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PEDIRHYTHM VII

Ablation in Children: Is there still something to say? STRATEGY TO OVERCOME ABLATION FAILURE IN CHILDREN

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NO CONFLICT OF INTEREST

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SCORE: 0

NON FINANCIAL INTERESTS

STRATEGY TO OVERCOME ABLATION FAILURE IN CHILDREN

1. Don't perform the ablation saying that there is no specific indication
2. Leave it to another operator saying that your wife needs you at home
3. Don’t go to the hospital on ablation days presuming that your car suddenly broke down ….
4. Leave the ablation catheter to another colleague because of a terrible stomach ache
5. Or…..do like me…
   call a better interventional electrophysiologist than you!

STRATEGY TO OVERCOME ABLATION FAILURE IN CHILDREN

NOW SERIOUSLY….

in any case, for general suggestions:

BEFORE THE PROCEDURE:

1. if you assume from ECG analysis that it is a difficult procedure or at risk due to the size of the patient, postpone the elective procedure to a more appropriate patient's age

DURING THE PROCEDURE

1. Re-evaluate the electrophysiologic diagnosis

2. Use more diagnostic catheters

3. If you are tired, change operator and re-examine the procedure from outside

MOST FREQUENT ABLATION SUBSTRATES IN CHILDREN

- AVNRT
- ACCESSORY PATHWAYS
- ECTOPIC ATRIAL TACHYCARDIA

MOST FREQUENT ABLATION SUBSTRATES IN CHILDREN

- AVNRT
- ACCESSORY PATHWAYS

  ECTOPIC ATRIAL TACHYCARDIA

HOW TO OVERCOME ABLATION FAILURE IN AVNRT WITH RF

No JR during RF application and failure?

1. Re-evaluate diagnosis
2. Improve your catheter contact using a long sheath
3. Try in CS ostium or more inside
4. Evaluate a left sided approach (especially for “slow-slow”)
5. Try a higher approach (please, use Cryo!)

RF vs CRYO
AVNRT ABLATION IN CHILDREN

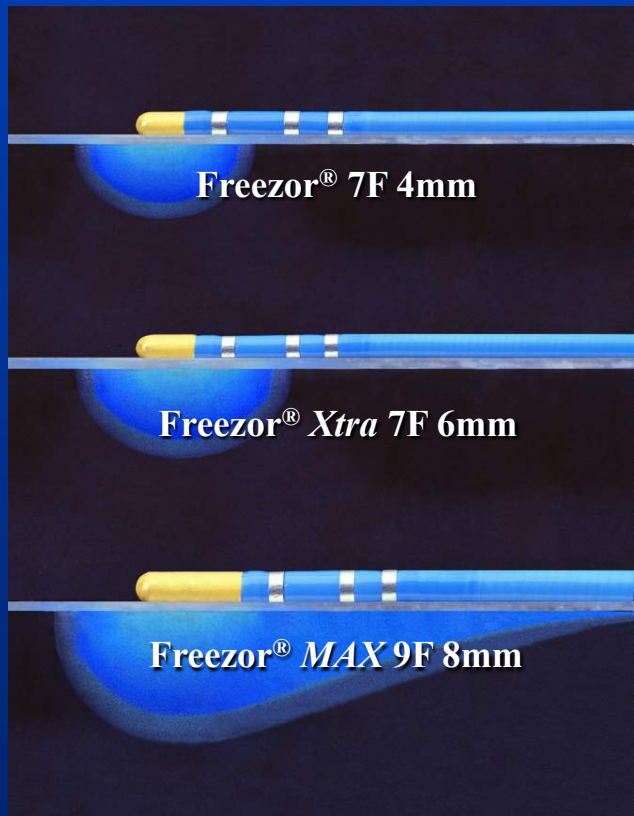
ENERGY	ACUTE SUCCESS RATE	RECURRENCE RATE	TOTAL SUCCESS RATE	IATROGENIC cAVB
RF Pediatric Radiofrequency Ablation Registry 2003 PEDIATRIC ELECTROPHYSIOLOGY SOCIETY	**99%**	**4.9%**	**94.1%**	**2%**
CRYO PAPERS 2006 - 2016	**97%**	**13.7%**	**83.3%**	**0%**

HOW TO OVERCOME ABLATION FAILURE IN AVNRT WITH CRYO

1) Use a longer cryoapplication (8 mins)

