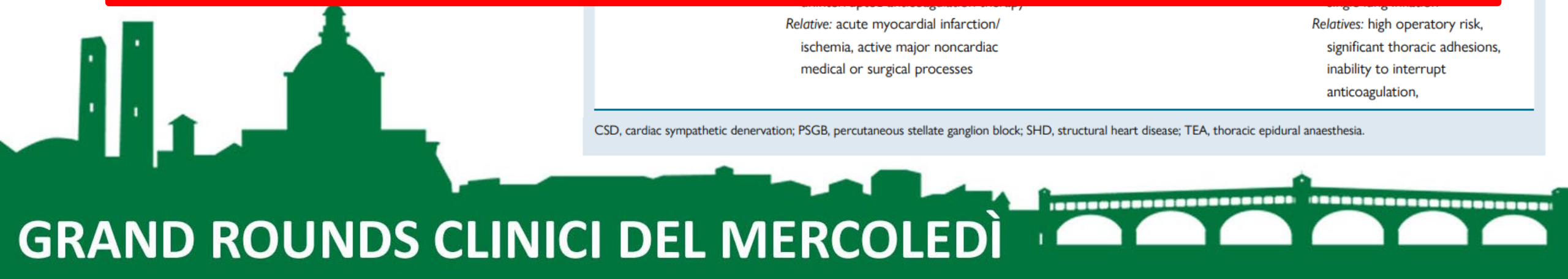
Veronica Dusi [1]* **and Marmar Vaseghi** [2]

	TEA	Pharmacological PSGB	CSD
Targeted neuronal level	T1–T4 (epidural level, pre-ganglionic block), with the needle typically inserted at the T1–T2 level	C8 + T1 ganglia (based on anatomical landmarks)	T1–T4 thoracic ganglia
Side of the neuronal block	Bilateral	Often performed unilaterally as left PSGB, but can be performed bilaterally	Bilateral for SHD
Duration of block	Until the catheter is in place (days)	For bolus injection: 2–6 h depending on the local anaesthetic used. For the continuous infusion: until the catheter is in place)	Permanent
Confirmation of the neuronal block (other than the anti-arrhythmic	Functional: cutaneous anaesthesia in the corresponding dermatomes. Additionally, skin temperature or	Functional: Horner's syndrome proves C8 blockade only (mostly ocular fibres), but the anaesthetic is expected to	Direct visualization of the ganglia and subsequent anatomopathological confirmation.
Contraindications	*Absolute:* Active infection, ongoing dual antiplatelet therapy, requirement for uninterrupted anticoagulation therapy *Relative:* acute myocardial infarction/ ischemia, active major noncardiac medical or surgical processes	Significant head/neck pathology	*Absolute:* severe pulmonary pathology/inability to tolerate single lung inflation *Relatives:* high operatory risk, significant thoracic adhesions, inability to interrupt anticoagulation,

Relative: acute myocardial infarction/ ischemia, active major noncardiac medical or surgical processes

Relatives: high operatory risk, significant thoracic adhesions, inability to interrupt anticoagulation,

CSD, cardiac sympathetic denervation; PSGB, percutaneous stellate ganglion block; SHD, structural heart disease; TEA, thoracic epidural anaesthesia.



Author year	Number of cases	Cardiac condition	EF	Technique	Effectiveness	Major Complications
Tian et al. 2019	30 pts: 15 left SGB 15 bilateral SGB 38 PSGB	Ischemic heart disease 17/30, non-ischemic heart disease 10/30; non-structural heart disease 2/30, LQTS 1/30	34%	Postero-lateralal echo-guided or antero-lateral fluoro-guided. With Lidocaine or Bupivacaine. First left sided then right sided but only on intubated pts.	Complete VT ression in 72	No
Fudim et al. 2020	20 pts	10/20 Ischemic heart disease, 10/20, non-ischemic heart disease	<35% in 16/20	Lateral echo-guided, bilateral	Complete s and sho on of VT/VF and 48 h	1 nt c a
Reinertsen et al. 2021	13 pts, 11/13 only left SGB, 2/13 only right	Structural heart disease in 13/13	23%	Lateral echo-guided with Lidocaine or Bupivacaine or with Desametasone and Ropivicaine. At the level of C6 in 12/13, of C5 in 1/13	Complete su 62% of Complete su 92% of n of VT/VF in at 96 h n of shocks in at 96 h	1 h ion
Sanghai et al. 2021	18 pts 9 (SI) 9 (CI)	Ischemic heart disease in 7/18, non-ischemic heart disease in 9/18, LQTS in2/18	30.9 %	Lateral echo-guided only left sided with Ropivacaine and Bupivacaine.	Complete su 24 h both i (SI) and in th (n of VT/VF at le injection ious infusion)	1 h 1 nia; nia
Savastano et al. 2021	11 pts/18 SGB 16 (SI) 2 (CI)	Structural heart disease in 11/11	31.6%	Anterior anatomical approach only left sided with Lidocaine and/or Bupivacaine	Complete su 1 h in a per p complete su per-p n of VT/VF at analysis and n at 24 h in a alysis	
Markman et al. 2022	11 SGB 5 left SGB 6 left and right	Structural heart disease in 11/11	15%	Echo-guided (9/11), fluoro-guided (or anatomical anterior	complete su sh n of VA and 4 h	

ATP: antitachycardia pacing, CI: continuous infusion, SGB: stellate ganglion block; SI: single injection, VT: ventricular tachycardia, VF: ventricular fibrillation.

Complete VT/VF suppression

No complications

TOT. 103 patients

Savastano S. Heart Rhythm. 2022 Dec 9:S1547-5271(22)02695-9

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ESC European Society of Cardiology
European Heart Journal (2024) 00, 1–11
https://doi.org/10.1093/eurheartj/ehae021

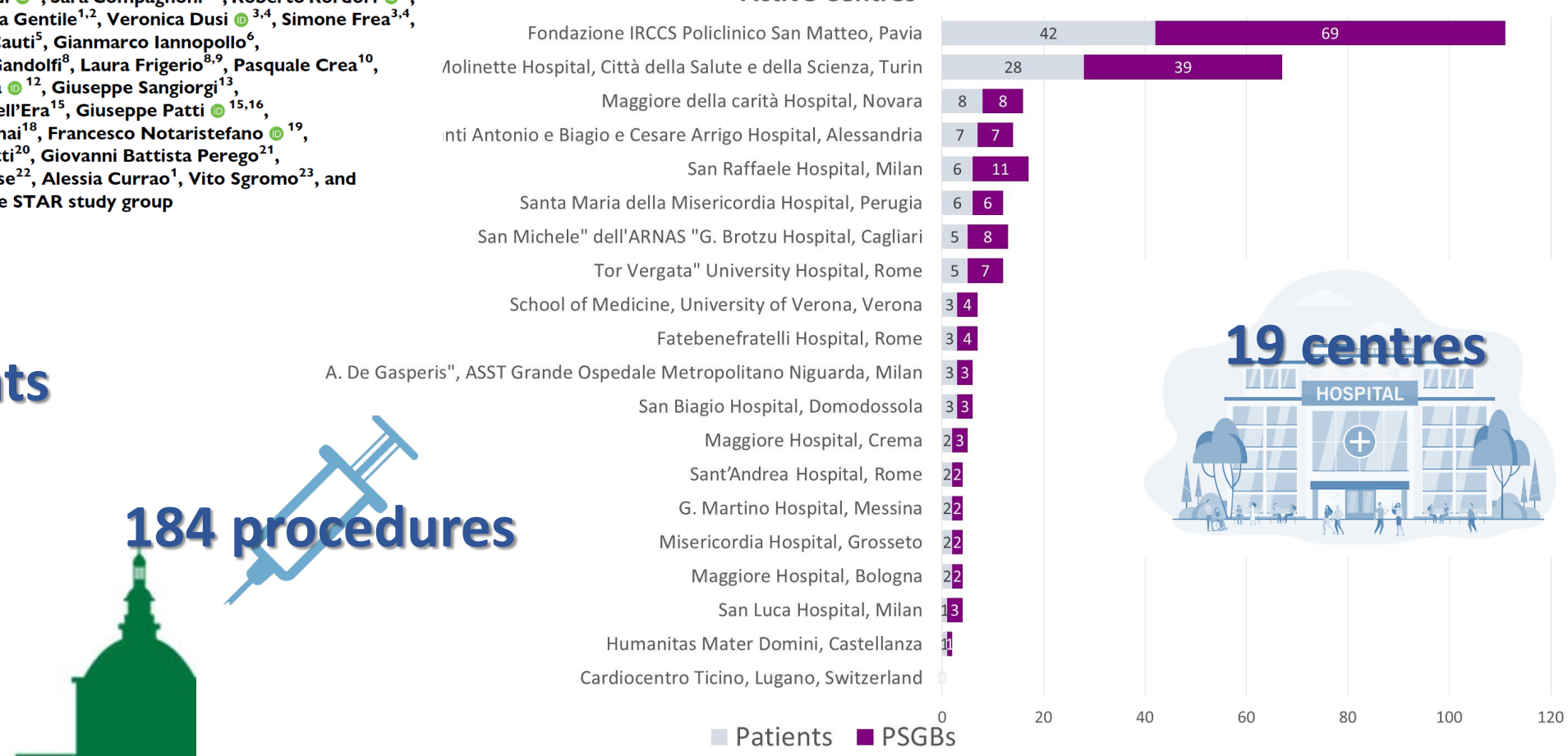
Electrical storm treatment by percutaneous stellate ganglion block: the STAR study

Simone Savastano [1]*, Enrico Baldi [1], Sara Compagnoni[1,2], Roberto Rordorf [1], Antonio Sanzo[1], Francesca Romana Gentile[1,2], Veronica Dusi [3,4], Simone Frea[3,4], Carol Gravinese[3,4], Filippo Maria Cauti[5], Gianmarco Iannopollo[6], Francesco De Sensi [7], Edoardo Gandolfi[8], Laura Frigerio[8,9], Pasquale Crea[10], Domenico Zagari[11], Matteo Casula [12], Giuseppe Sangiorgi[13], Simone Persampieri[14], Gabriele Dell'Era[15], Giuseppe Patti [15,16], Claudia Colombo[17], Giacomo Mugnai[18], Francesco Notaristefano [19], Alberto Barengo[19], Roberta Falcetti[20], Giovanni Battista Perego[21], Giuseppe D'Angelo[22], Nikita Tanese[22], Alessia Currao[1], Vito Sgromo[23], and Gaetano Maria De Ferrari [3,4], the STAR study group

STAR
STellate ganglion block for Arrhythmic storm

131 patients

184 procedures



19 centres

Savastano et al. Eur Heart J. 2024 Jan 30:ehae021

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131 patients

Shock
27 (20.6%) Cardiogenic
7 (5.3) Septic

Reduced LVEF
25±12.3%

23 (17.6%) Acute MI
14 (10.7) NSTE-ACS
37 (28.2%) chronic CAD
29 (22.1%) DCM
.....

