

TIGULLIO Il Congresso Nazionale di 2024 ARITMOLOGIA

16-17 Aprile Sestri Levante (GE)

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Sestri Levante



Il mappaggio e l'ablazione della preeccitazione complessa

Luca Segreti, MD, FESC, FAIAC
UO Cardiologia 2 – AOUP - Pisa

La pre-eccitazione ventricolare è determinata da una via anomala che by-passa il normale sistema di conduzione.

Le vie anomale sono di due tipi:

- rapide, sodio-dipendenti (fasce di Kent)
- lente, calcio-dipendenti (fasce di Mahaim).

Nel primo caso si parla di WPW, nel secondo caso di pre-eccitazione tipo Mahaim. In entrambi i casi, esiste un impastamento iniziale del QRS definito onda delta. Nel WPW di regola coesiste un intervallo PR corto, mentre nel Mahaim il PR può essere solo di poco accorciato o anche di durata normale.

Clinical characteristics of challenging catheter ablation procedures in patients with WPW syndrome: A 10 year single-center experience



515 AP among 475 WPW patients

The main findings of the present study were: first, in symptomatic WPW patients, catheter ablation of APs achieved a successful outcome of 98.5% without any AADs; second, the multivariate logistic regression analysis showed that multiple, parahisian, and broad APs were associated with an unsuccessful ablation outcome after the initial ablation; and third, in half of the patients with a recurrence, conduction over the AP was recorded during the acute phase and within three days, but rarely were recorded during the very late phase.

Clinical characteristics of challenging catheter ablation procedures in patients with WPW syndrome: A 10 year single-center experience

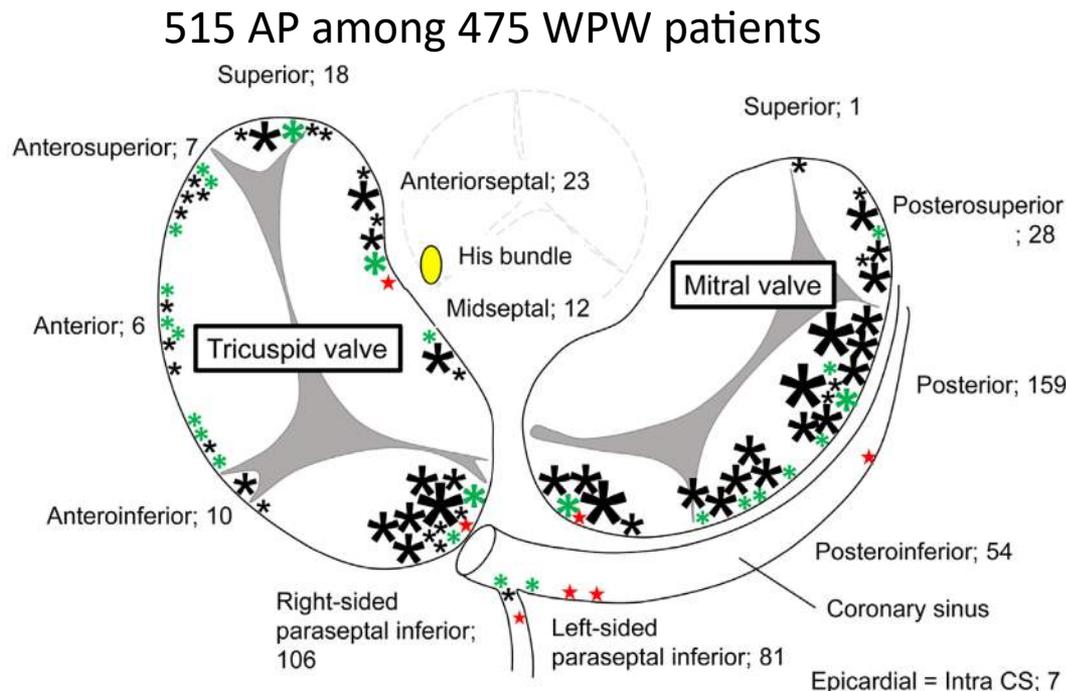


Fig. 1. Diagram of the locations of 512 APs among all 475 WPW patients. The numbers indicate each location of the APs. The biggest five-pointed asterisks indicate 50 cases, big five-pointed asterisks 10, normal five-pointed asterisks 5, and small five-pointed asterisks 1. Furthermore, the black five-pointed asterisks indicate the successful sites, green six-pointed asterisks subacute recurrence sites and red stars failure sites. WPW, Wolff-Parkinson-White syndrome; AP, accessory pathway.

Il mappaggio e l'ablazione della preeccitazione complessa

TABLE 23-6 Troubleshooting the Difficult Case

Problem	Causes	Solution
<u>Misdiagnosis</u>	Atrioventricular nodal reentry with eccentric atrial activation Atrial tachycardia near atrioventricular annulus or from CS musculature	Demonstrate only decremental retrograde conduction, dissociate atrium and/or ventricle from tachycardia Dissociate ventricle from tachycardia
No early or favorable target sites	Poor catheter mobility CS distant from mitral annulus Unable to discriminate component electrograms Long AP conduction times Epicardial AP location Ligament of Marshall connection Ebstein anomaly	Use preformed sheaths or halo catheter, change catheter reach or stiffness Map mitral annulus directly Map AP conduction in opposite direction, change approach of mapping catheter (e.g., transaortic to transeptal), reverse direction of AP activation wave front, map electrogram polarity reversal, simultaneous pacing Map electrogram polarity reversal or shortest times with electroanatomic mapping system Map CS and venous branches, map right coronary artery, epicardial mapping by pericardial access, map atrial appendages or ventricle apical to atrioventricular annulus Map left atrium anterior to left superior pulmonary vein Simultaneous atrial and ventricular pacing or atrial or ventricular premature stimuli to separate fractionated electrograms, map right coronary artery, use computerized mapping system
Unsuccessful energy delivery	Poor catheter stability and/or contact Low temperatures with radiofrequency ablation Low-current delivery with radiofrequency ablation Epicardial AP Wrong location	Use preformed sheaths, change catheter curvature, reach, or stiffness; change catheter approach to ablation site (e.g., femoral to subclavian for right-sided AP); for one rapid pacing during ablation, use cryoablation Improve catheter contact; use high-output generator and large-tip catheter Lower system impedance (additional skin patches); use irrigated or cooled radiofrequency catheter; use cryoablation Ablation in CS or tributary with cryoablation or cooled radiofrequency; percutaneous epicardial ablation Continued mapping, map polarity reversal, map AP conduction in alternate direction, map for epicardial AP, consider unusual AP location

A: anatomy
B: biophysics
C: cognitive

HUANG, MILLER
 CATHETER ABLATION
 OF CARDIAC
 ARRHYTHMIAS, 3 ed.

- Oblique pathways

- Anteroseptal pathways

- Posteroseptal pathways

- Atypical pathways

- Previous ablation failures



- **Oblique pathways**

- Anteroseptal pathways

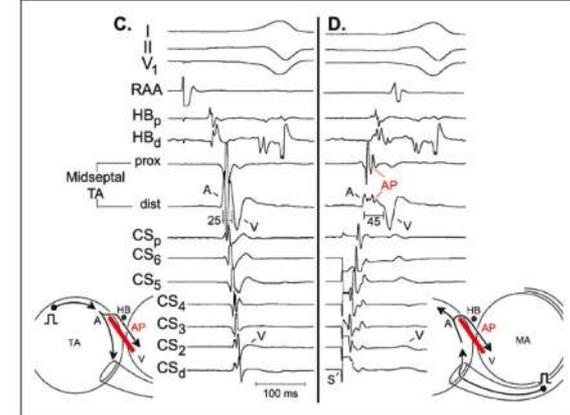
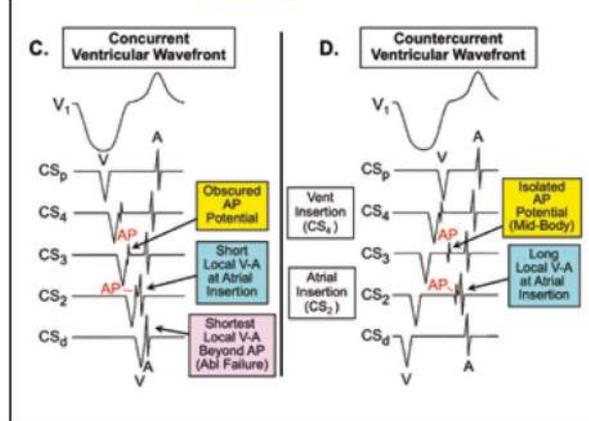
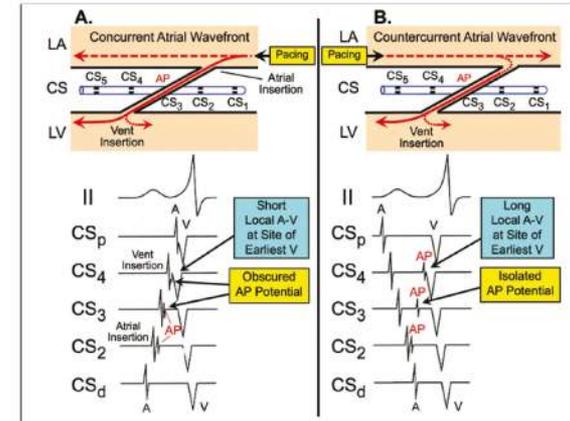
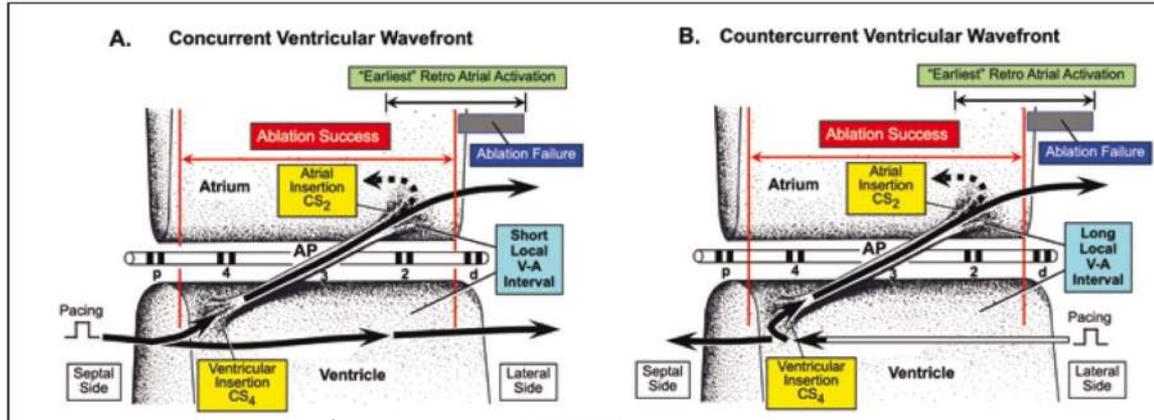
- Posteroseptal pathways