2) Use cryobonus to consolidate the cryolesion

3) Use a larger tip



HOW TO OVERCOME ABLATION FAILURE IN AVNRT WITH CRYO

1) Use a longer cryoapplication

2) Use cryobonus to consolidate the cryolesion

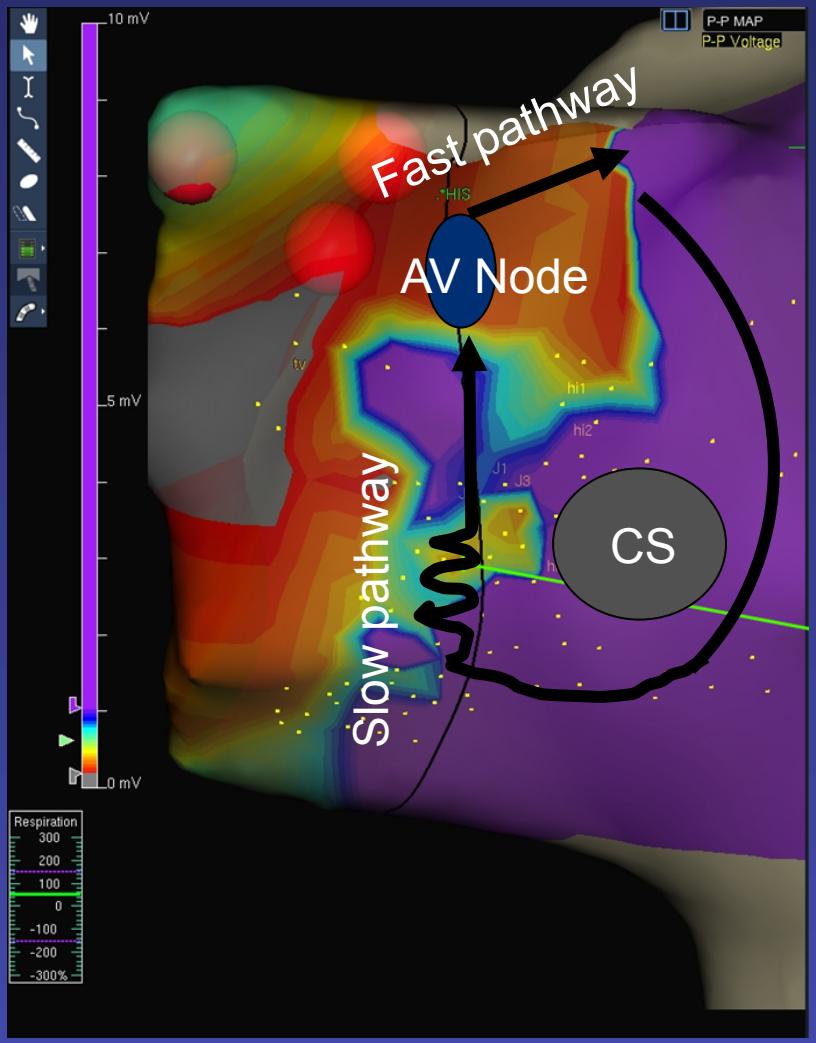
3) Use a larger tip

4) Use the voltage gradient mapping and electrophysiology-guided cryoablation!

LOW VOLTAGE BRIDGES

Bailin SJ, EUROPACE 2011
Malloy L, Pediatr Cardiol 2014

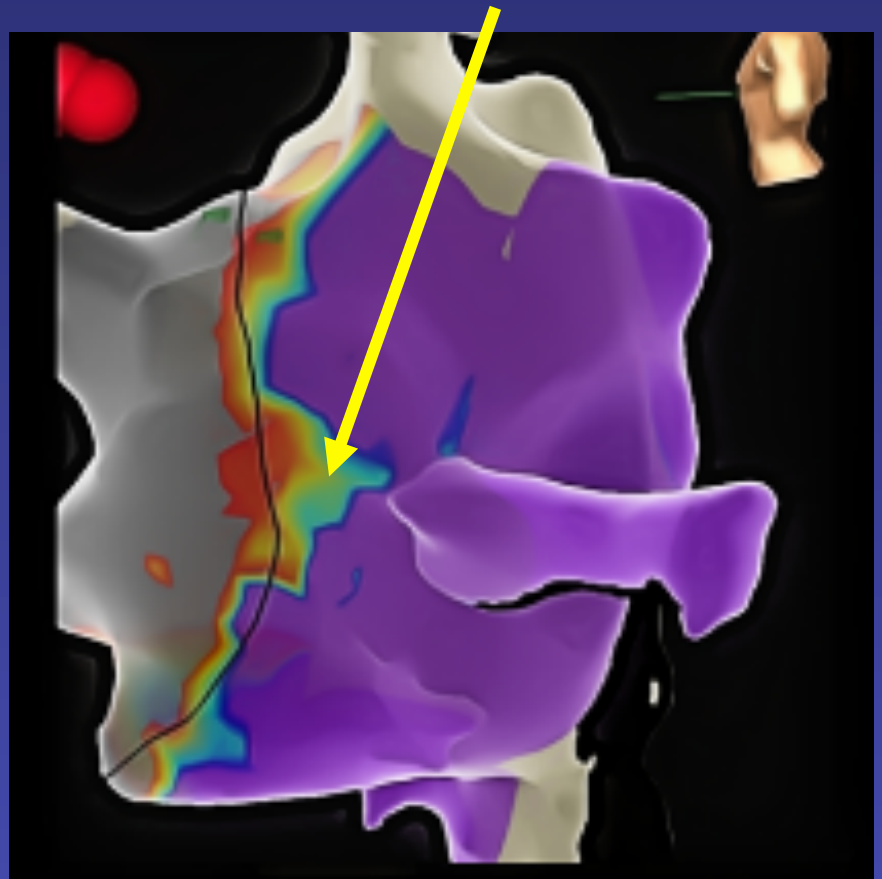
- Very high-density voltage 3D map is created for the atrial septum within Koch's triangle.
- The voltage color bar is individually adjusted for each patient in order to highlight a low-voltage bridge, if present, starting from a voltage range of 0.1-2 mV.
- Both high-voltage and low-voltage values are modified until a voltage bridge is evident. This adjustment is necessary because of voltage variability in each patient.