11 (8.4%)
Refractory cardiac arrest

36 (27.5%) In-hospital mortality
6 (4.6%) for ES

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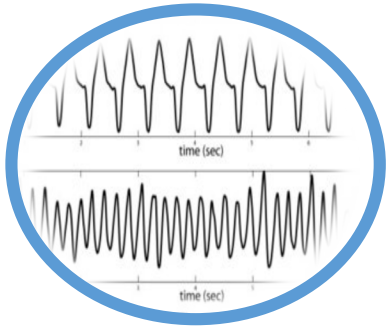
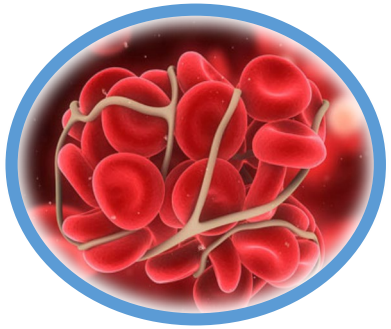
184procedures



118 (64.1%) VT
35 (19%) VF
31 (16.8%) VT&VF

On intubated pts
37 (20.1%)

106 (57.6%) Anatomical
48 (42.4%) Echo



Anticoagulant/Antiplatelet
26 (14.1%) None
13 (7.1%) DAPT
58 (31.5%) DOAC/VKA/Heparin
……

181 (98.4%) left
3 (1.6%) right

1 (0.5%) major complication
8 (4.3%) side effects

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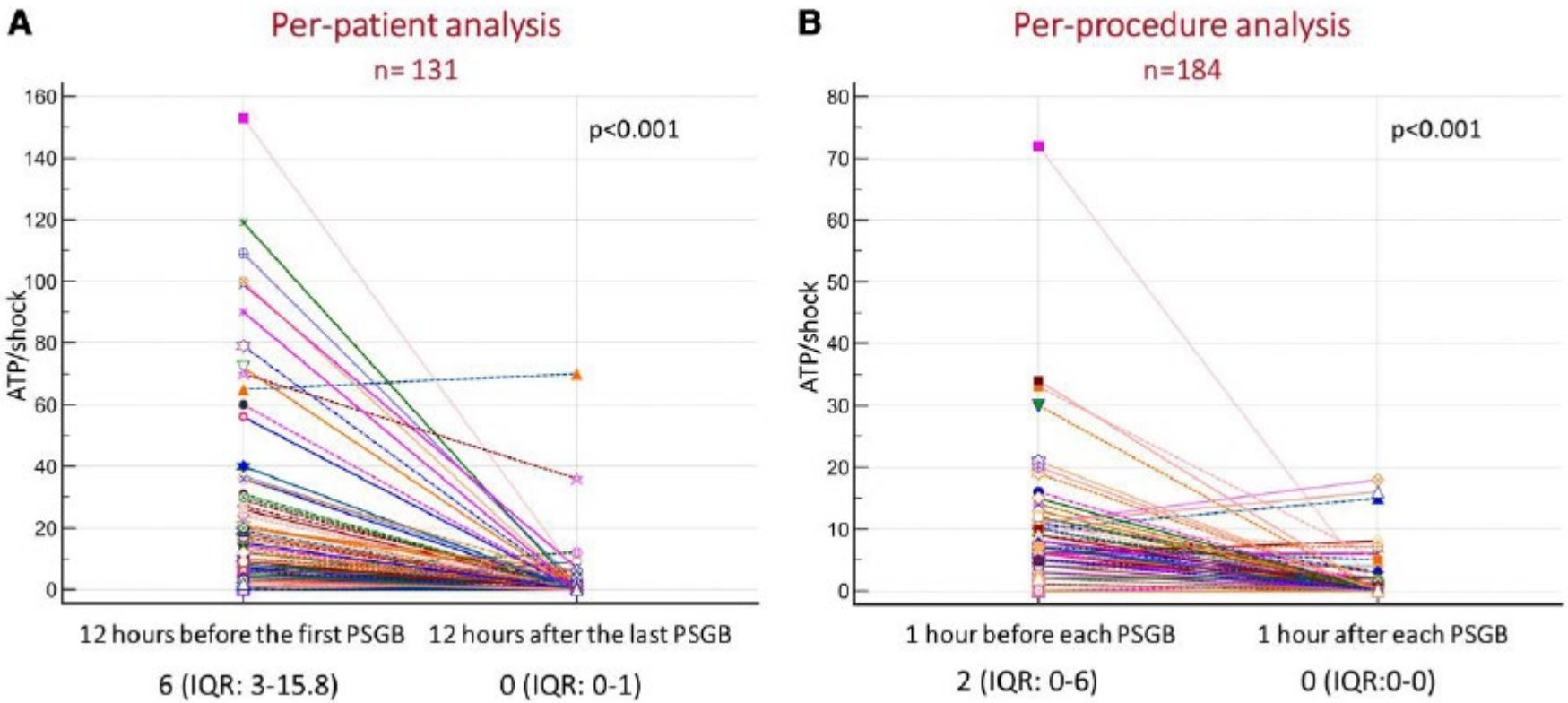
92%

STAR
STellate ganglion block for Arrhythmic storm



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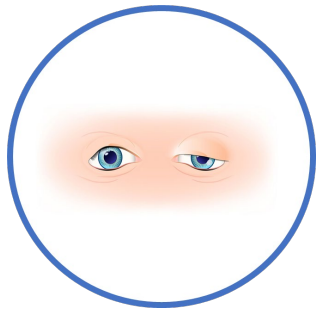

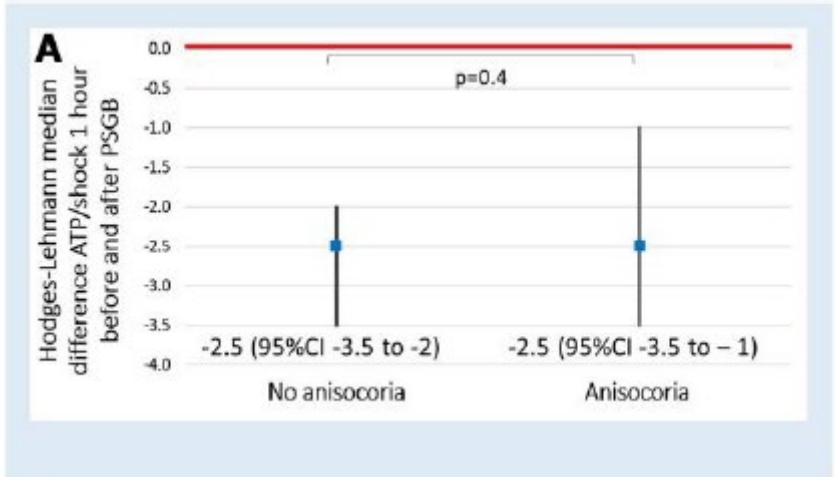

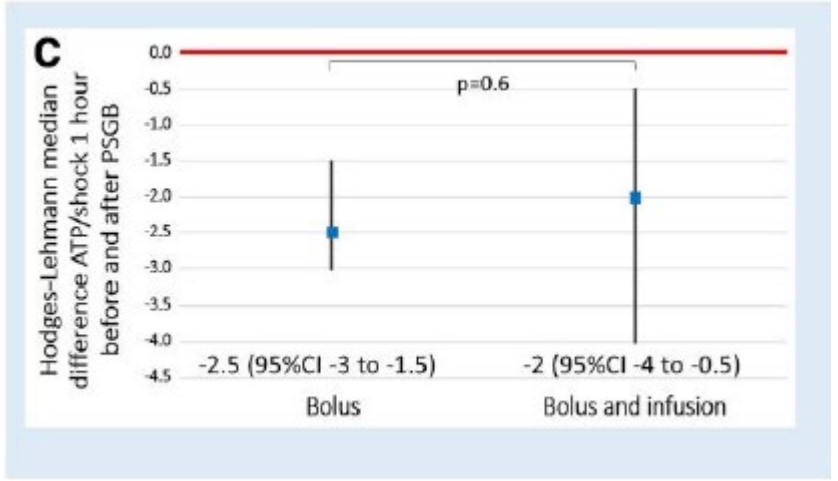

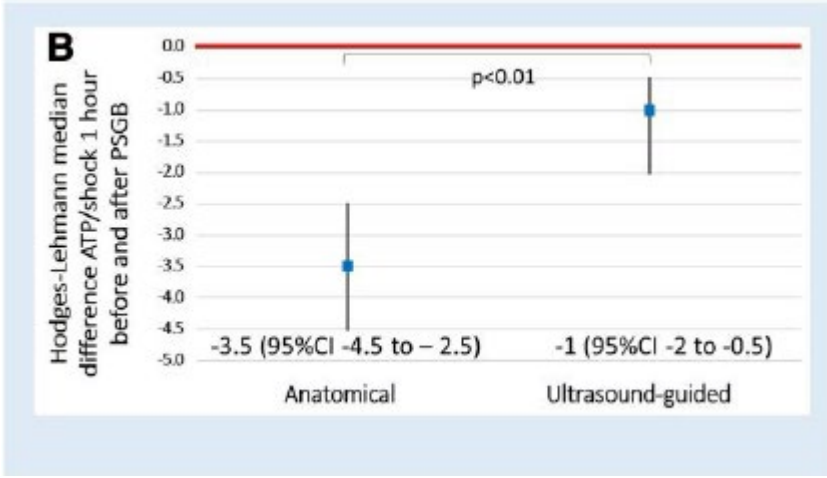

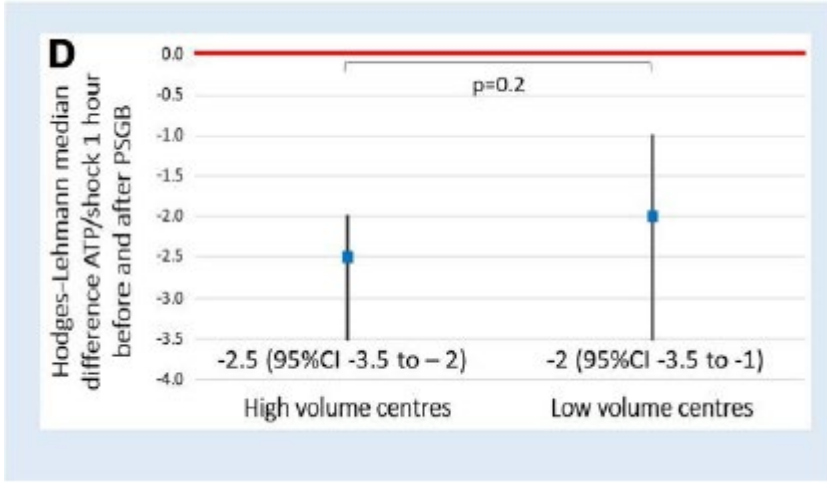

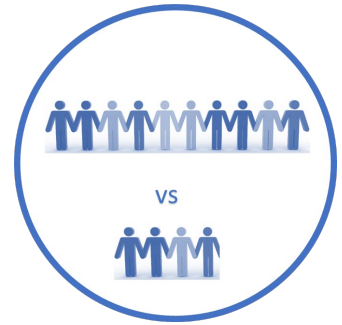

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Clinical condition	Strongly recommended	Mildly recommended	Not recommended
Refractory or recurrent VT/VF during the acute or subacute phase of myocardial infarction	✔		
Refractory or recurrent VT/VF in chronic ischemic heart disease	✔		
Refractory or recurrent VT/VF in non- ischemic heart disease	✔		
Refractory or recurrent VT/VF in other structural heart disease	✔		
Refractory or recurrent VT/VF in LQTS and CPVT	✔		
Refractory or recurrent VT/VF in LQTS and CPVT or in structural heart disease in paediatric patients	✔		