- Atypical pathways

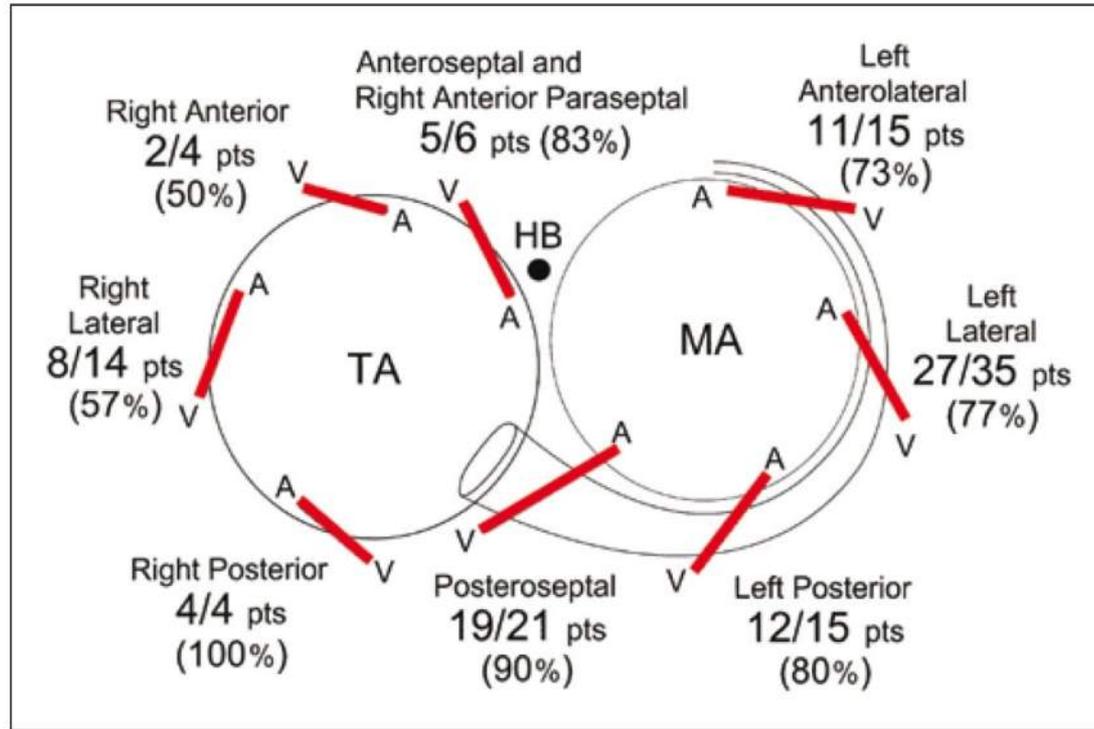
- Previous ablation failures



Mappaggio & Ablazione nella preeccitazione complessa



Orientation of oblique course of 114 APs in 8 anatomic regions

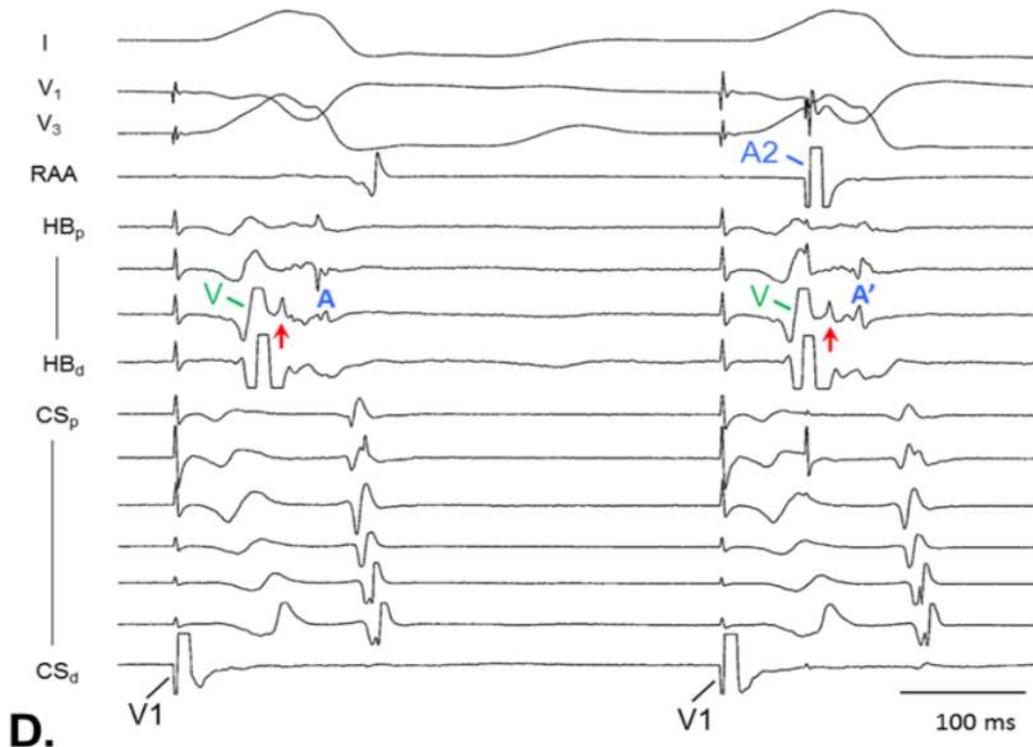




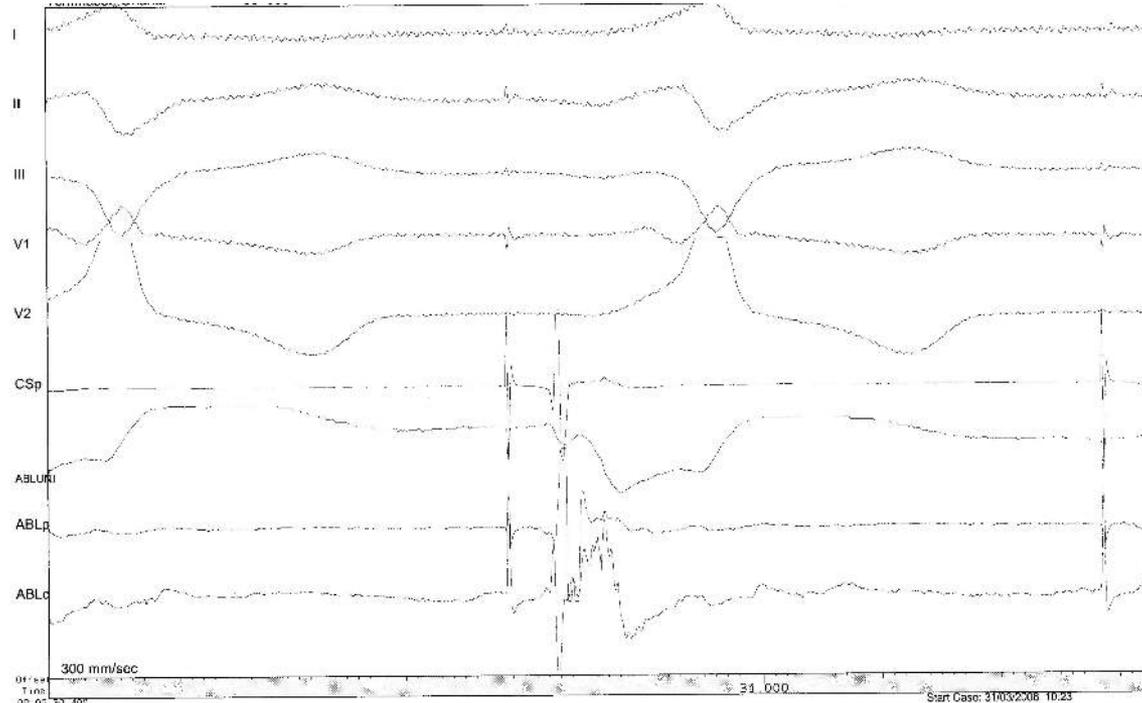
	CCW ventricular wavefront	CW ventricular wavefront
Left anterolateral / Left lateral AP	Inferobasal RV septum / MCV shorter AV	RVOT / AIV longer AV
Posteroseptal AP	Inferobasal RV septum shorter AV	Posterior or lateral coronary vein / LV longer AV
Right free wall AP	Inferobasal RV septum shorter AV	basal RV free wall anterior to the AP longer AV
Ateroseptal / Right anterior paraseptal	Basal anterior RV septum (paraHis) longer AV	Basal anterolateral RV free wall shorter AV



The AP potential can be validated by dissociating the AP potential from the local atrial and ventricular potentials.



In the event that an AP potential is not identified during mapping, we target earliest anterograde ventricular activation (QS pattern on the unipolar EGM at the site of earliest activation) or earliest retrograde atrial activation.



- Oblique pathways

- Anteroseptal pathways

- Posteroseptal pathways

- Atypical pathways

- Previous ablation failures

WHAT THE STUDY ADDS

- We developed a novel strategy using pacing from the mapping catheter to recognize near field and far-field His electrograms to select safe ablation sites.
- Observations in a series of patients suggests that this technique may help improve outcomes for ablation of arrhythmias in the para-His region.

FF His sites were defined if they required >10 mA/2 ms to capture the HB.