TYPE OF LOW-VOLTAGE BRIDGE

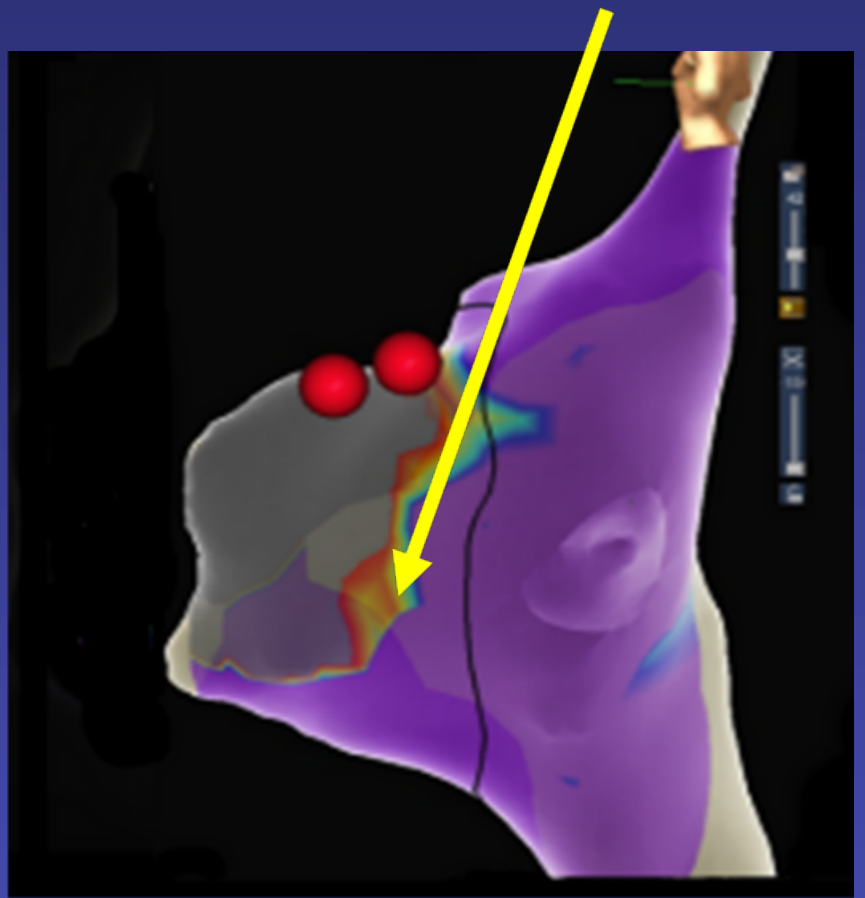
TYPE I

A clear, rather large area of low voltage within Koch's triangle between the coronary sinus ostium and the AV node



TYPE II

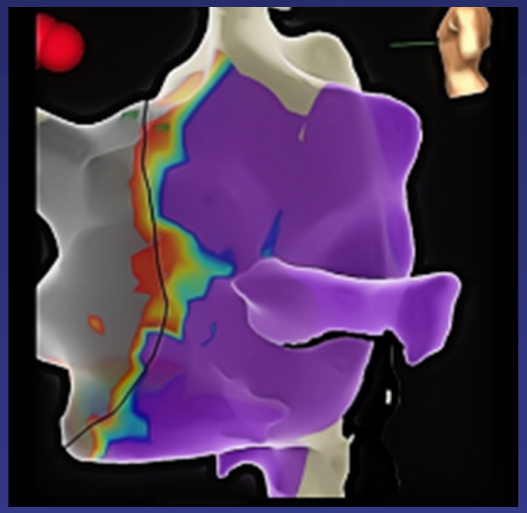
Narrow corridor made of low-voltage points between adjacent normal-voltage regions

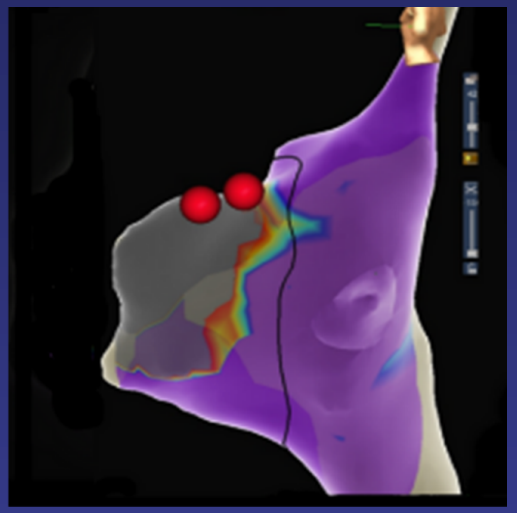


LOW VOLTAGE BRIDGE AND ELECTROPHYSIOLOGICALLY GUIDED 3D CRYOABLATION IN CHILDREN WITH AVNRT

Drago F, EUROPACE 2017 (in press)