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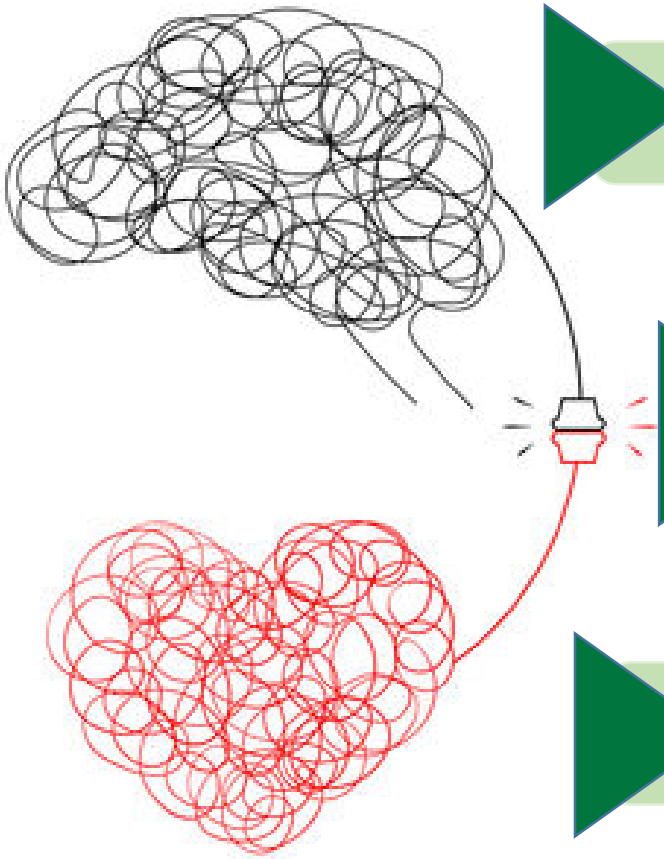
Il ruolo del San Matteo

- **Corsi di formazioni**
  - 15 edizioni (375 colleghi formati)
  - 2 edizioni in Inglese (16 colleghi formati)
  - Un manuale in Italiano
  - Un manuale in Inglese (coming soon)

- **Ricerca clinica**
  - Studio STAR osservazionale multicentrico internazionale
  - Studi randomizzati



Sistema nervoso simpatico e aritmie

Ruolo della neuromudalazione acuta pe ril trattamento dello storm aritmico

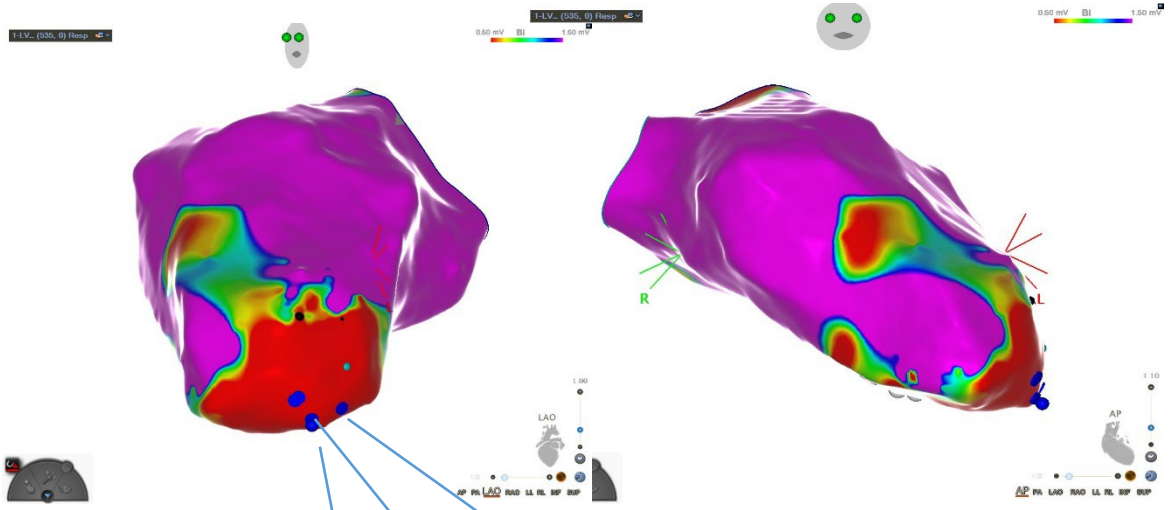
Ruolo della neuromudalazione per la prevenzione delle recidive

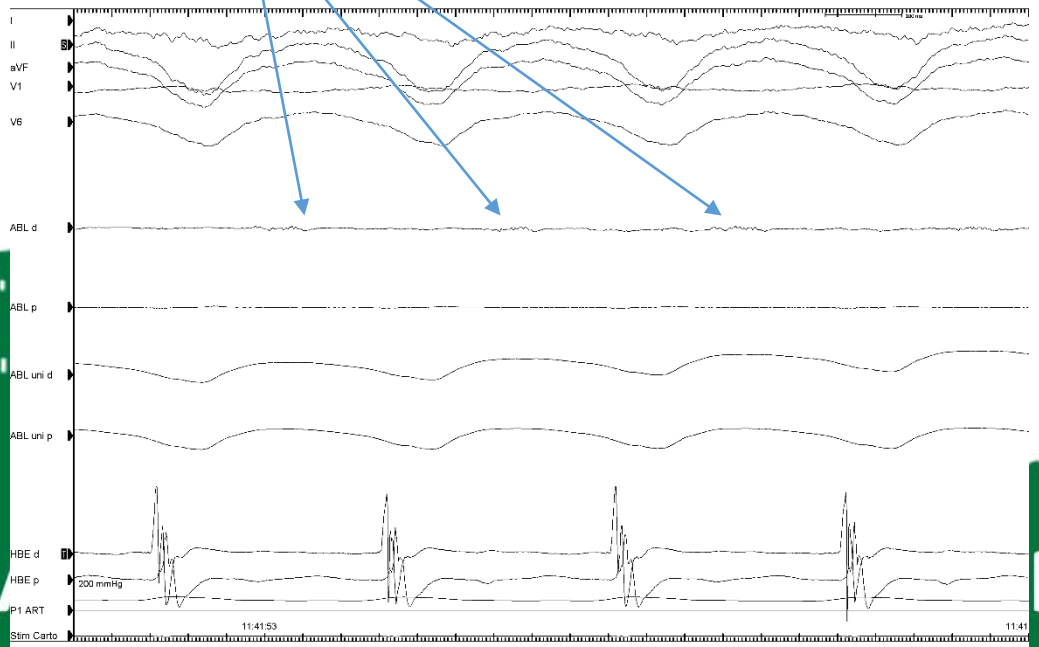
Electrical storm: aims of treatment

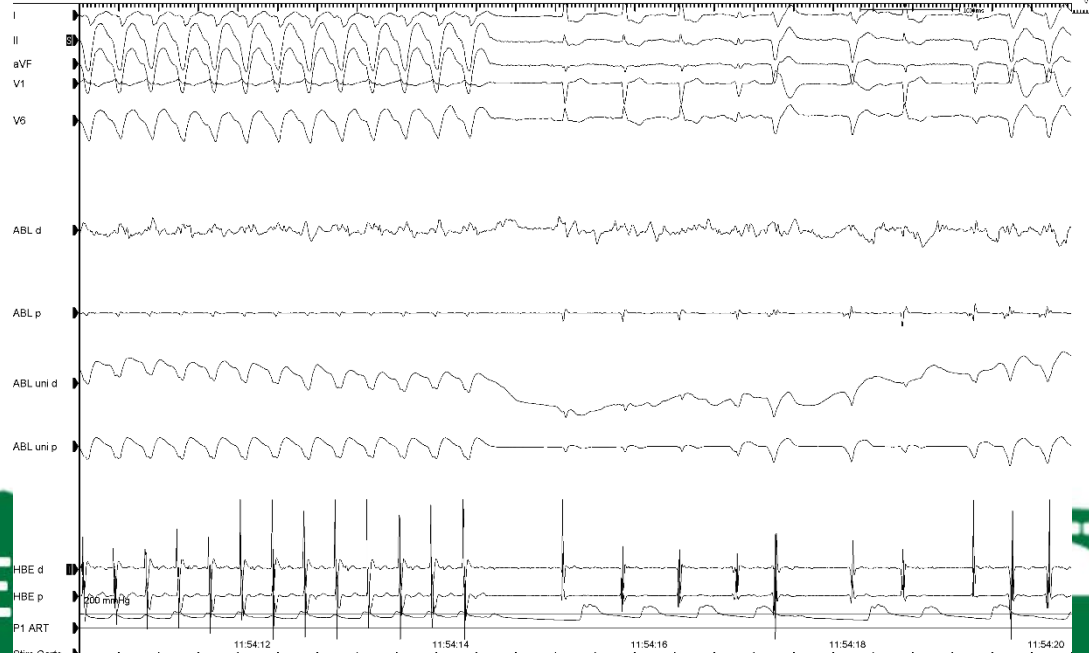
- Acute phase stabilization: emergency setting

- Chronic phase stabilization: prevention of recurrences.