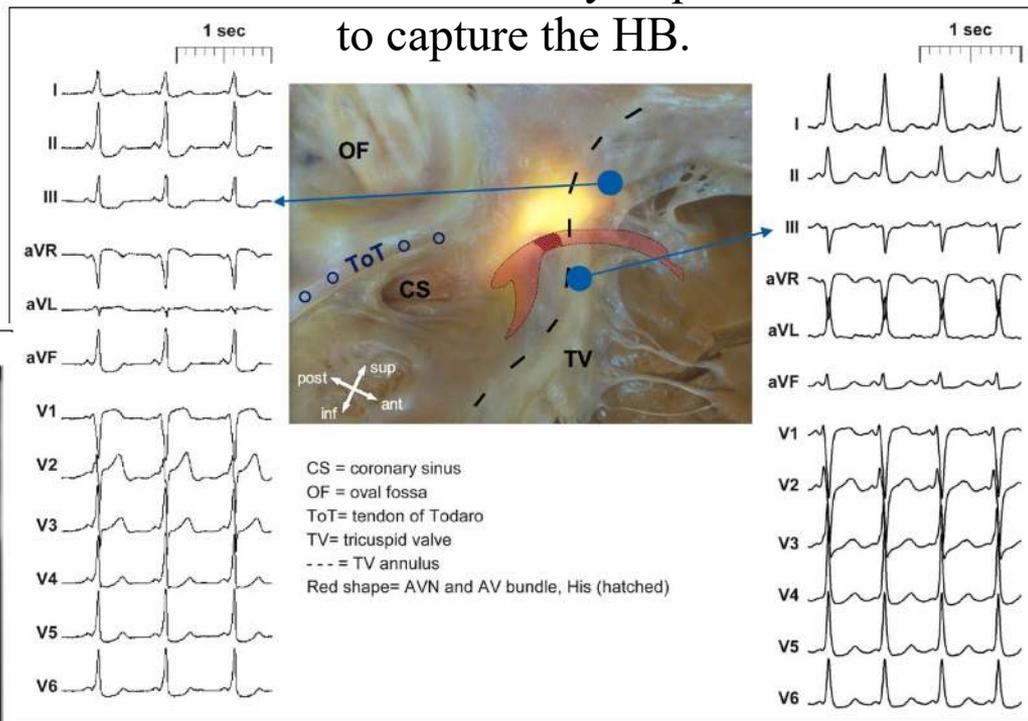
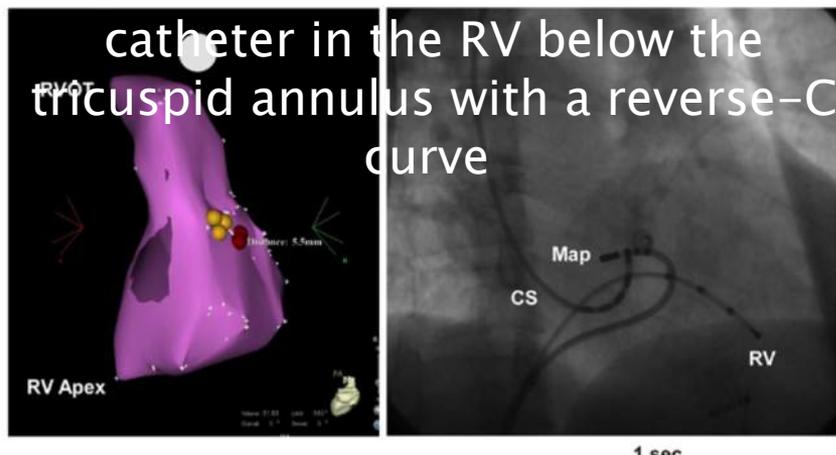
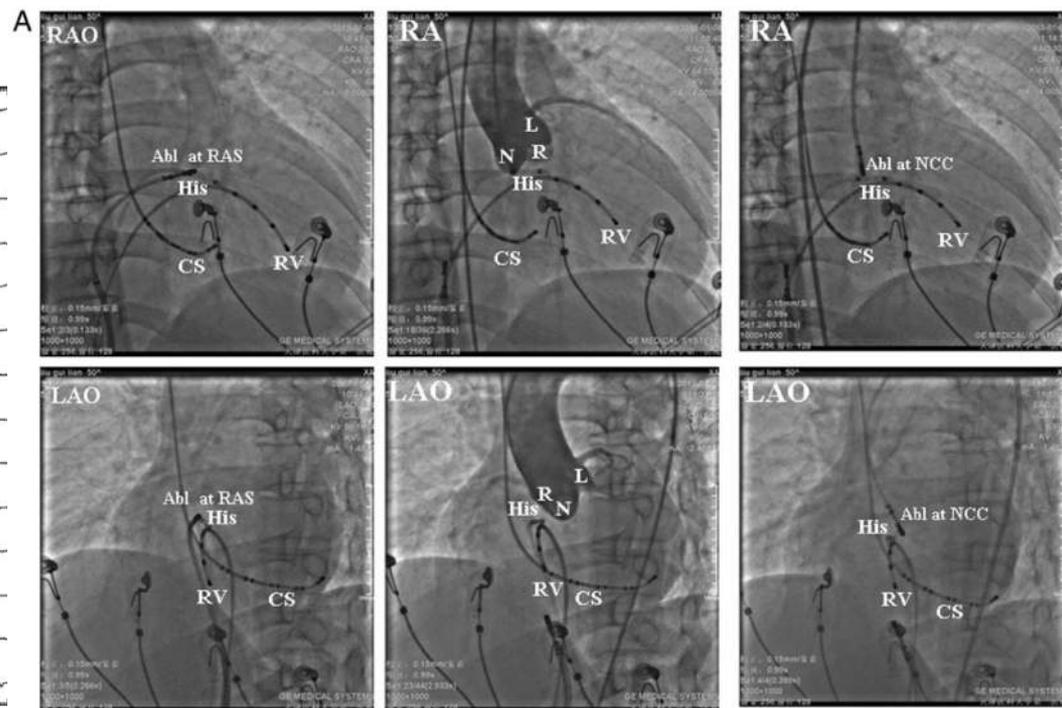


Figure 8. Typical QRS morphology during preexcitation in a superior para-Hisian accessory pathway (PH-AP; left) and an inferior PH-AP (right). Middle shows Koch triangle with the membranous septum being transilluminated. Note the difference of the QRS complexes of ad III between the 2 groups. CS indicates coronary sinus; OF, oval fossa; ToT, tendon of Todaro; and TV, tricuspid valve.

Radiofrequency catheter ablation at the non-coronary cusp for the treatment of para-hisian accessory pathways

Gang Xu¹, Tong Liu¹, Enzhao Liu¹, Lan Ye¹, Michael Shehata²,
Xunzhang Wang², and Guangping Li^{1*}