- 35 children (mean age 12.1±4.5 years) with AVNRT

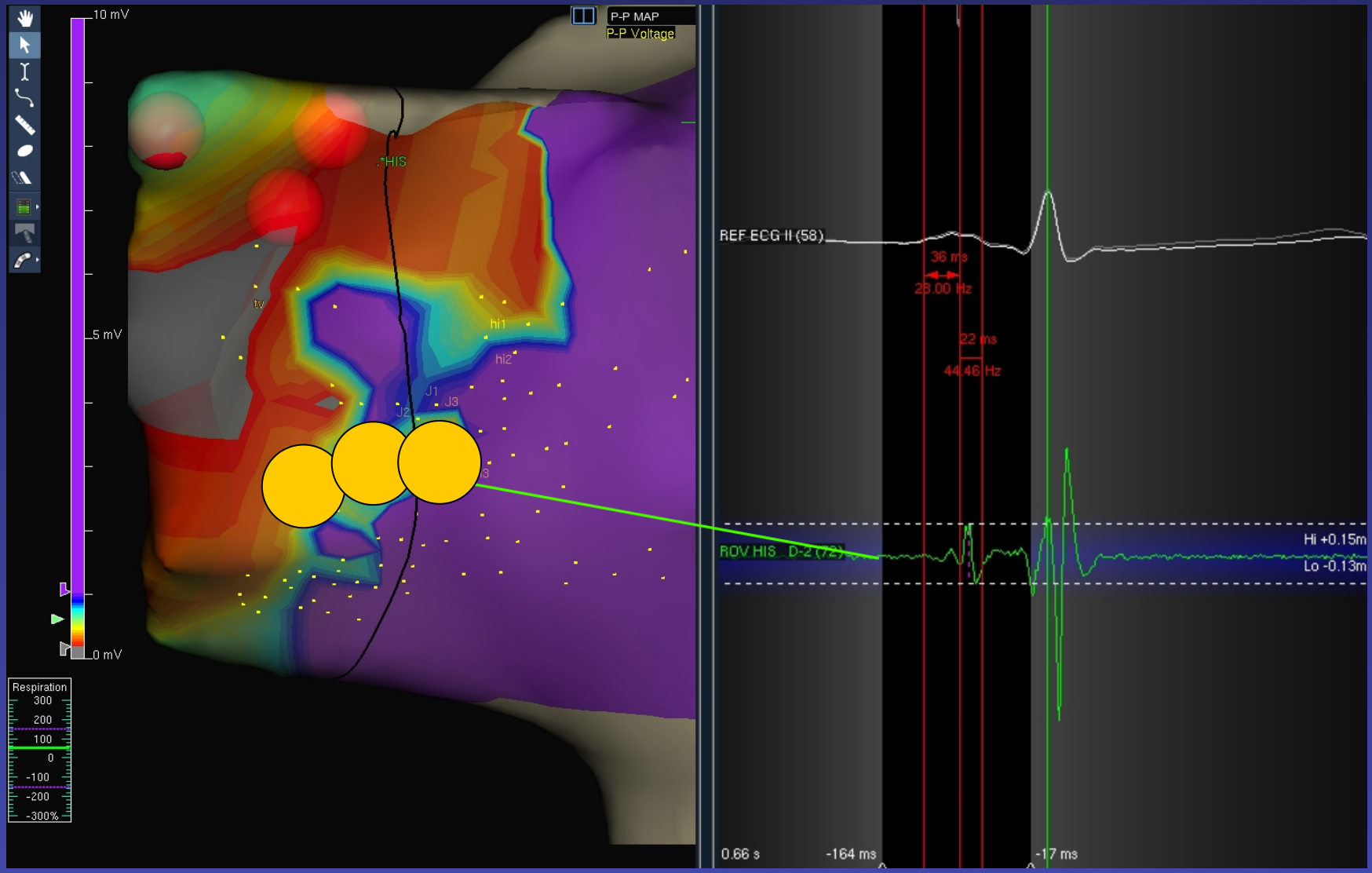




- 19 children without AVNRT (control group)