Catheter ablation of TV from myocardial scar



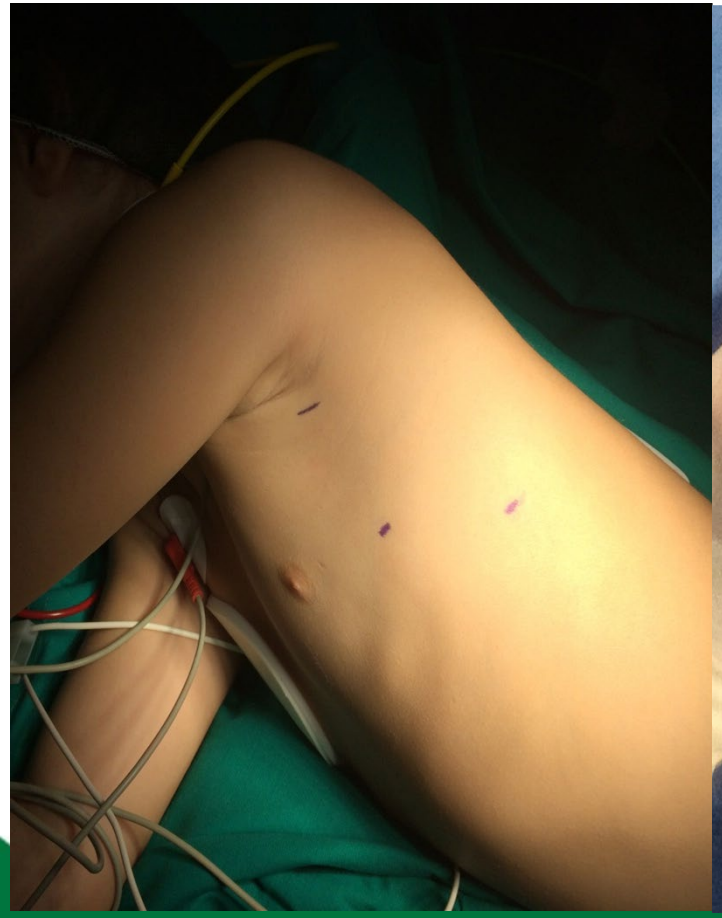




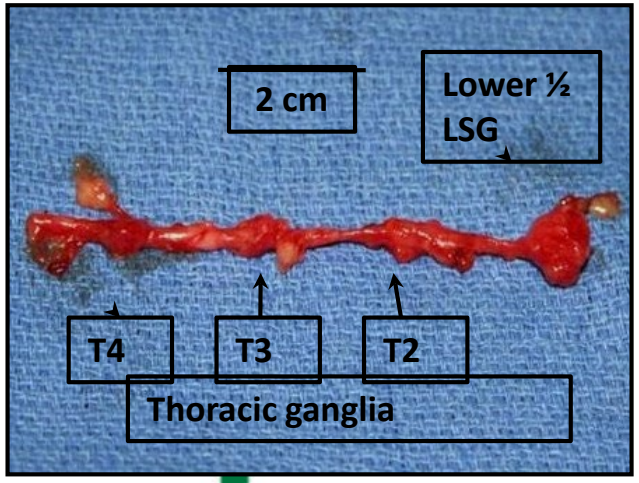
Thoracoscopic cardiac denervation

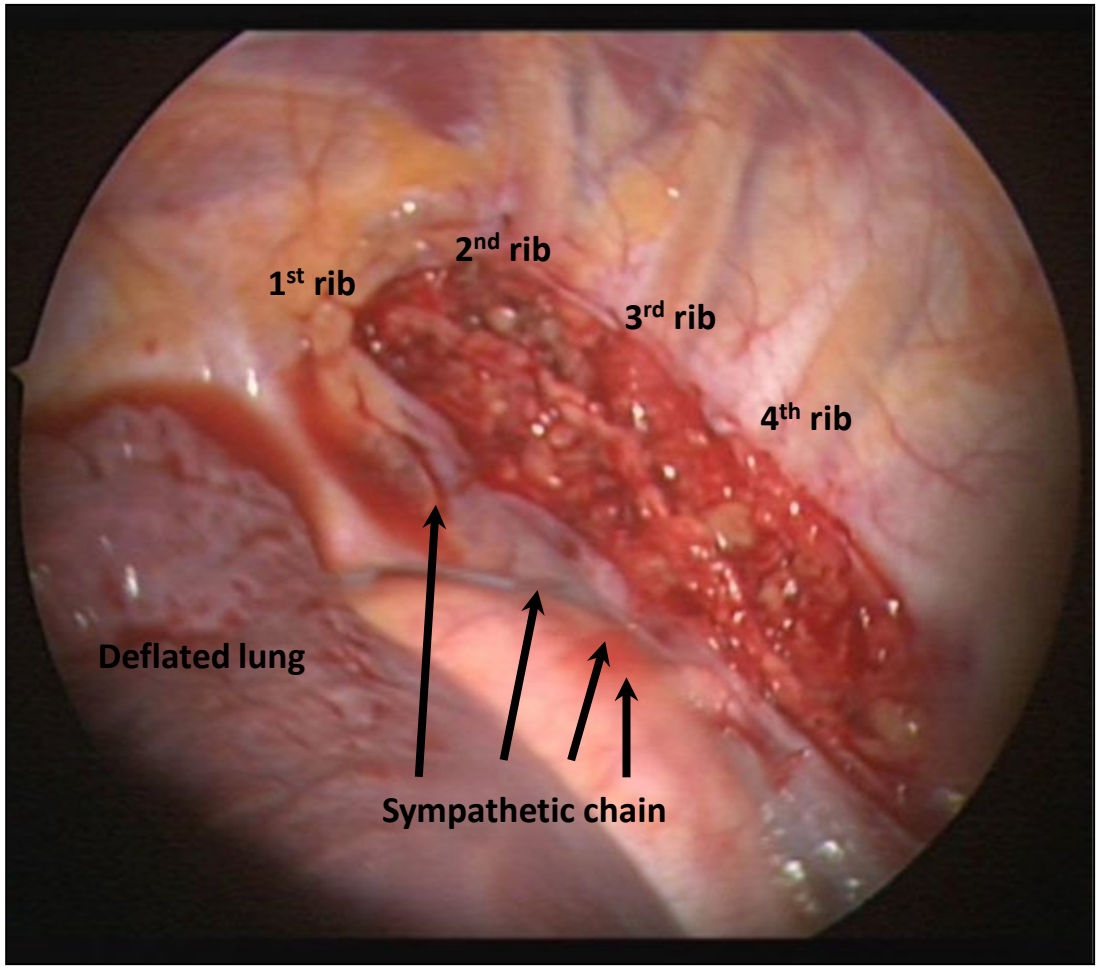
Standard technique:
- 3 intercostal accesses
- Traditional surgical