17 patients with para-hisian APs

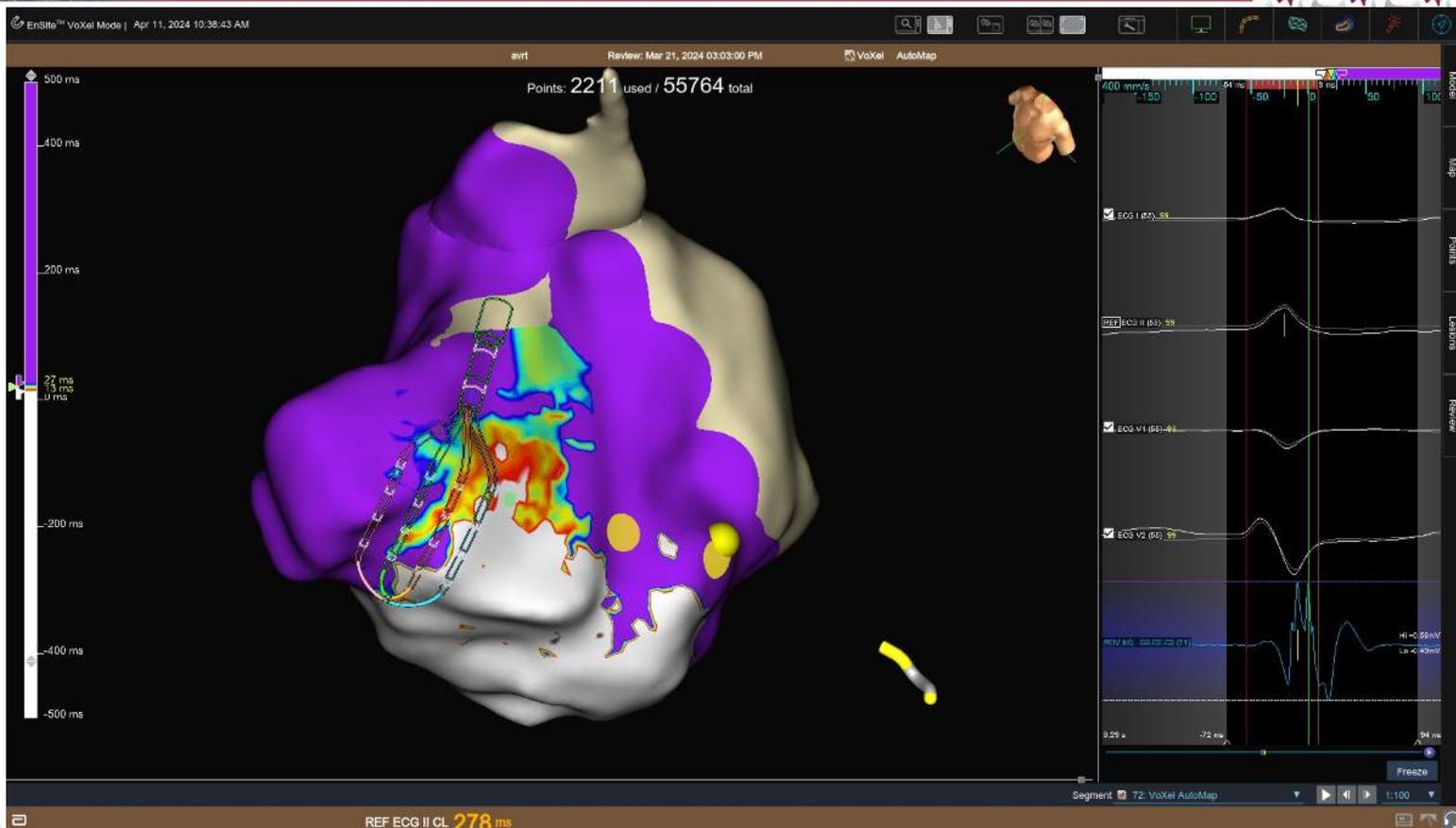




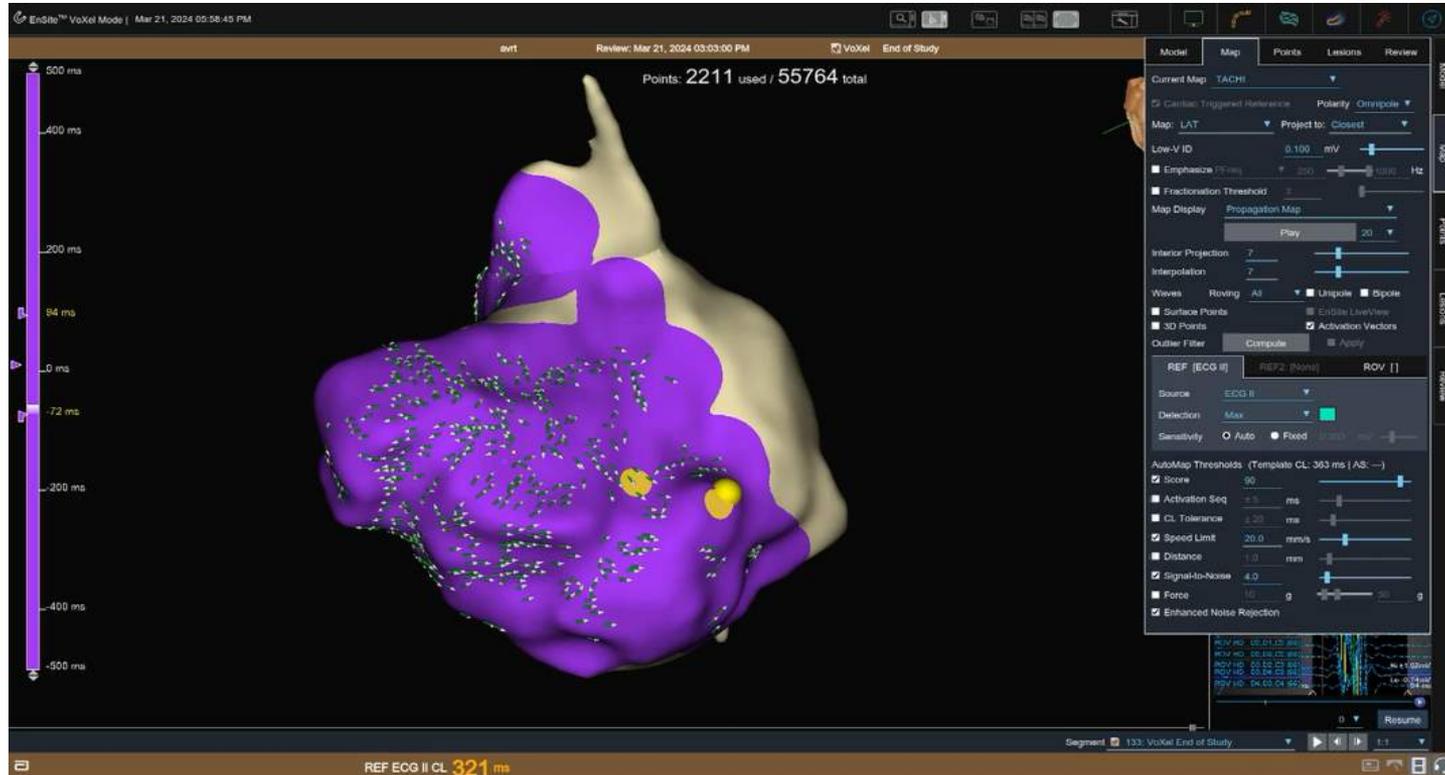
Accesso ecoguidato alla vena succlavia sinistra



Mappante multipolare dalla vena succlavia sinistra



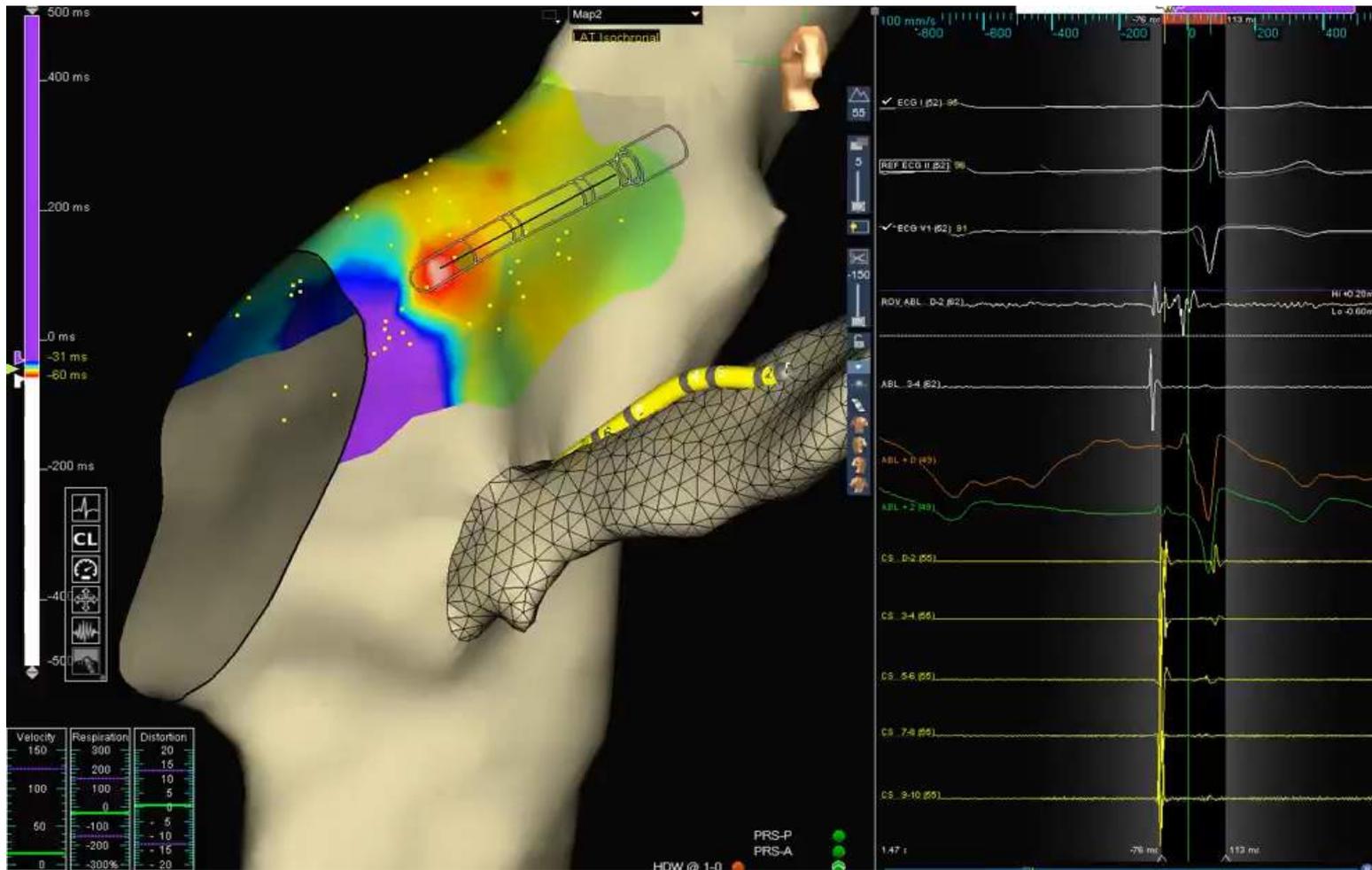
Inserzione ventricolare verso la parete libera