LOW VOLTAGE BRIDGE AND ELECTROPHYSIOLOGICALLY GUIDED 3D CRYOABLATION IN CHILDREN WITH AVNRT

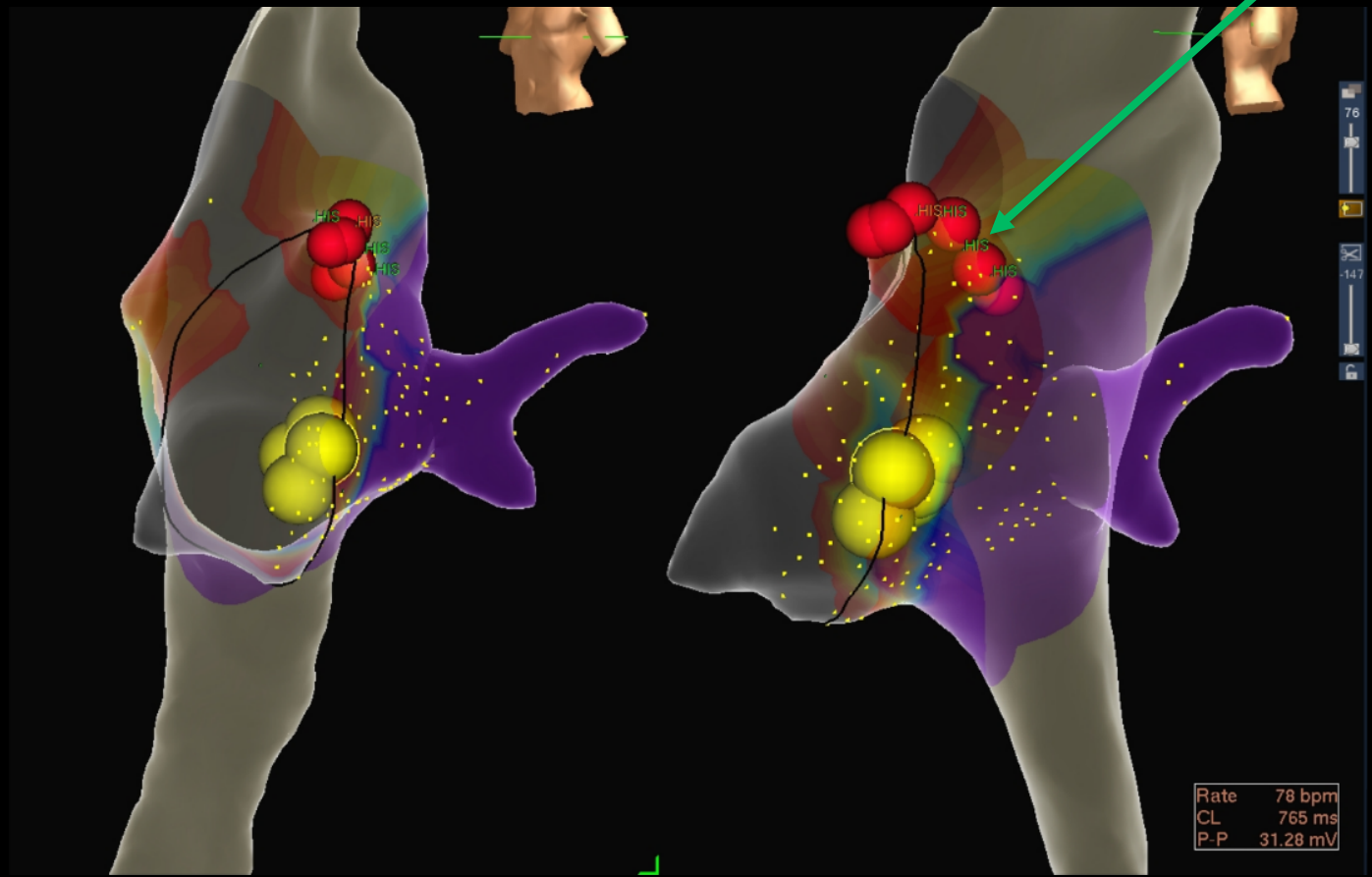
Drago F, EUROPACE 2017 (in press)



TYPE OF CRYOLESIONS

FOCAL LESION

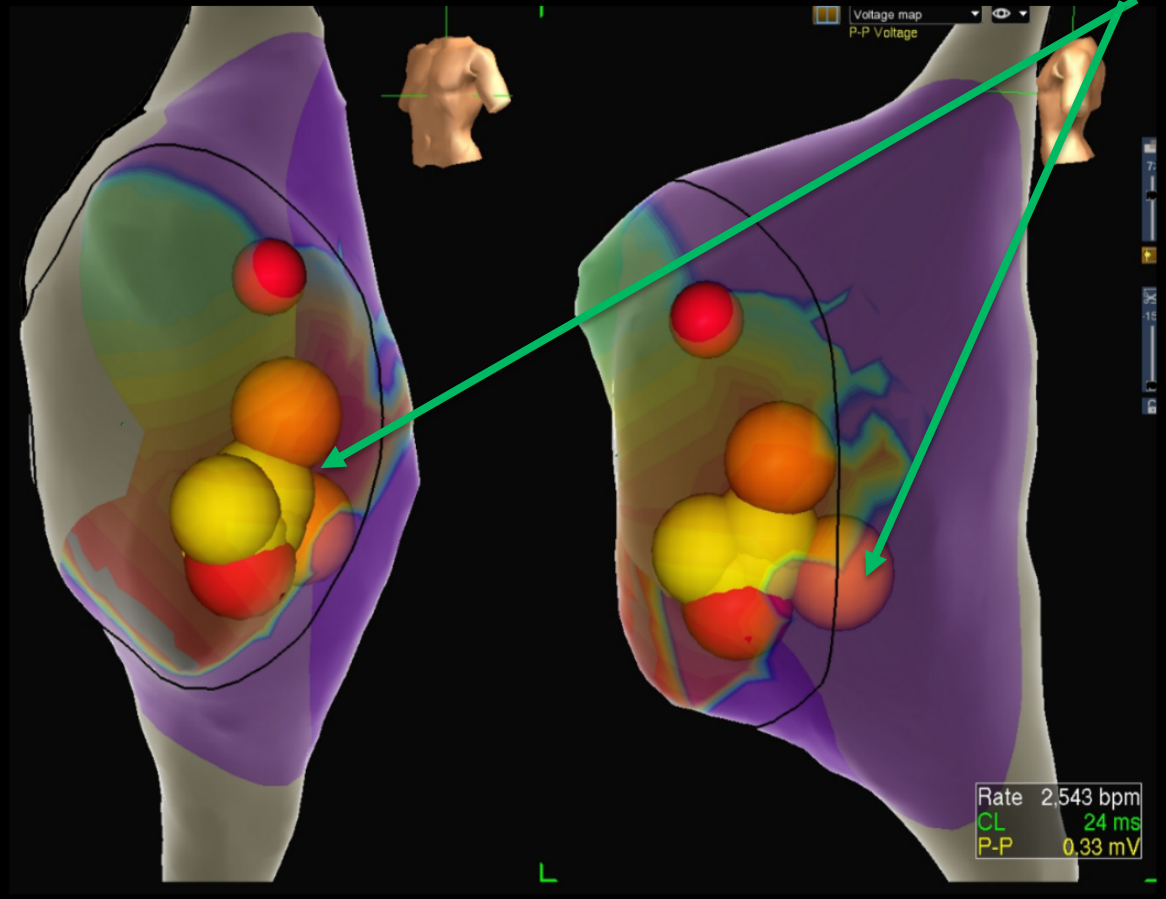
SINGLE LESION → CRYOBONUS
one or more cryoenergy application → IN THE SAME SPOT
consolidate and slightly enlarge the successful cryolesion