Robotic technique



Cardiac denervation

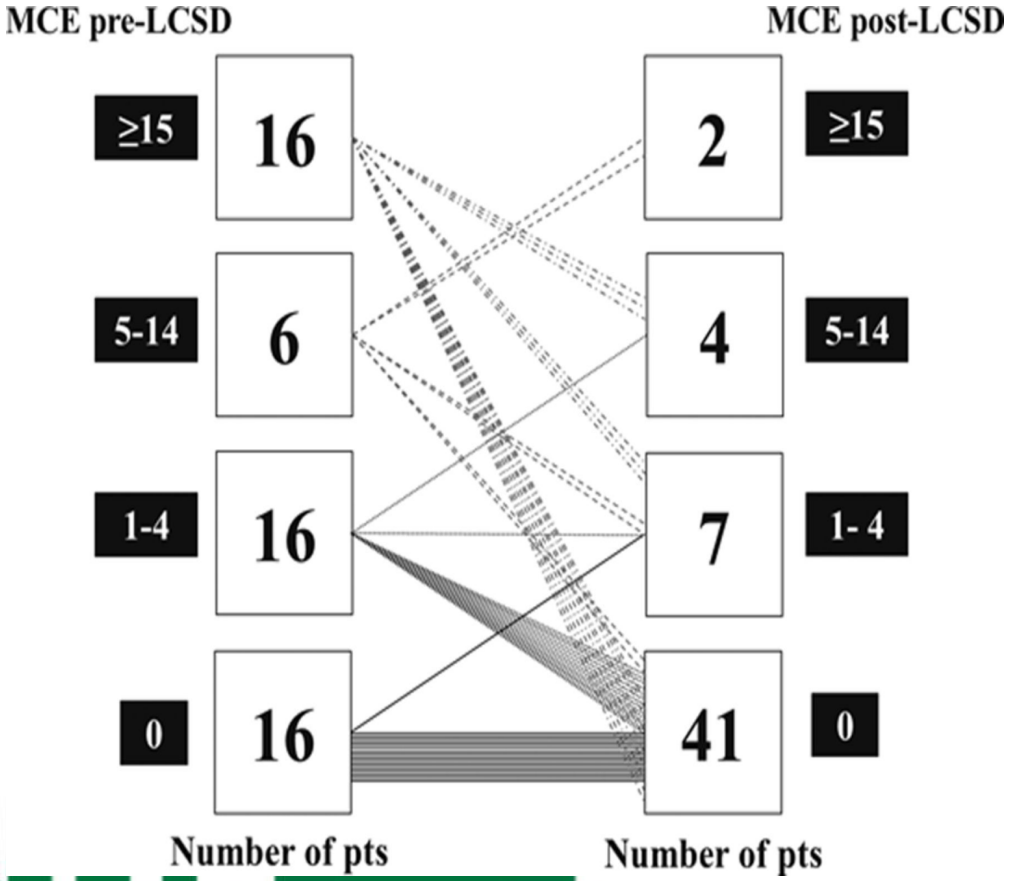


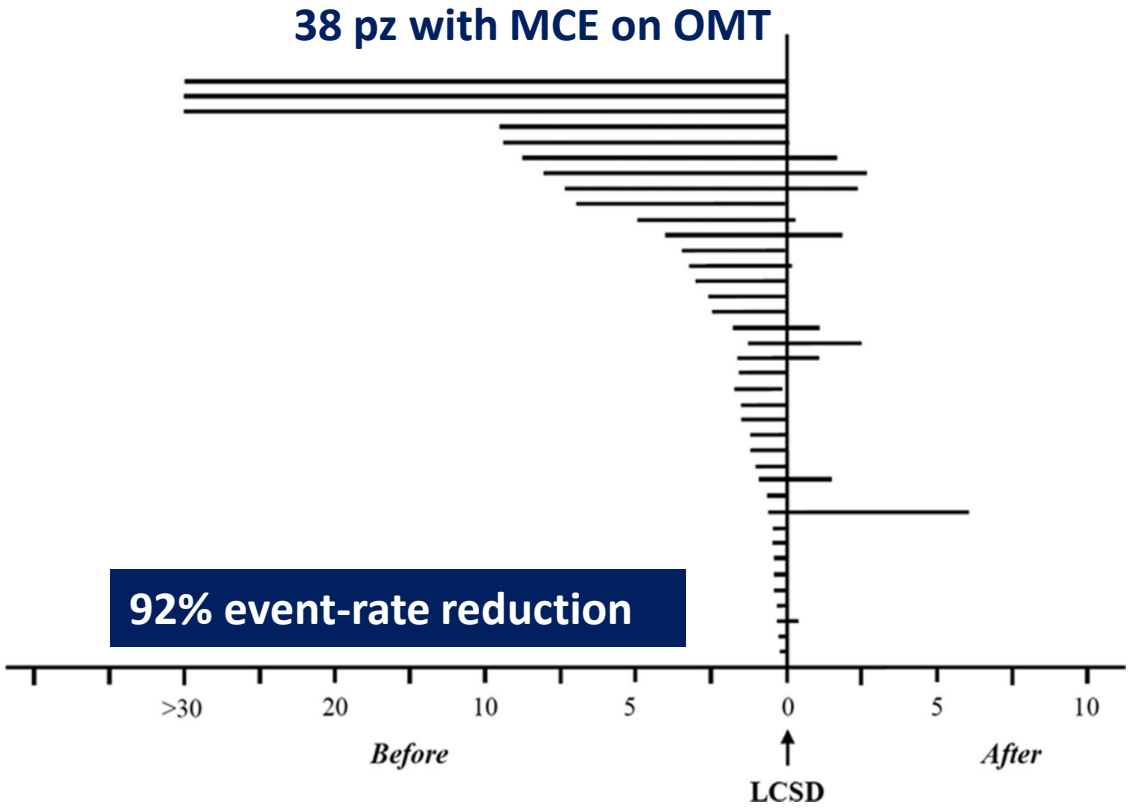


Bourke T, et al. Circulation. 2010;121(21):2255-2262

Left Cardiac denervation in CPVT

63 CPVT, 85% with symptoms, 97% on BB, 25% on BB+ fleca, 59% with ICD

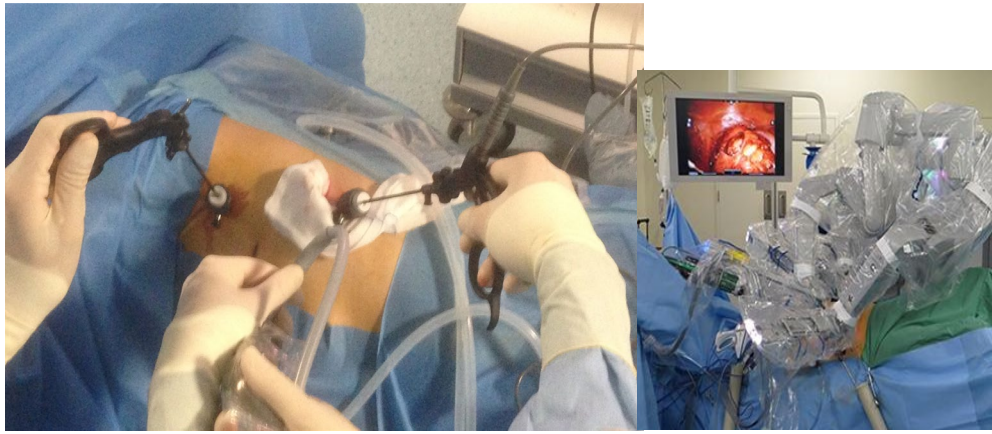




De Ferrari GM, et al. Circulation 2015;131:2185-2193

Intervento di denervazione cardiaca sinistra

- ✓ **Ragazzo** di **17 anni (S-O)** affetto da una **grave forme di malattia genetica**, la tachicardia ventricolare catecolaminergica da mutazione della calmodulina.
- ✓ Storia di arresto cardiaco all'età di 3 anni, successivamente impianto di defibrillatore con multiple recidive aritmiche e shock dell'ICD
- ✓ Marzo 2023 inviato da Stoccolma a Pavia per denervazione cardiaca simpatica di sinistra
- ✓ Ad oggi non più recidive di aritmie ventricolari

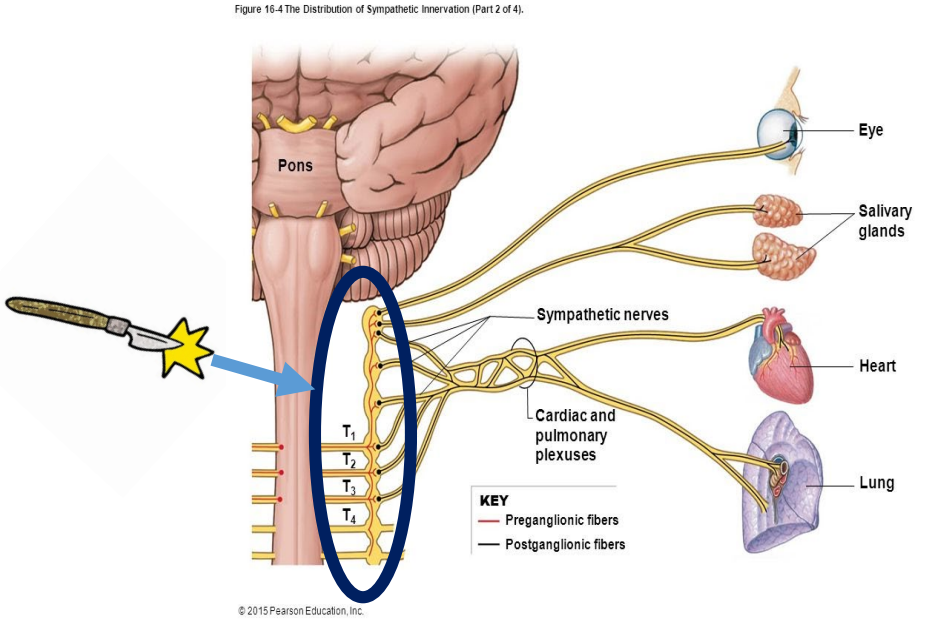


Ha una malattia che "spegne" il suo cuore, 17enne svedese salvato in Italia

Il giovane è stato trasferito da Stoccolma a Pavia e sottoposto a un delicato intervento al Policlinico San Matteo. Dopo un periodo di monitoraggio in Terapia intensiva coronarica è stato dimesso

San Matteo: centro di riferimento per denervazione cardiaca toracoscopica a scopo anti-aritmico

L. Pugliese (Chirurgo), A. Mori (Anestesista) R.Rordorf, A.Vicentini (Cardiologi-Aritmologi)

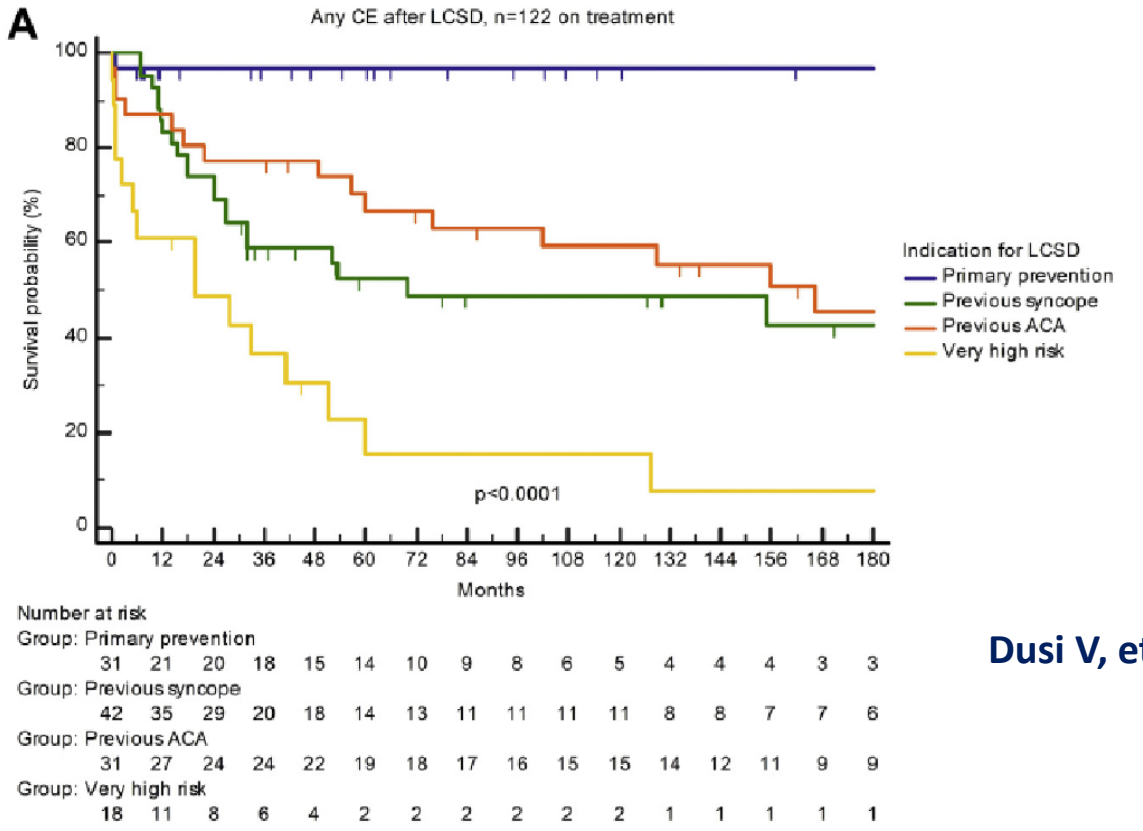


Left Cardiac Sympathetic Denervation for Long QT Syndrome

50 Years' Experience Provides Guidance for Management

Veronica Dusi, MD, PhD,[a,b] Luigi Pugliese, MD,[c] Gaetano M. De Ferrari, MD,[b] Attilio Odero, MD,[d] Lia Crotti, MD, PhD,[a,e,f,g] Federica Dagradi, MD,[a] Silvia Castelletti, MD,[a] Alessandro Vicentini, MD,[h] Roberto Rordorf, MD,[h] Cuilan Li, PhD,[i] Maria Shkolnikova, MD,[j] Carla Spazzolini, DVM, MS,[a] Peter J. Schwartz, MD[a,e]