Crioablazione durante tachicardia



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- Oblique pathways

- Anteroseptal pathways

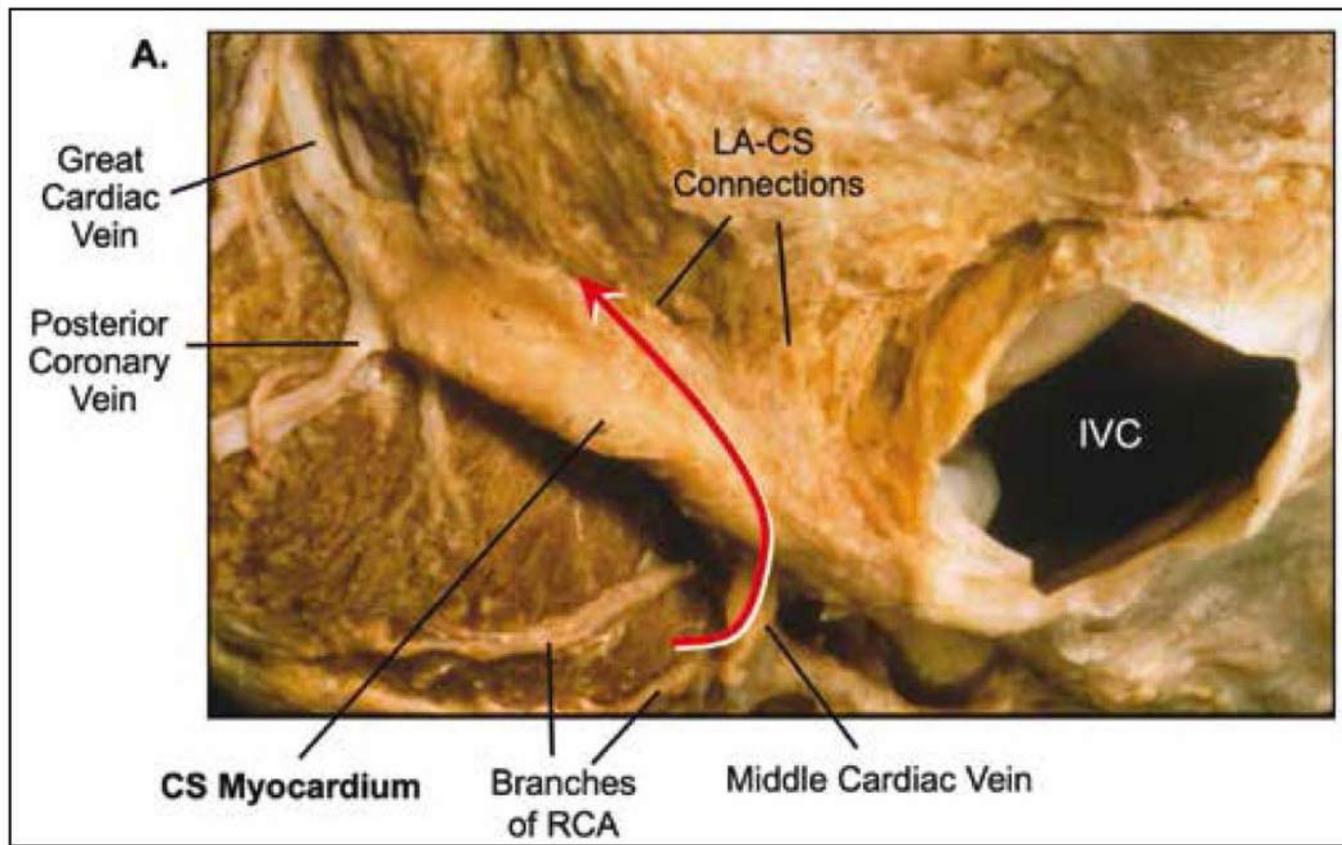
- **Posteroseptal pathways**

- Atypical pathways

- Previous ablation failures

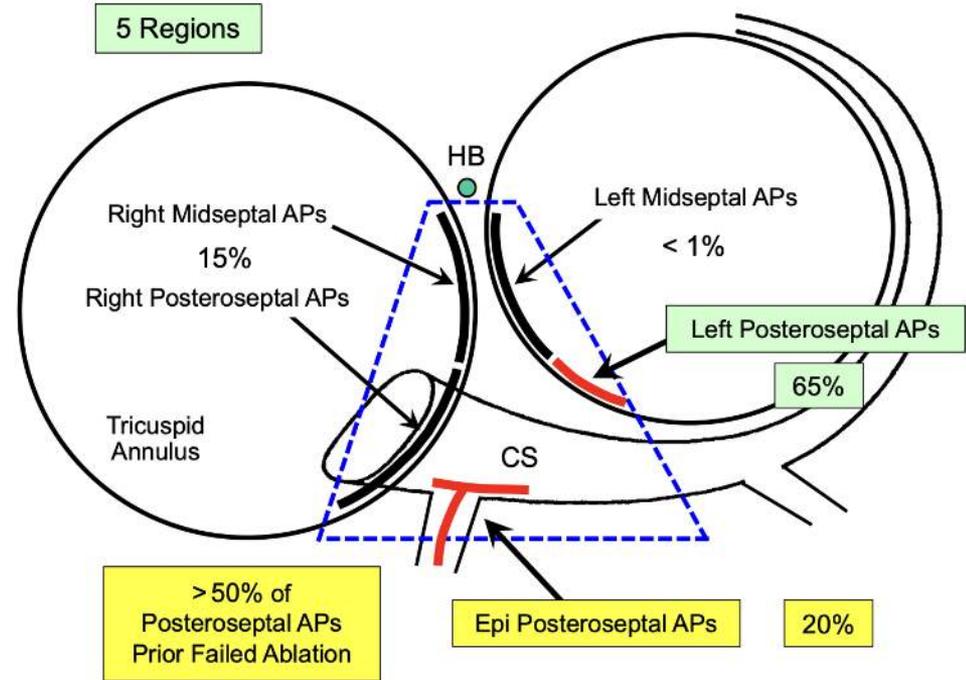
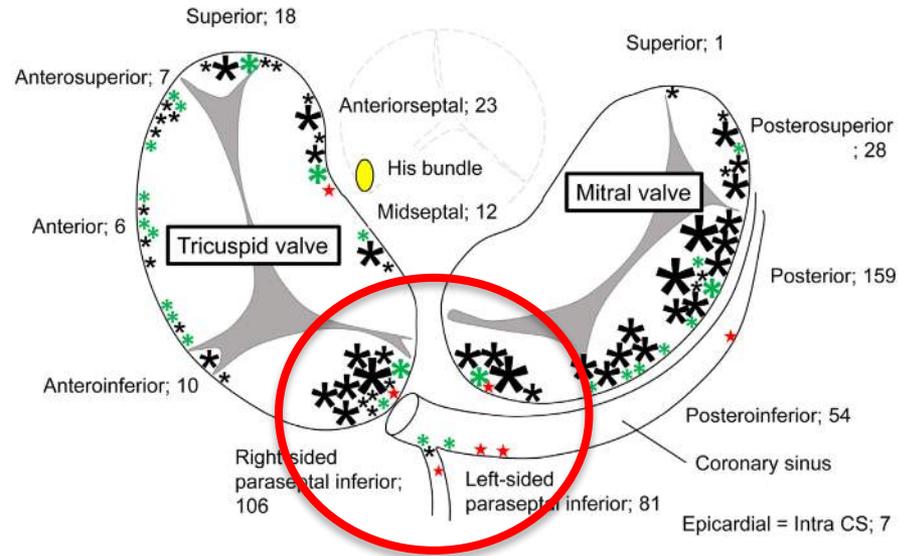


Posteroseptal Accessory Pathways



Warren Jackman's Art of War:
A Sniper's Approach to Catheter Ablation

Posteroseptal Accessory Pathways



T. Fujino et al. Journal of Cardiology 2020

Warren Jackman's Art of War:
A Sniper's Approach to Catheter Ablation

Predictors of Epicardial Posteroseptal APs

TABLE 24-4 Predictors of Epicardial Posteroseptal Atrioventricular Connection

Finding	Sensitivity (%)	Specificity (%)	PPV (%)
Steep negative delta wave in lead II*	87	79	50
Steep positive delta wave in lead aV _R *	61	98	88
Deep S wave in lead V ₆ *	70	87	57
Presence of CS diverticulum	NA	NA	NA
Sharp/blunt CS EGM at earliest retrograde site [†]	100	47	NA

CS, Coronary sinus; EGM, electrogram; NA, not assessed; PPV, positive-predictive value.

*From Takahashi A, Shah D, Jais P, et al. Specific electrocardiographic features of manifest coronary vein posteroseptal accessory pathways. *J Cardiovasc Electrophysiol.* 1998;9:1015-1025.

[†]Estimated from Pap R, Traykov VB, Makai A, et al. Ablation of posteroseptal and left posterior accessory pathways guided by left atrium-coronary musculature activation sequence. *J Cardiovasc Electrophysiol.* 2008;19:653-658.

onda delta positiva rapida in aVR + R < S in V6 → valore predittivo positivo del 91% per l'ablazione all'interno del seno coronarico o della vena cardiaca media

Mappaggio del tetto CS (catetere dal basso) e del pavimento CS (catetere dall'alto)

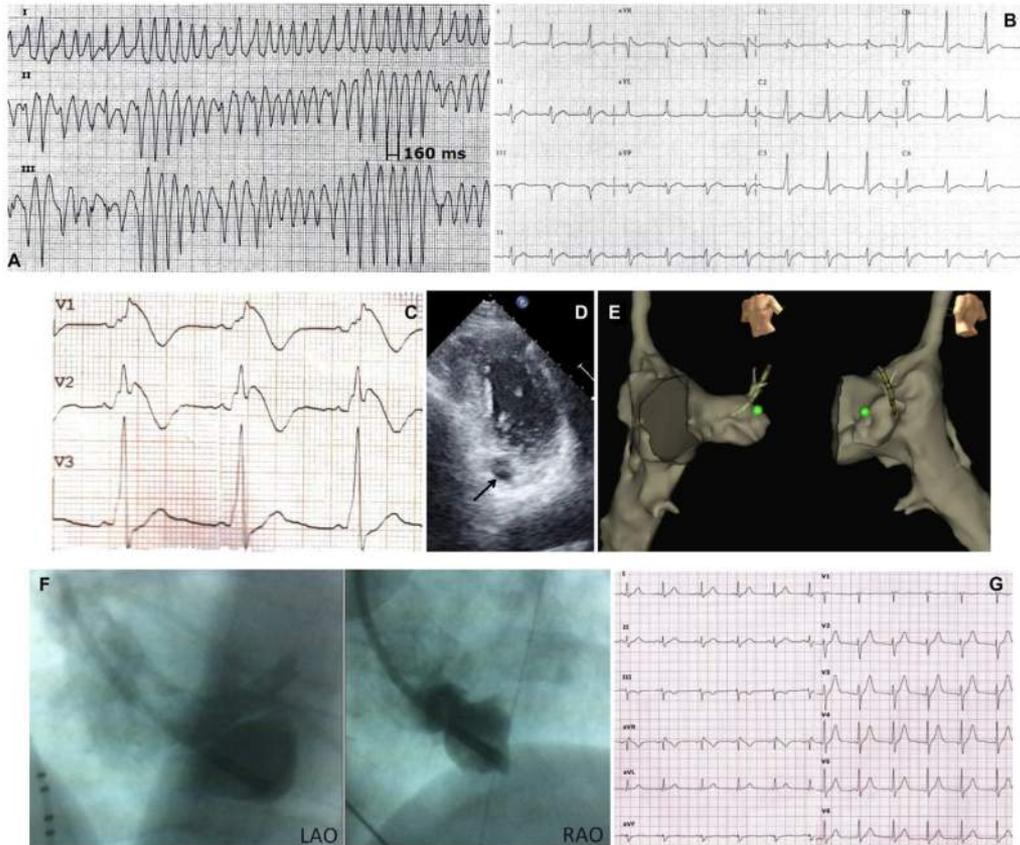
Attivazione atriale più precoce durante conduzione retrograda AP:

- Tetto CS → mappaggio anulus mitralico (transettale)
- Pavimento CS → mappaggio pavimento CS e tributari venosi (MCV / PL)

se pavimento CS più precoce di MCV e PL ablazione difficile (estesa connessione tra estensione CS e ventricolo): → mappare la AP durante pacing ventricolare

- considerare angiografia del seno coronarico, soprattutto nei casi redo

High Risk Accessory Pathway Ablation Inside a Large Coronary Sinus Diverticulum in a Patient with Coexistent Drug-Induced Type 1 Brugada ECG Pattern



[LAO]; right anterior oblique projection [RAO]). The earliest ventricular activation during sinus rhythm was found to be at the diverticulum neck. There, radiofrequency ablation (Panel E, dot) with an irrigated catheter (Biosense Webster, Celsius thermocool, D curve) from left subclavian vein eliminated preexcitation (Panel G).

The association between CS diverticulum and APs at risk of sudden death has been already described, whereas the coexistence of APs with a Brugada ECG pattern is a really rare entity. To the best of our knowledge, this is the first report of concomitant CS diverticulum-related AP and provoked Brugada ECG pattern. It is worth noticing that using class IC antiarrhythmic drugs to prevent arrhythmias in case of unsuccessful ablation may result deleterious in this particular kind of patients.