TYPE OF CRYOLESIONS

EXTENDED FOCAL LESION

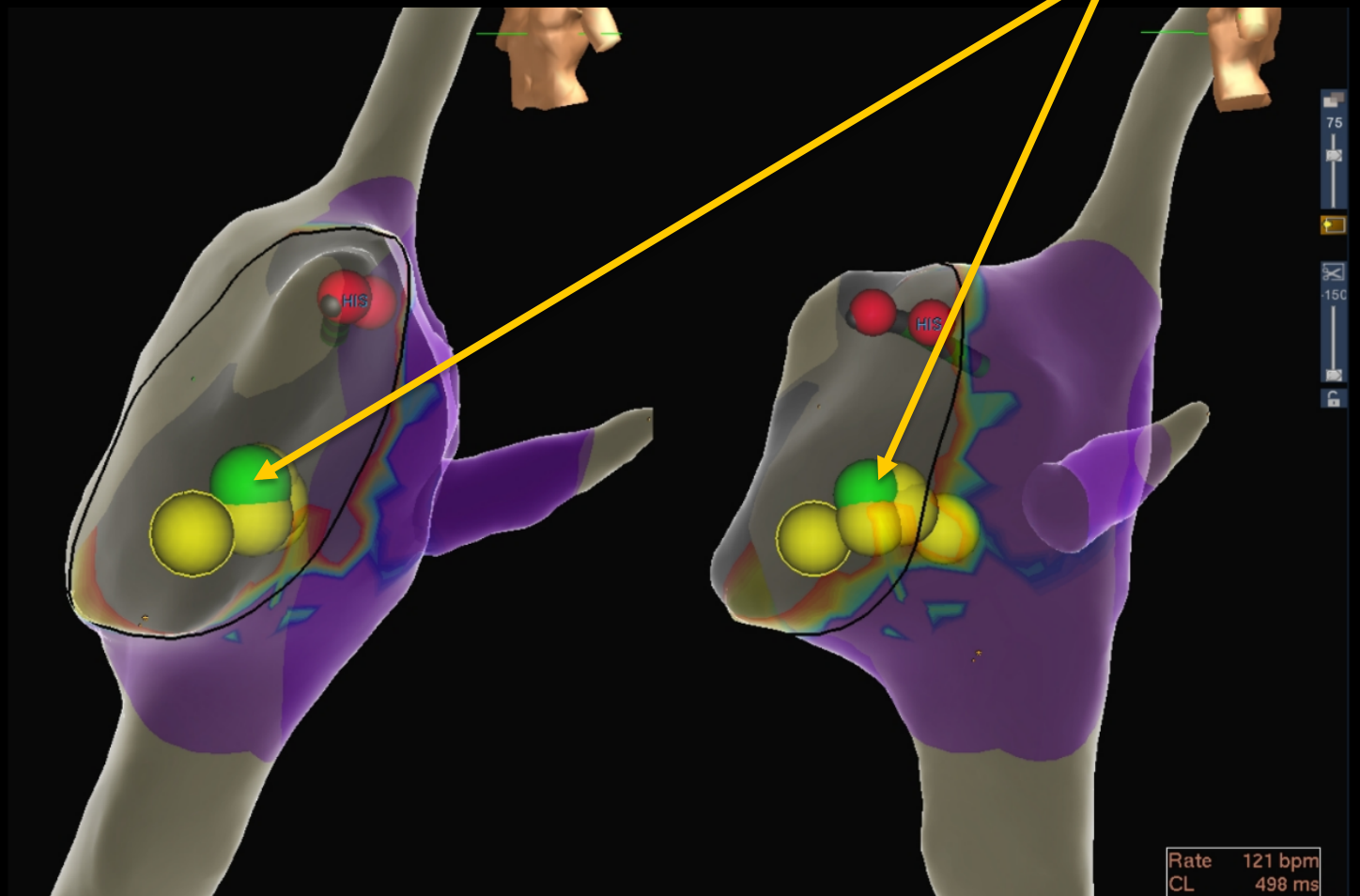
SINGLE LESION → CRYOBONUS one or more cryoenergy application → SLIGHTLY ANTERIORLY AND POSTERIORLY to the first successful or apparently successful lesion