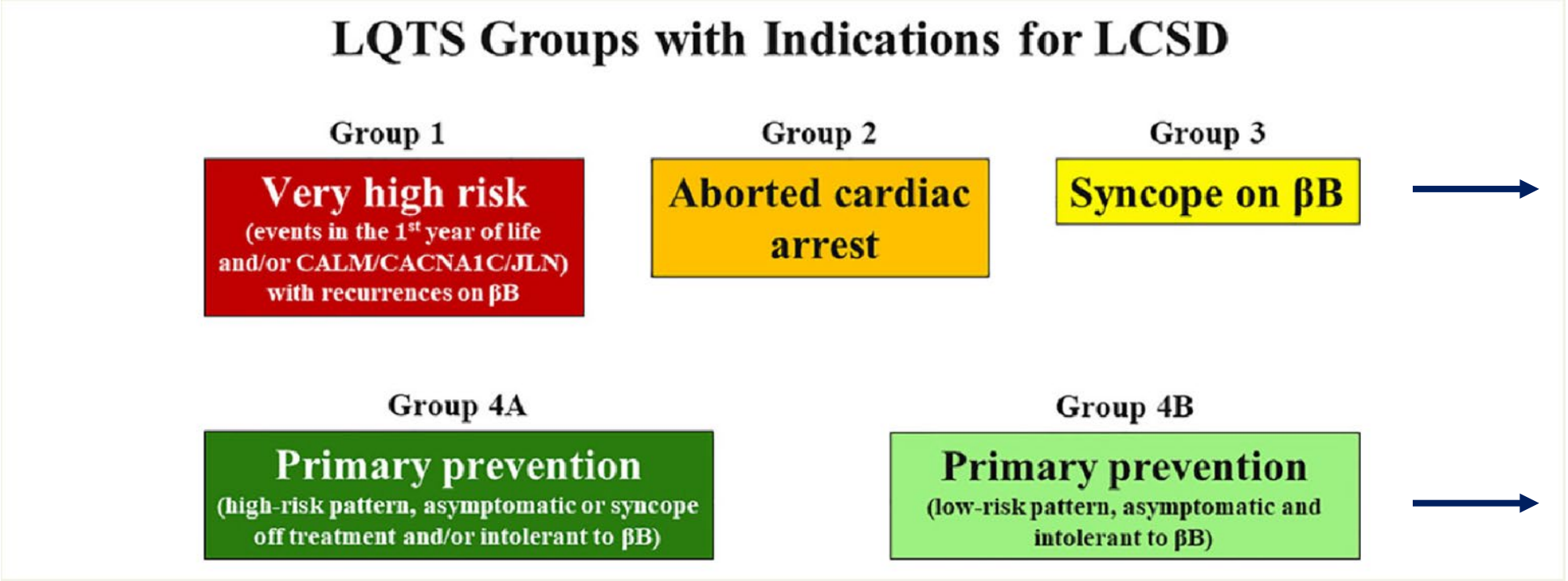
125 pz LQTS
LCSD 1973-2020



86% annual event-rate reduction.

Dusi V, et al JACC EP 2022

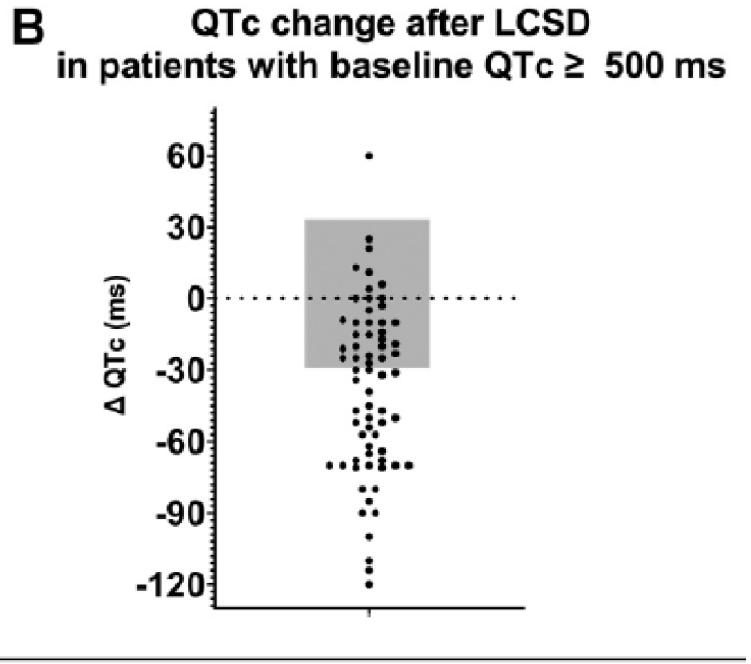
Cardiac denervation in LQTS

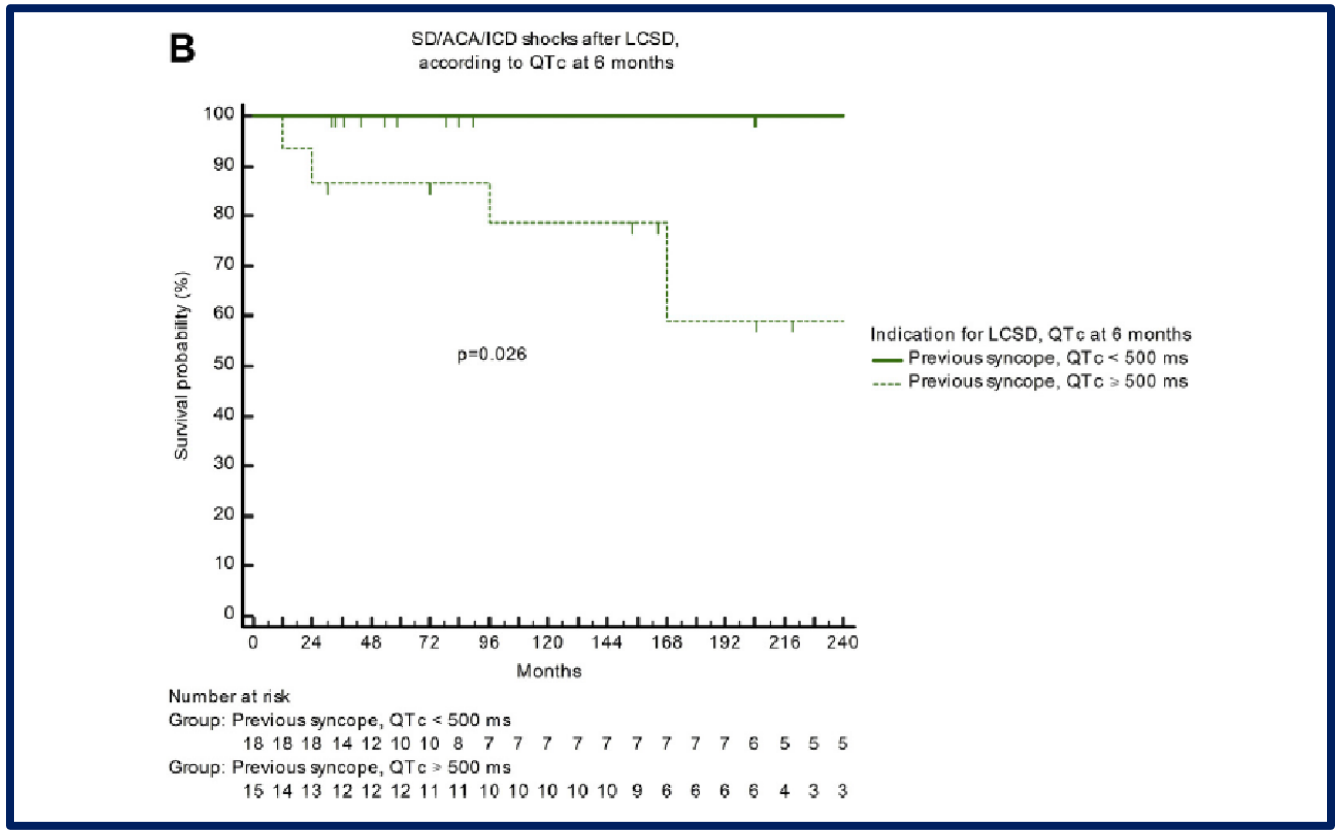


Schwartz PJ, Ackerman MJ European Heart 2022;43:2096-2102

Denervazione cardiaca e intervallo QT

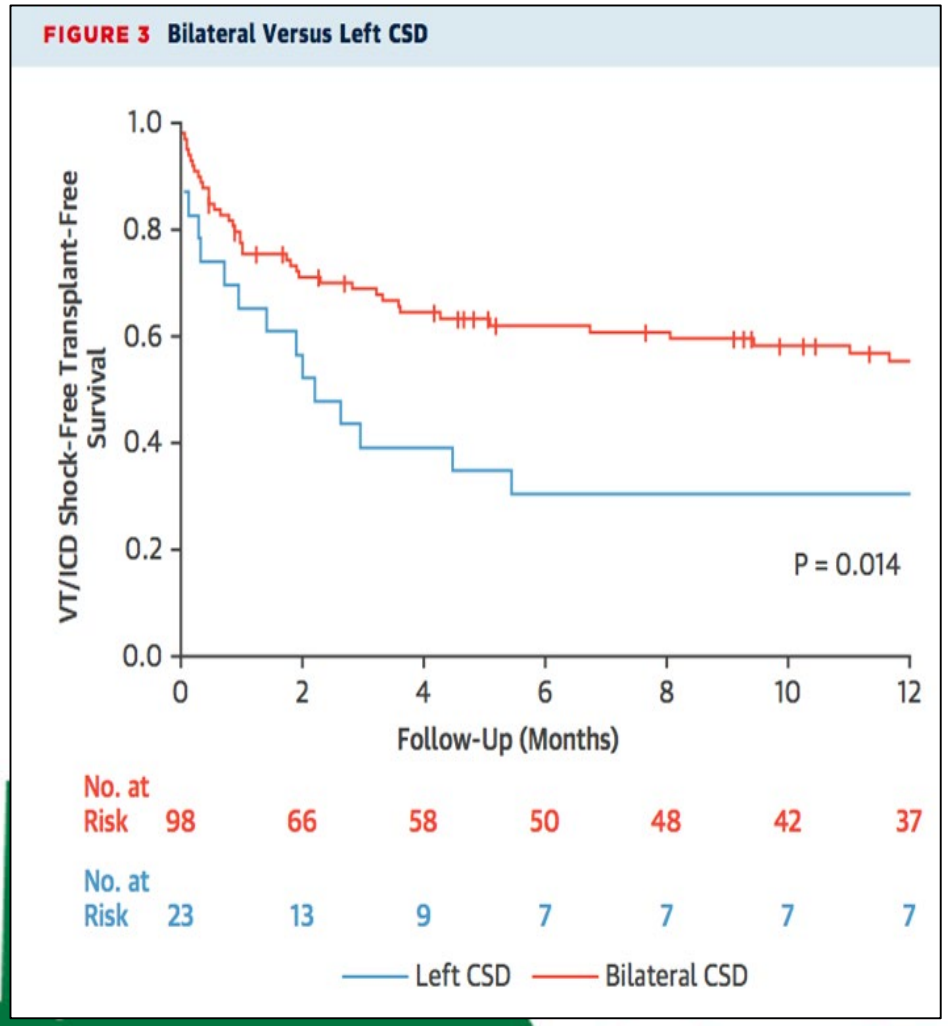
QT<500 msec dopo LCSD e outcome





Dusi V, et al JACC EP 2022

Surgical cardiac denervation



Retrospective study (5 non European centers)

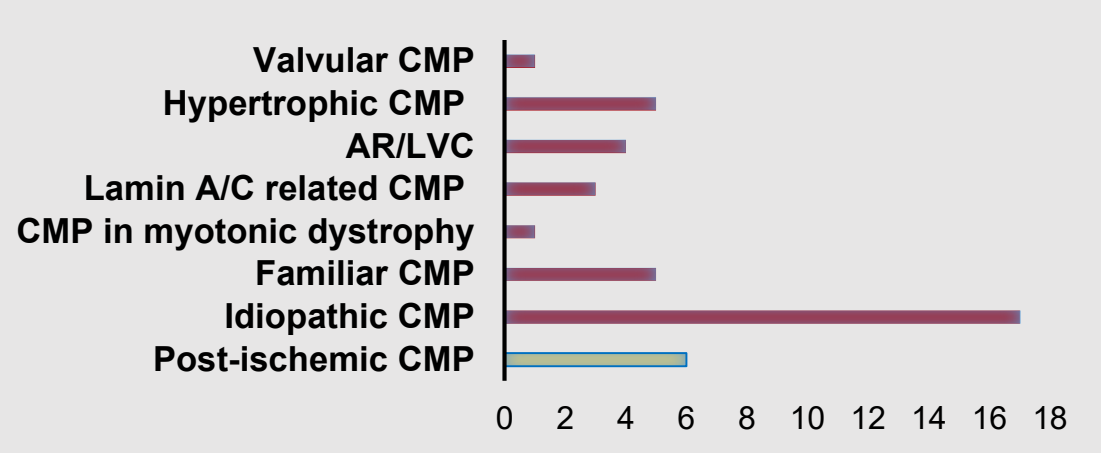
121 pts with SHD (mean 55 yrs, LVEF 30%), 27% ICM, 71% NICM (0.8% familiar)

19% had LCSD, 81% BCSD

CSD reduced the burden of ICD shocks from of 18 ± 30 (median 10) in the year before study entry to 2.0 ± 4.3 (median 0) at a median follow-up of 1.1 years ($p < 0.01$).