- Oblique pathways

- Anteroseptal pathways

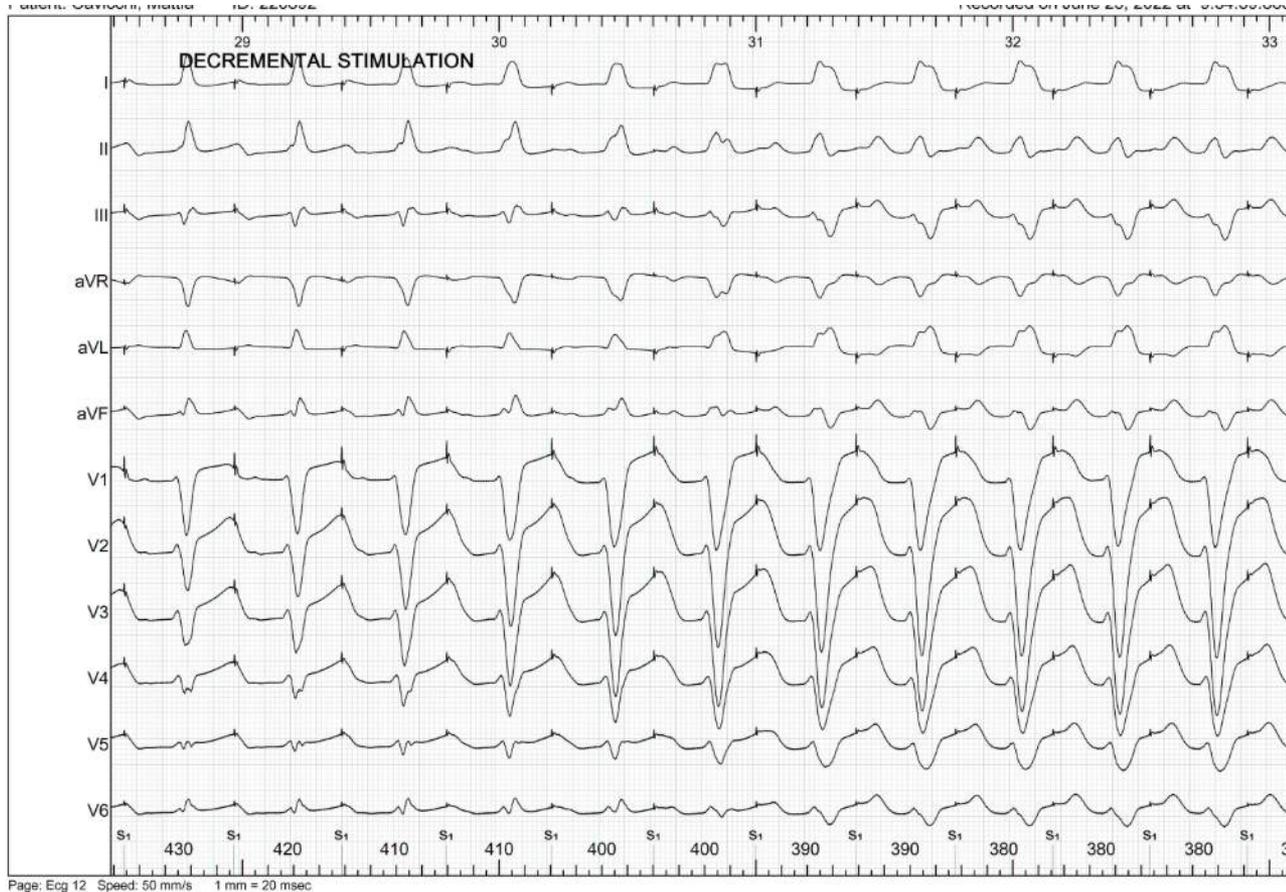
- Posteroseptal pathways

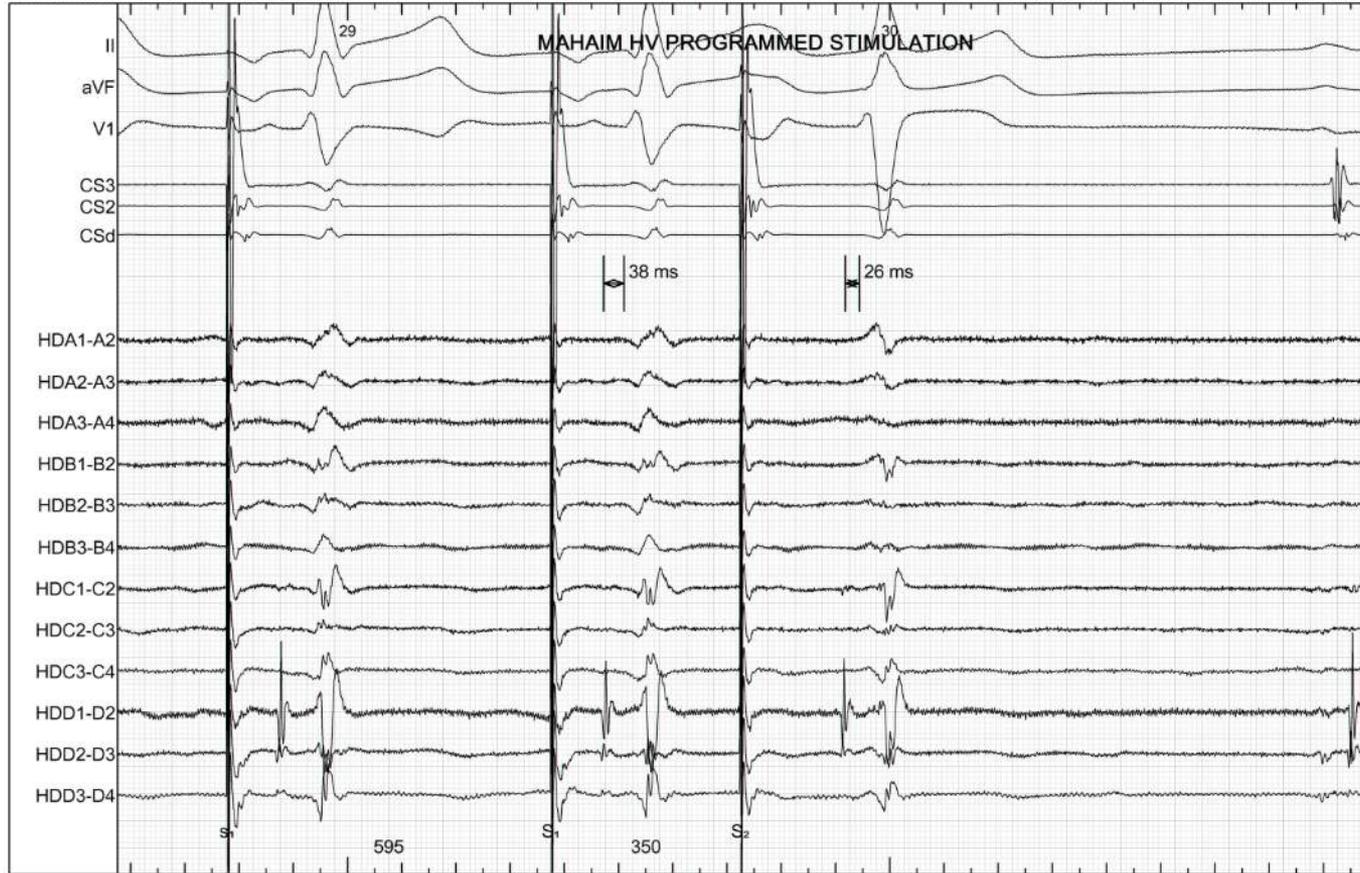
- **Atypical pathways**

- Previous ablation failures



Atypical pathways - Mahaim





Page: HD Grid Speed: 100 mm/s 1 mm = 10 msec Current Event: Paced single Procedure: Ablation Date of Procedure: June 23 2022

Current Event Info: Time = 09:32:40. ggg

Stim1 = CD4 E:-4 E+:3; Stim2 = Off; Stim3 = Off; Stim4 = Off;PCL* = 600, PCL* = 595, PCL* = 600, PCL* = 595, PCL* = 600, PCL* = 600, PCL = 595, S₁S₂ = 350, Stimuli = S₂; Site = CD4;

Right Atriofascicular Accessory Pathways

“Mahaim Fibers”