TYPE OF CRYOLESIONS

HDLL

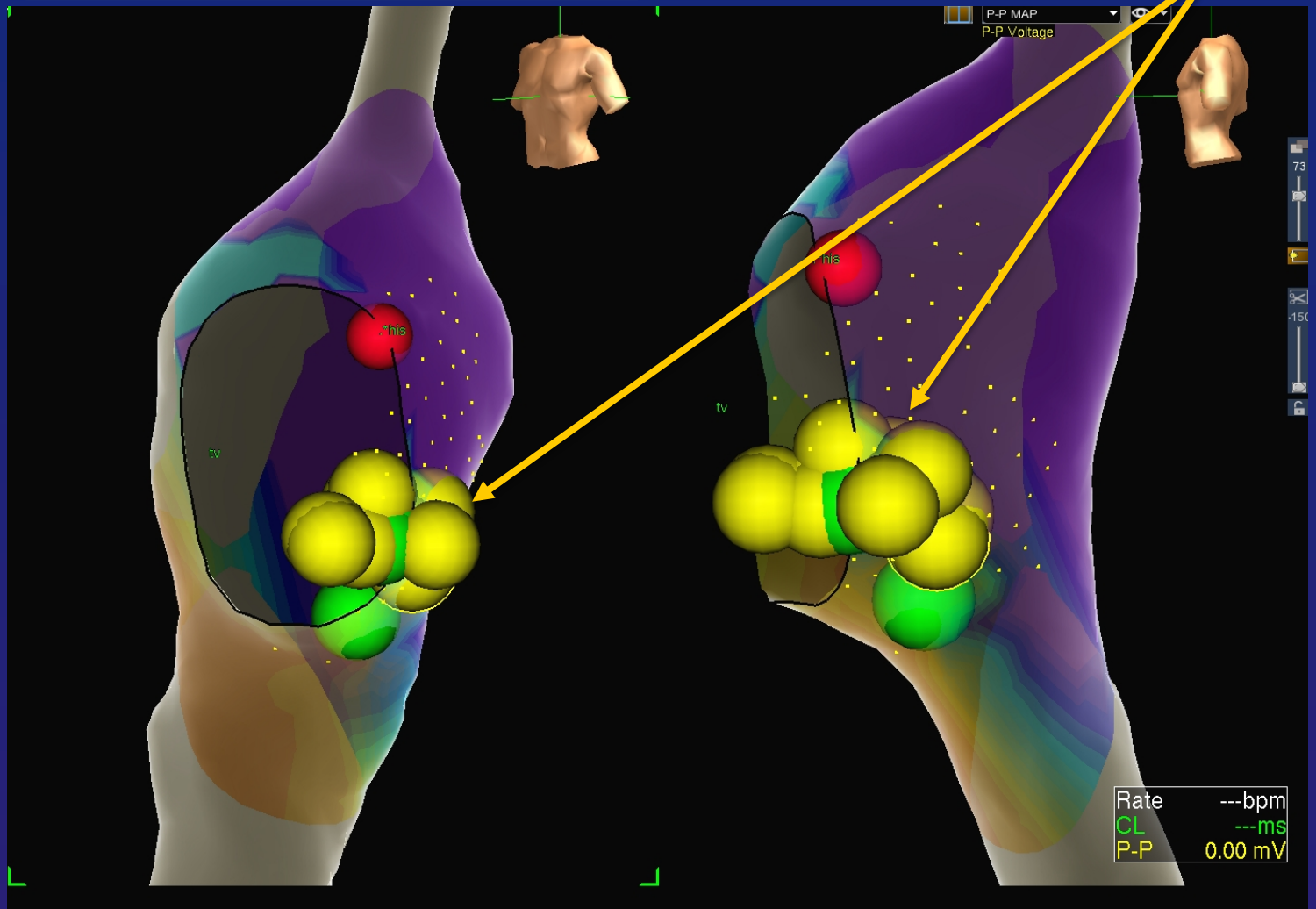
multiple overlapping cryolesions → from the ventricular to the atrial side of the tricuspid annulus → final cryolesion at least 10 mm long With 3D spheres/lesions overlapping of at least half of their diameter or at least 2 mm



TYPE OF CRYOLESIONS
EXTENDED HDLL

Extending the multiple overlapping cryolesions of HDLL

anteriorly and posteriorly



The Need for a Lengthier Cryolesion Can Predict a Worse Outcome in 3D Cryoablation of AV Nodal Slow Pathway in Children

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ROMOLO REMOLI, M.D.,* VINCENZO PAZZANO, M.D.,*
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Background: *Transcatheter cryoablation is a well-established technique for the treatment of atrioventricular nodal reentry tachycardia (AVNRT) in children. Nevertheless, atrioventricular nodal slow-pathway conduction may recur after an acutely successful procedure. The aim of this study was to evaluate the long-term outcome of acutely successful AVNRT cryoablations in pediatric patients in case of focal cryolesion and in case of need for High-Density Linear Lesion (HDLL) cryoablation due to focal failure.*