Vaseghi M et al J Am Coll Cardiol 2017;69:3070–80

Our experience: CUT-VT Registry



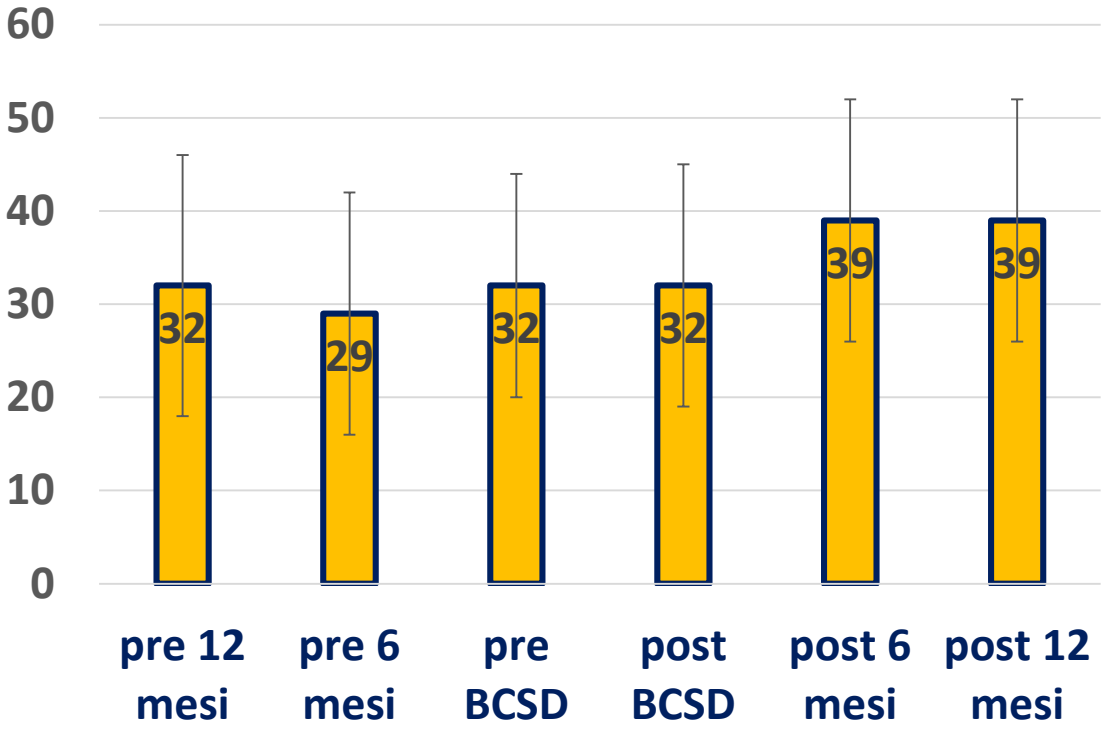
36, 85% NICM (all types)

- ✓ 1 case of hemothorax (mechanical aortic valve)
- ✓ No need for hemodynamical support

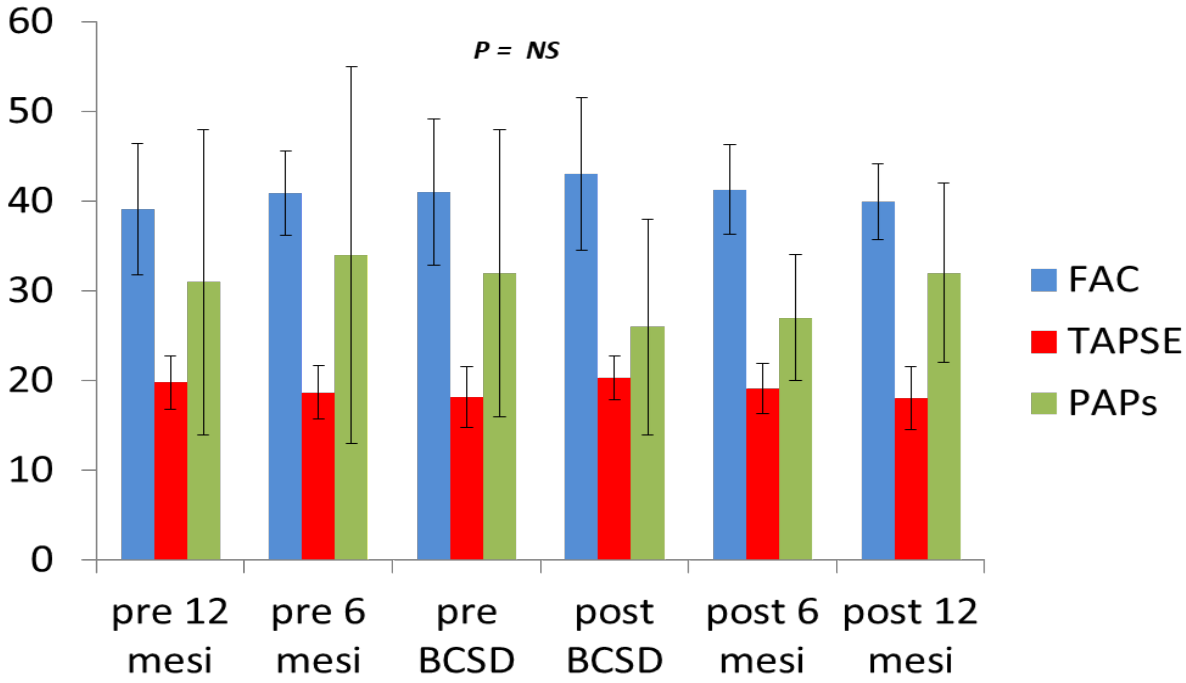
Baseline characteristics, N = 42	N, %
Male	36, 86%
Mean age	54 ± 16 (range 16-81)
OSM/Molinette (%)	59/41
LCSD	4, 10%
ICD (all types)	41, 98%
CRT-D	15, 36 %
LVEF (%)	32 ± 12
NYHA Class I/II/III/IV (%)	19/48/31/2
LVAD/OHT indication (for HF)	13, 41%
History of electrical storm	31, 74%
History of ICD EOT condition	11/41, 27%
Chronic amiodarone	25, 60%
Previous amiodarone-induced thyrotoxicosis	7, 17%
Previous VT/PVC ablation	22/2, 60%
Previous PLSGB	6, 42%
pVT/fast VT (<250 msec)	24, 57%
Referred from other Centers	15, 36%