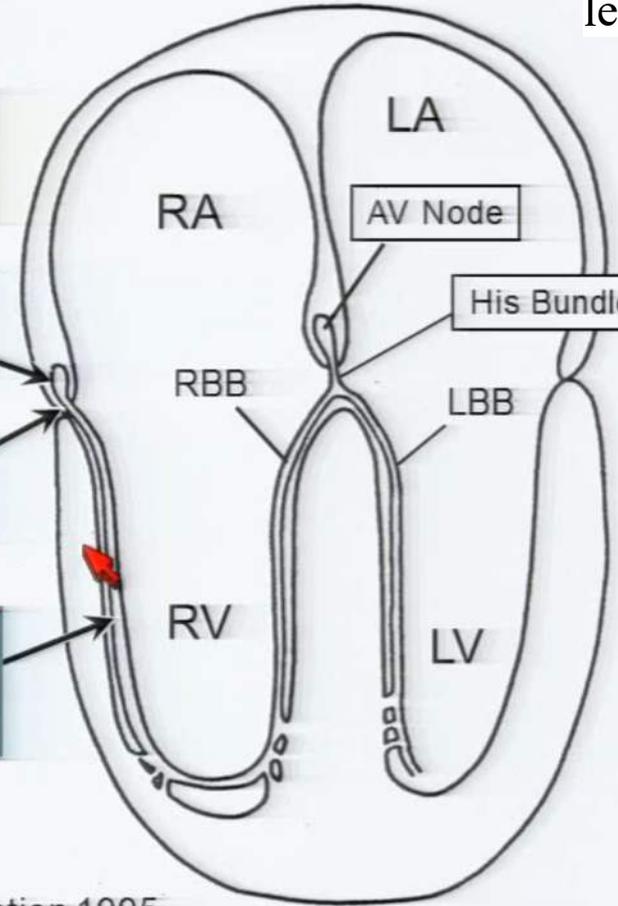
lente, calcio-dipendenti

Duplication of Normal AV Conduction System

Accessory AV Node

Accessory His Bundle

Accessory Right Bundle Branch



Mapping A-F pathways with HD grid



- Oblique pathways

- Anteroseptal pathways

- Posteroseptal pathways

- Atypical pathways

- Previous ablation failures





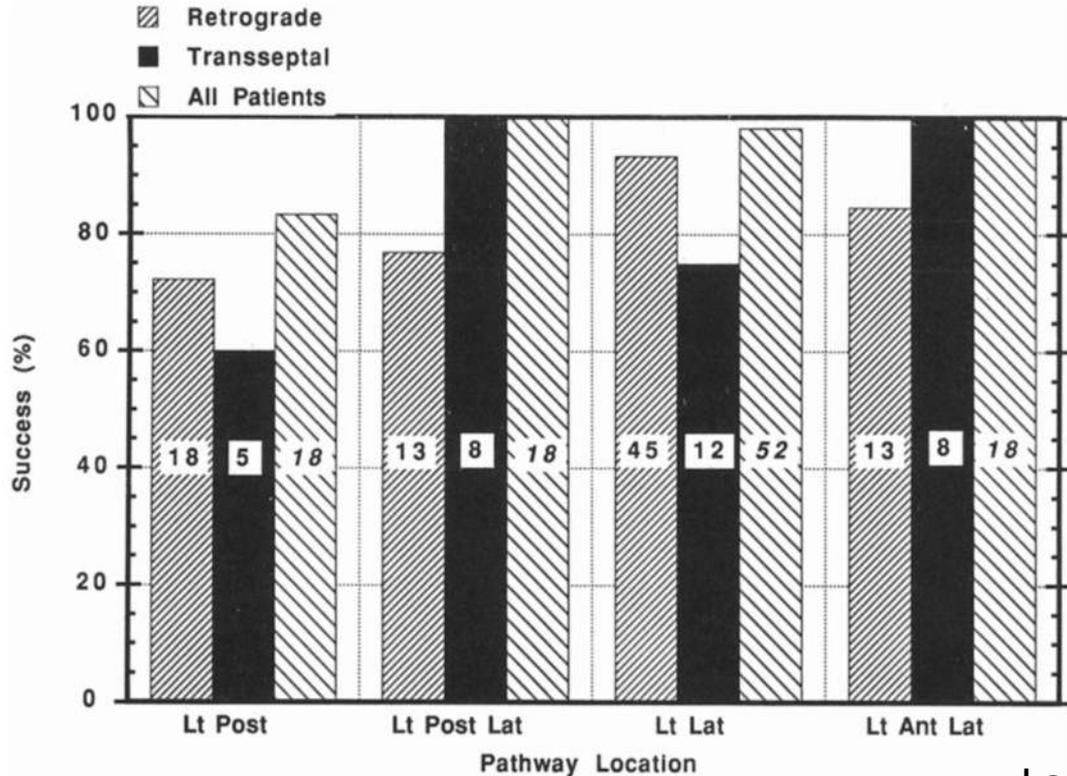
Do the opposite of your predecessor

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You can

- Change approach
 - Change introducer or ablator
 - Change mapping technique
 - Change energy (cryo/RF)
- 

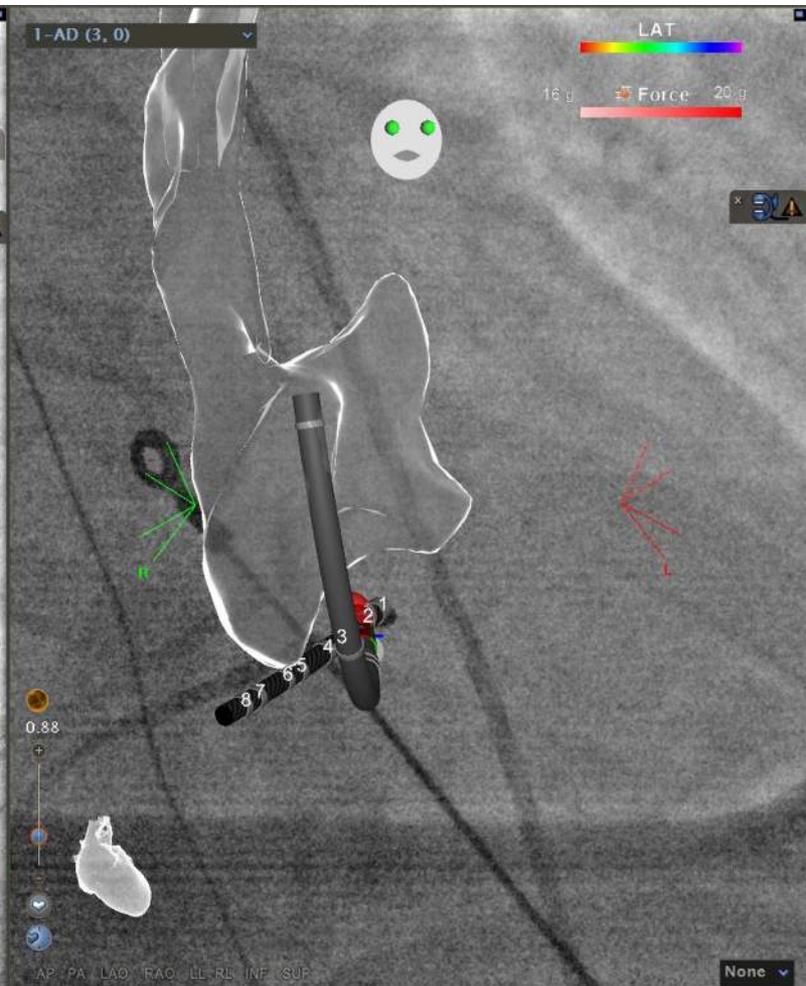
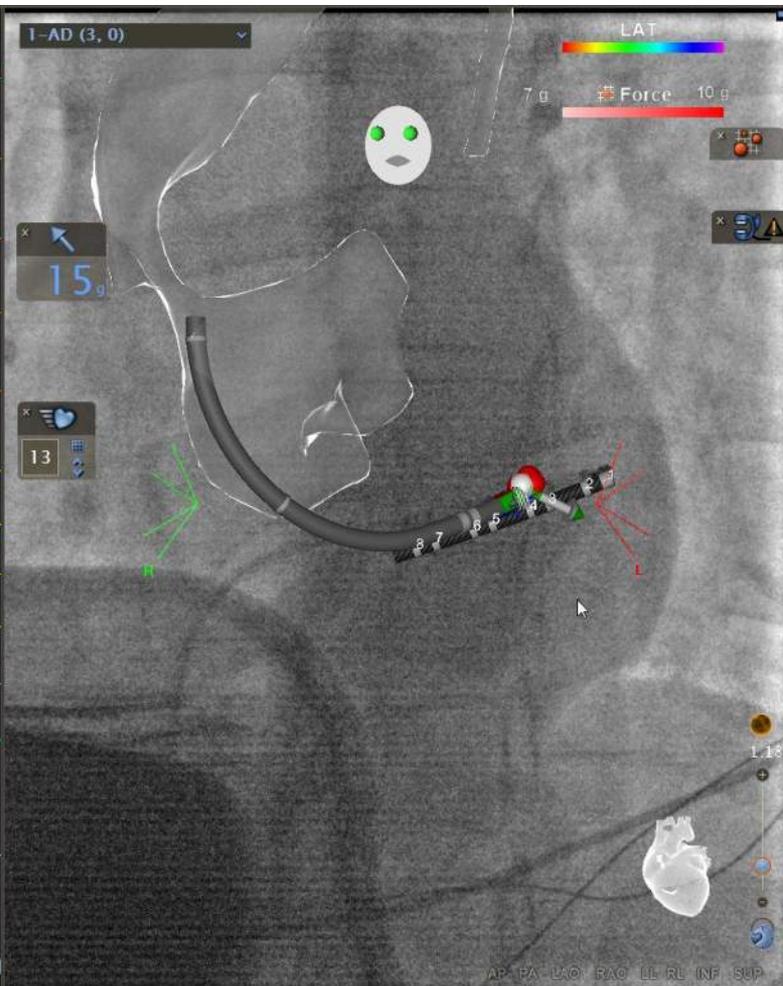
Comparison of the Retrograde and Transseptal Methods for Ablation of Left Free Wall Accessory Pathways



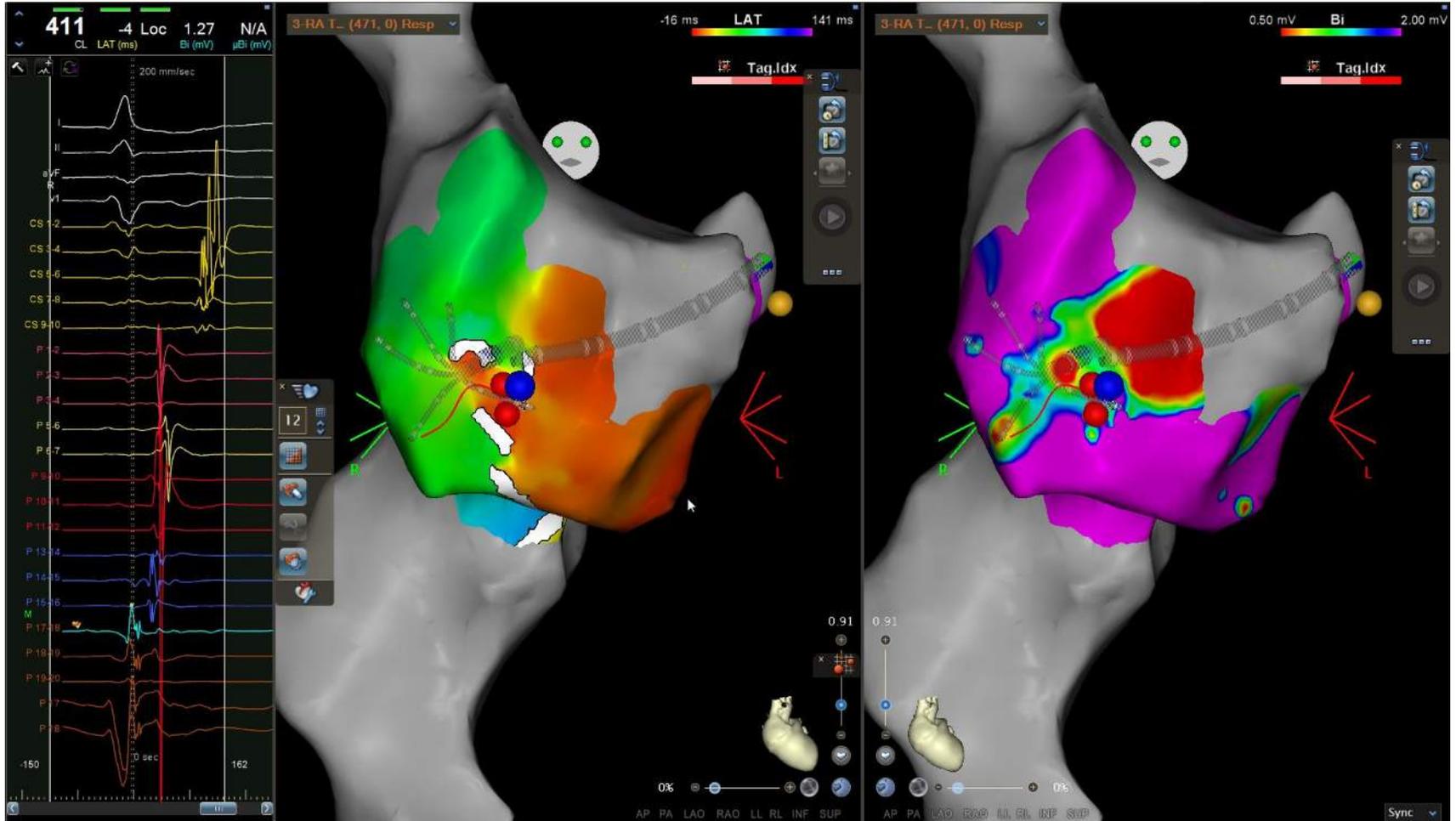
To avoid complications related to access, the transseptal method should be the first used in:

- children,
- the elderly and
- those with arterial disease or hypertrophic ventricles.