Bilateral cardiac sympathetic denervation: hemodynamic effect over time

Left ventricular ejection fraction



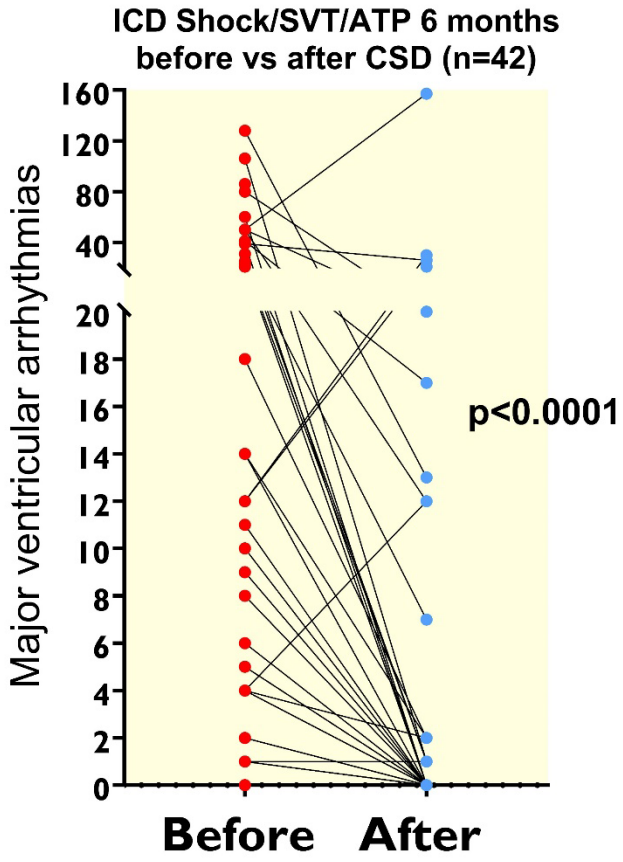
Right ventricular function



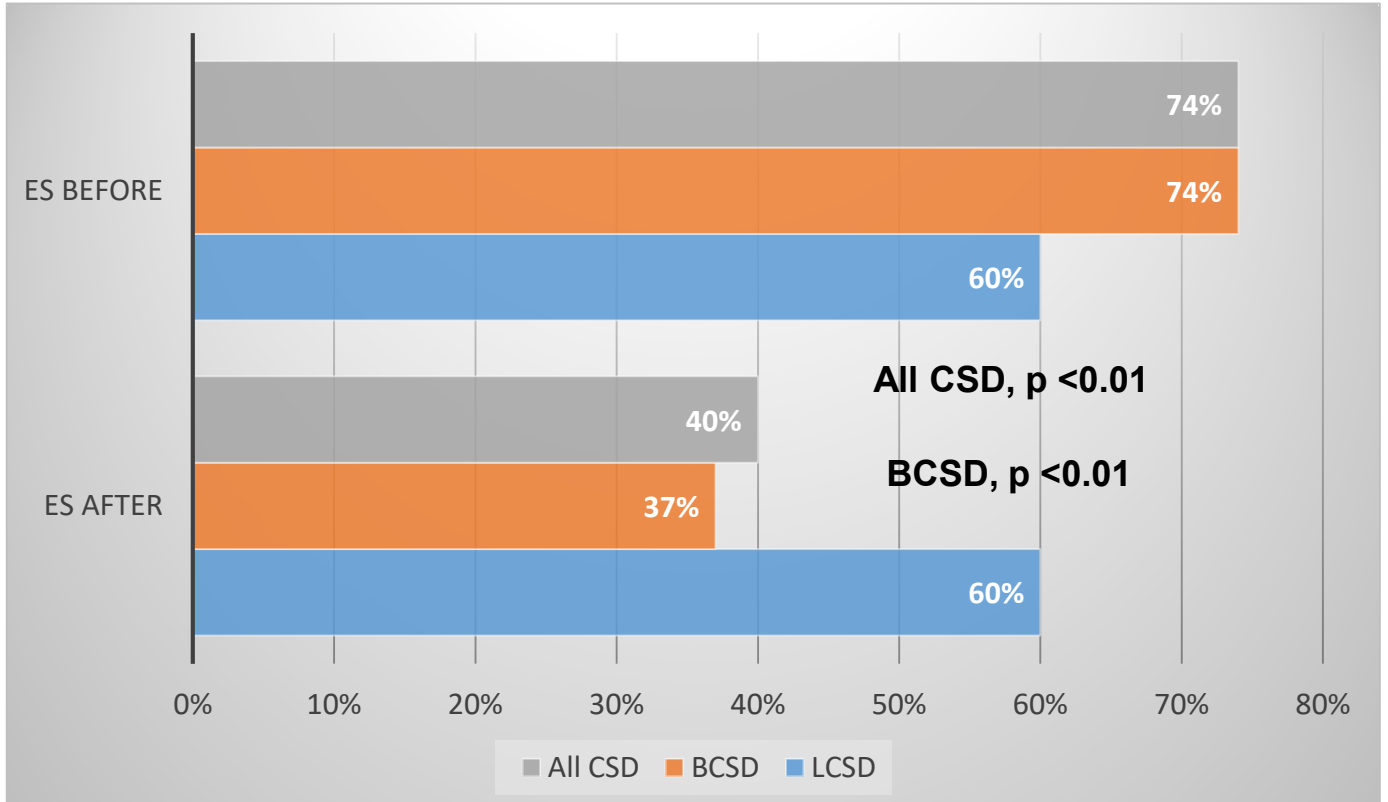
Cardiac sympathetic denervation: efficacy

Median FU 25 months (IQR 7-42):

- **12 deaths (29%), 10 due to refractory HF, 1 due to refractory ES, 1 non cardiac**
- **3 HTx (7%)**

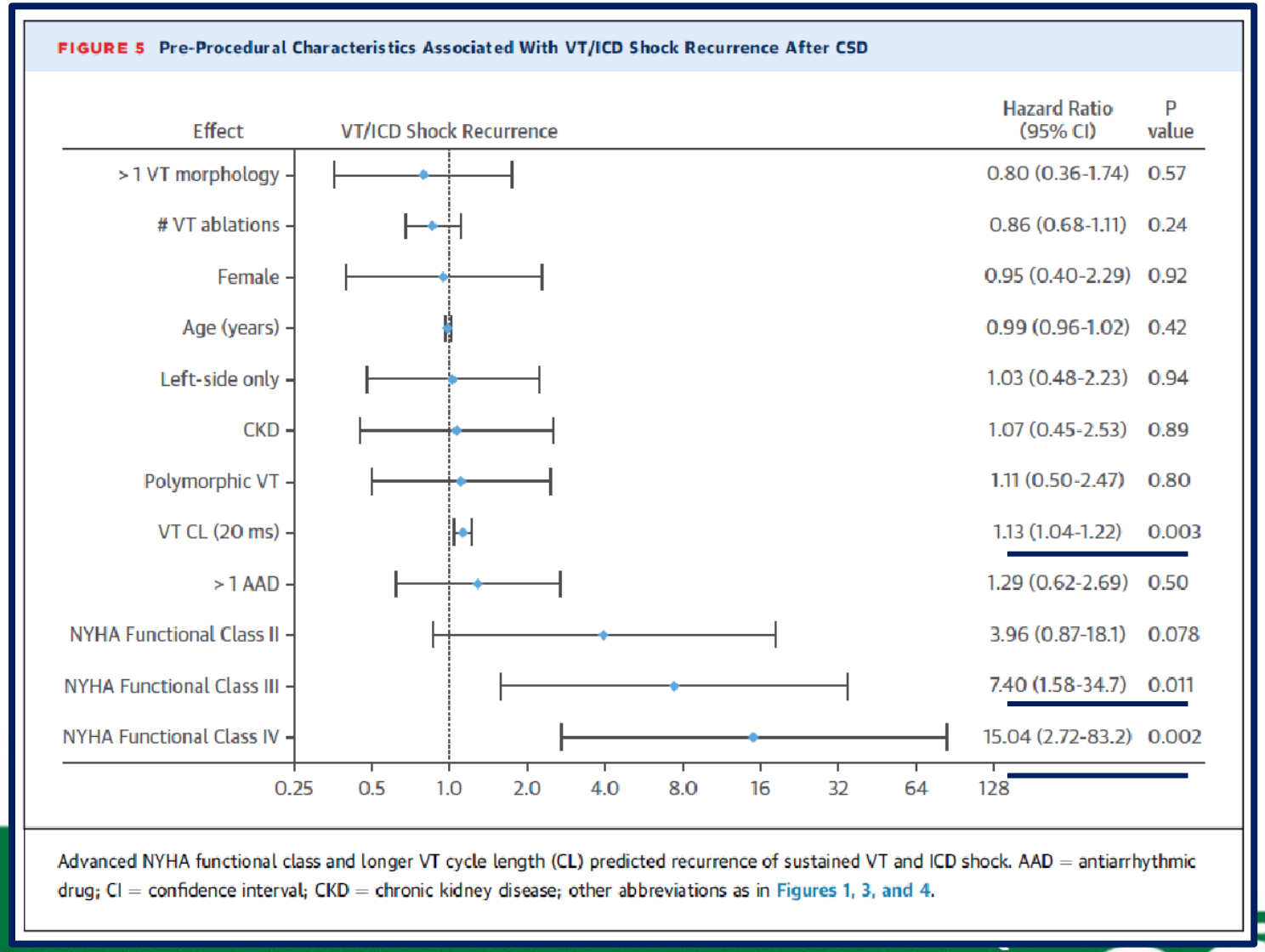


From 12 (IQR 4-43) to 0 (IQR 0-12)



No ICD end of treatment conditions occurred after CSD (vs 27% before, p<0.01)

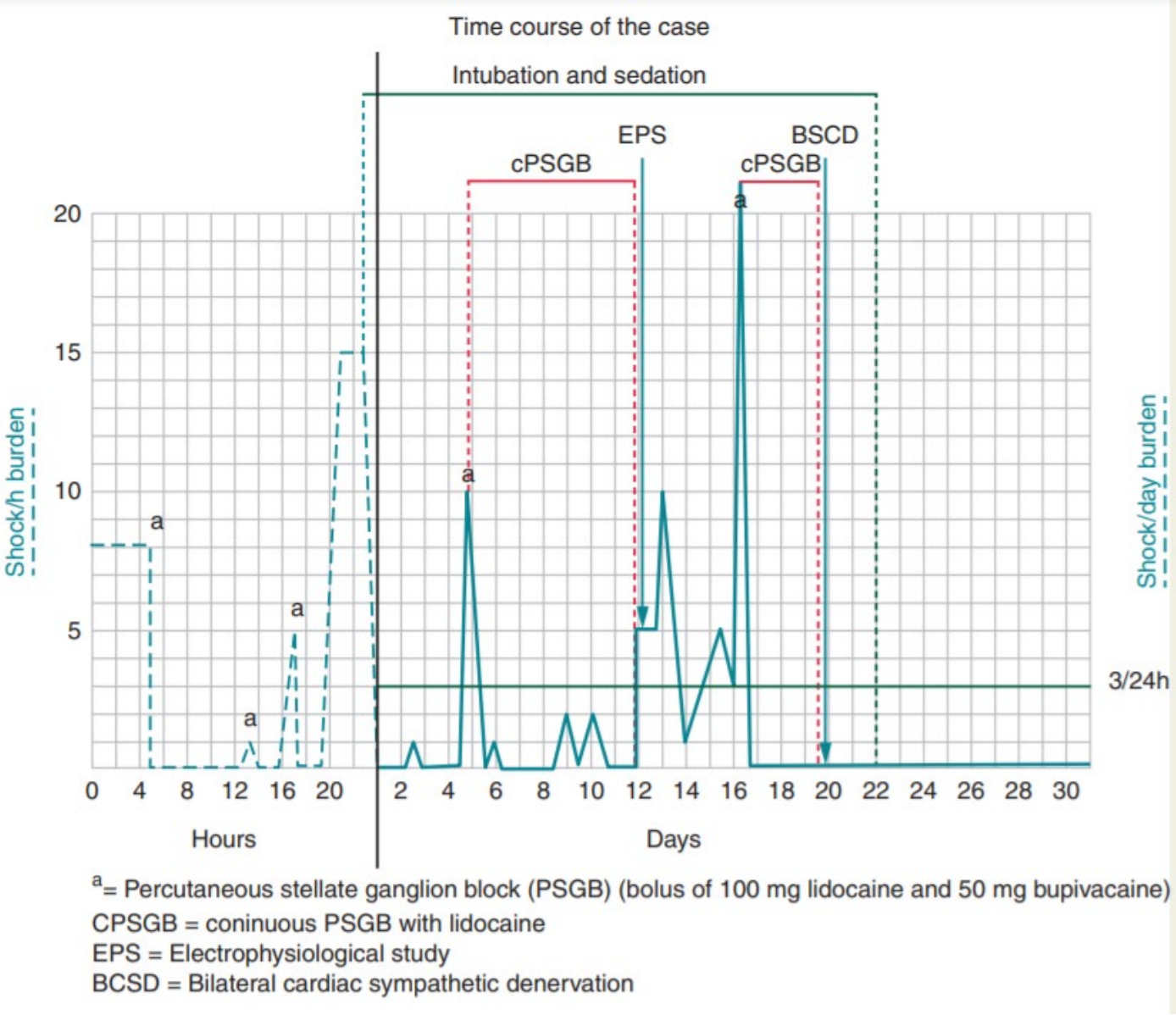
Cardiac sympathetic denervation: clinical predictors



Vaseghi M et al.
J Am Coll Cardiol
2017;69:3070–80

2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death

Autonomic modulation may be considered in patients with electrical storm refractory to drug treatment and in whom catheter ablation is ineffective or not possible.[326,328,340]	IIb	C



Savastano et al. Europace. 2020 Apr 1;22(4):606