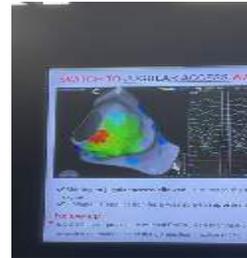
Change approach (transseptal → transaortic)



Change approach (transfemoral → transjugular)

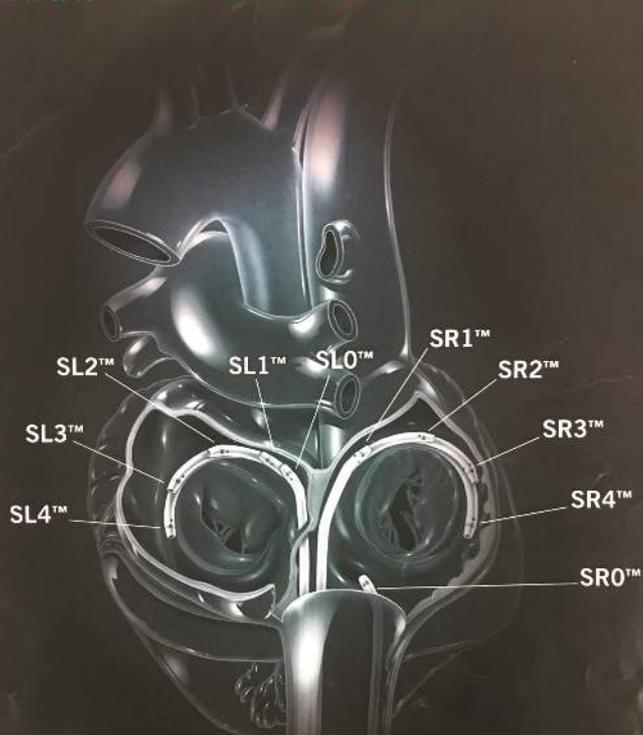


Change approach (transfemoral → transjugular)



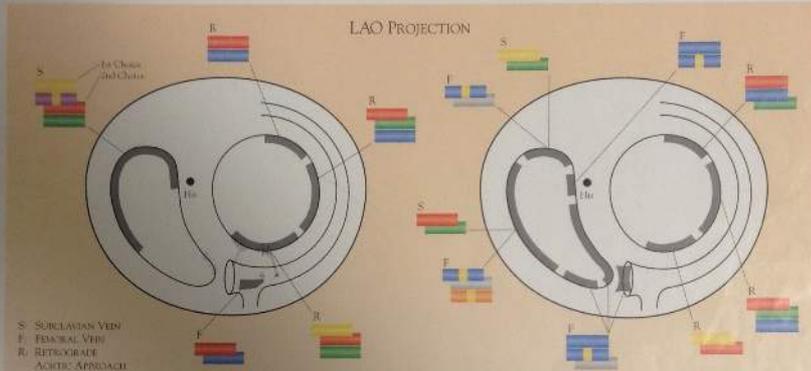
Change introducer or ablator

SWARTZ™ INTRODUCER CURVE REFERENCE



CATHETER SELECTION FOR MAPPING ACCESSORY PATHWAY ACTIVATION

COLOR	CURVE TYPE	CATALOG NUMBER
Yellow	2.5"	D0-ALG03-252-PS
Red	2"	D0-BL03-252-PS
Green	2.5 5/8"	D0-CL03-252-PS
Blue	2.5"	D0-EL03-252-PS
Brown	2.5 5/8"	D0-FL03-252-PS
Orange	2 1/2"	D0-HL03-252-PS
Purple	2 1/2"	D0-JL03-252-PS
8 Ft.		
Green	BRANDED Tip	D8B-CL03-252-PS
Blue		D8B-EL03-252-PS
Orange		D8B-FL03-252-PS



Catheter selection can be based on the impedance of a catheter. Catheter using Wharton catheter in right atrial mapping procedure. Individual impedance may vary.



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- Oblique pathways
Take advantage and obtain the longest AV/VA to unmask AP
- Anteroseptal pathways
Avoid AV block with different approaches
- Posteroseptal pathways
Think about epicardial AP – CS anatomy
- Atypical pathways
Mahaim fibers – advanced mapping (multielectrode, open window)
- Previous ablation failures
Do the opposite of your predecessor

Ciao Ezio



06/07/1957

09/04/2024

Box 27-1 Causes of Failed Catheter Ablation of Accessory Pathways

- *Inability to Heat*
Catheter instability, poor tissue contact, difficult access to target site
Pathway location beyond range of RF lesion size (e.g., epicardial location)
- *Misdiagnosis*
Misinterpretation of electrophysiologic data
Previous ablation, low amplitude, or distorted electrogram recordings
Incomplete electrophysiology study, inaccurate pathway localization, incomplete mapping
Multiple tachycardia mechanisms (e.g., AP with AVNRT or ectopic tachycardia, pathway-to-pathway tachycardia)
- *Associated Structural Cardiac Abnormalities*
Ebstein anomaly
Persistent left-sided superior vena cava
- *Atypical Pathway Configuration*
Multiple APs
Oblique APs
Epicardial APs
Atypical AP connections
- *High-Risk AP Location*
Adjacent to the AV node: midseptal or anteroseptal pathway (risk of inadvertent AV block)
Epicardial APs: Accessible within the coronary sinus or associated with diverticulum (risk of arterial stenosis–circumflex artery or distal right coronary branches)

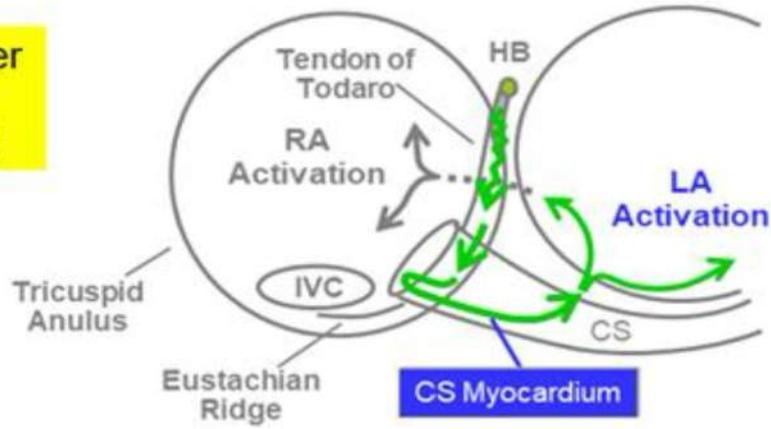
AP, Accessory pathway; AV, atrioventricular; AVNRT, atrioventricular nodal reentrant tachycardia; RF, radiofrequency energy.

A: anatomy
B: biophysics
C: cognitive

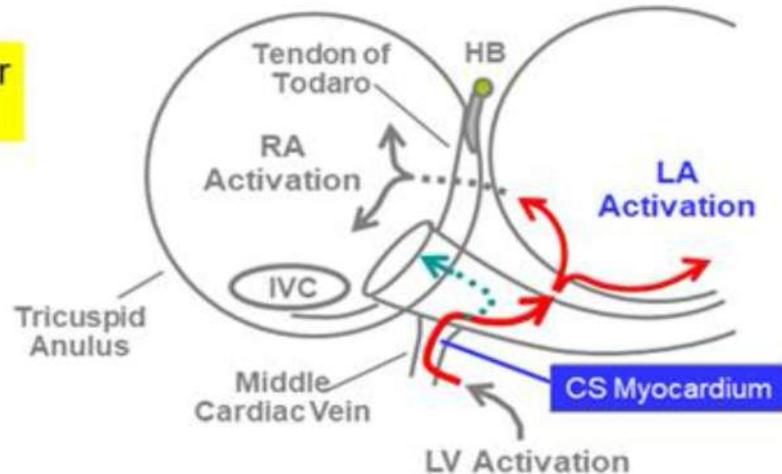
ISSA, MILLER, ZIPES. CLINICAL ARRHYTHMOLOGY AND ELECTROPHYSIOLOGY: A COMPANION TO BRAUNWALD'S HEART DISEASE, THIRD EDITION

The posteroseptal area as the site of earliest atrial activation

Retrograde Conduction over Slow Pathway:
(Right Inferior Extension)



Retrograde Conduction over an Epicardial PS-AP

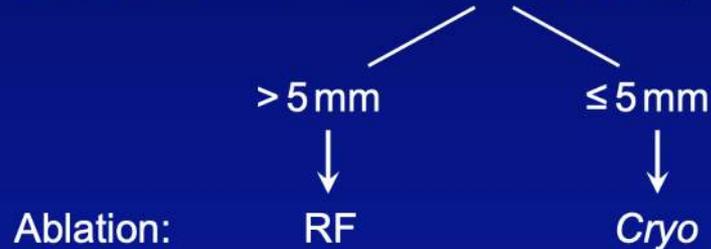


Epicardial Posteroseptal AP (CS-LV Connection)

Workflow

1. CS Angiogram (Balloon Occlusion)
2. Complete Map of CS Floor (*All Venous Branches*)
3. Position Ablation Electrode at *Ideal Ablation Site* (*Sharpest Uni 1 CSE*)
4. Coronary Arteriography (Right \pm Left Coronary Arteriogram)

Distance: *Ablation Electrode* – Closest Significant Coronary Artery



Warren Jackman's Art of War:
A Sniper's Approach to Catheter Ablation