Methods: *Sixty-nine consecutive pediatric patients (30 males, mean age 12.4 ± 3.2 years; range: 5.4–18.0 years) underwent 3D-guided cryoablation for AVNRT at our institution from July 2013 to November 2014. When a focal cryoablation was acutely unsuccessful, a 3D-guided HDLL was created delivering multiple overlapping cryolesions/cryoenergy applications from the ventricular side of the tricuspid annulus to the atrial side, including the site of focal cryoablation if transiently successful.*

Results: *No permanent cryoablation-related complications occurred. Acute success rate was 98.5% (68 out of 69): in 55.9% (38 out of 68) with focal-lesion and in 44.1% (30 out of 68) with HDLL. Mean follow-up was 25.3 months and AVNRT recurrence rate was 13.2% (nine out of 68): 5.2% (two out of 38) with focal lesion and 23.3% (seven out of 30) with HDLL ($P = 0.036$).*

Conclusions: *In cryoablation of AVNRT in children, the need for a more aggressive protocol (HDLL), due to the failure of focal ablation, is strictly related to higher recurrence rates. Indeed, AVNRT recurrences after cryoablation in children seem to be due to a larger and deeper substrate rather than due to the type of energy used. (PACE 2016; 39:1198–1205)*

transcatheter cryoablation, atrioventricular nodal reentry tachycardia, children

LOW VOLTAGE BRIDGE AND ELECTROPHYSIOLOGICALLY GUIDED 3D CRYOABLATION IN CHILDREN WITH AVNRT

Drago F, EUROPACE 2017 (in press)

- The procedural acute success rate was 100%
- During a median follow up of 8.0 ± 3 months (range 3-13 months) no recurrences occurred
- Now the children treated are 68 and acute and mid-term success rate is 100%

TYPE I BRIDGE:
25 patients (71.4%)

TYPE II BRIDGE:
10 patients (28.6%)

2 LOW-VOLTAGE BRIDGES:
1 patient
(both typical and atypical AVNRT)

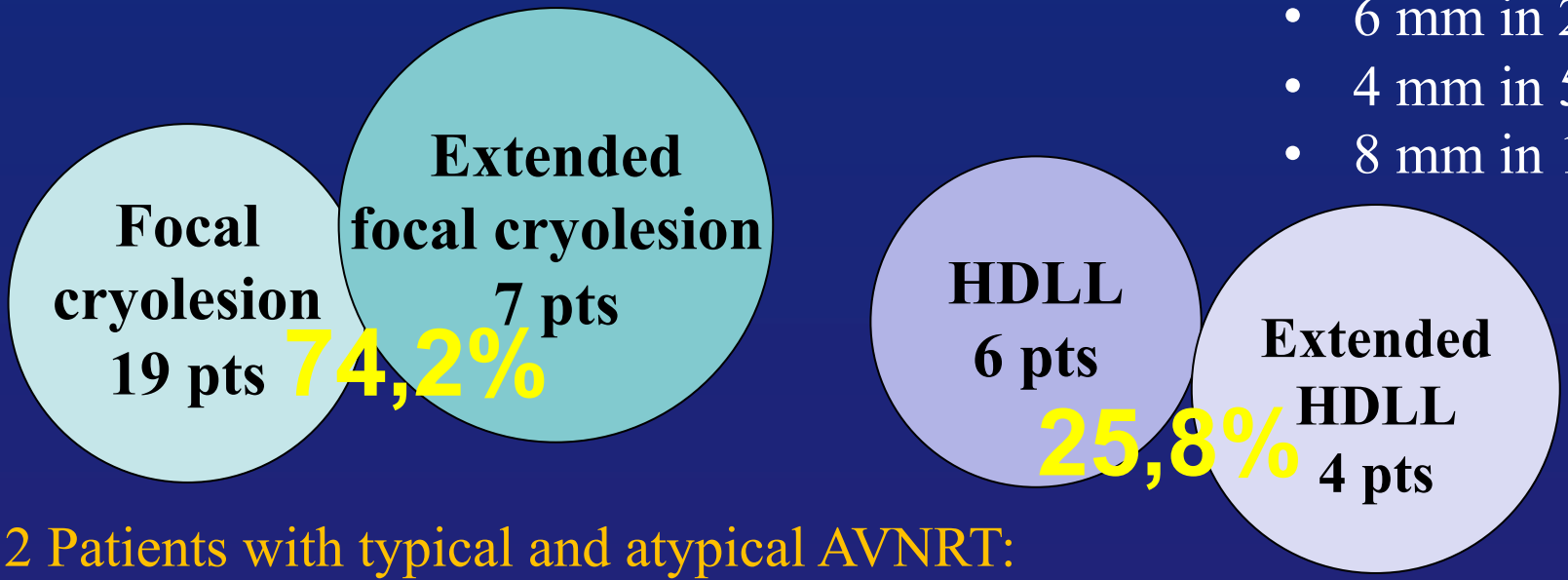
"HUMP AND SPIKE" SIGNAL was observed and detected in all patients:

- 2 in the lower border of the bridge,
- 17 scattered in the low-voltage bridge area,
- 5 localized in the middle part of the bridge
- 1 case the slow pathway signal in the higher portion of the low-voltage area

RESULTS
Cryoablation Details

CRYOCATHETER TIP:

- 6 mm in 29 pts
- 4 mm in 5 pts
- 8 mm in 1 pt



- 2 Patients with typical and atypical AVNRT:

1st pt:

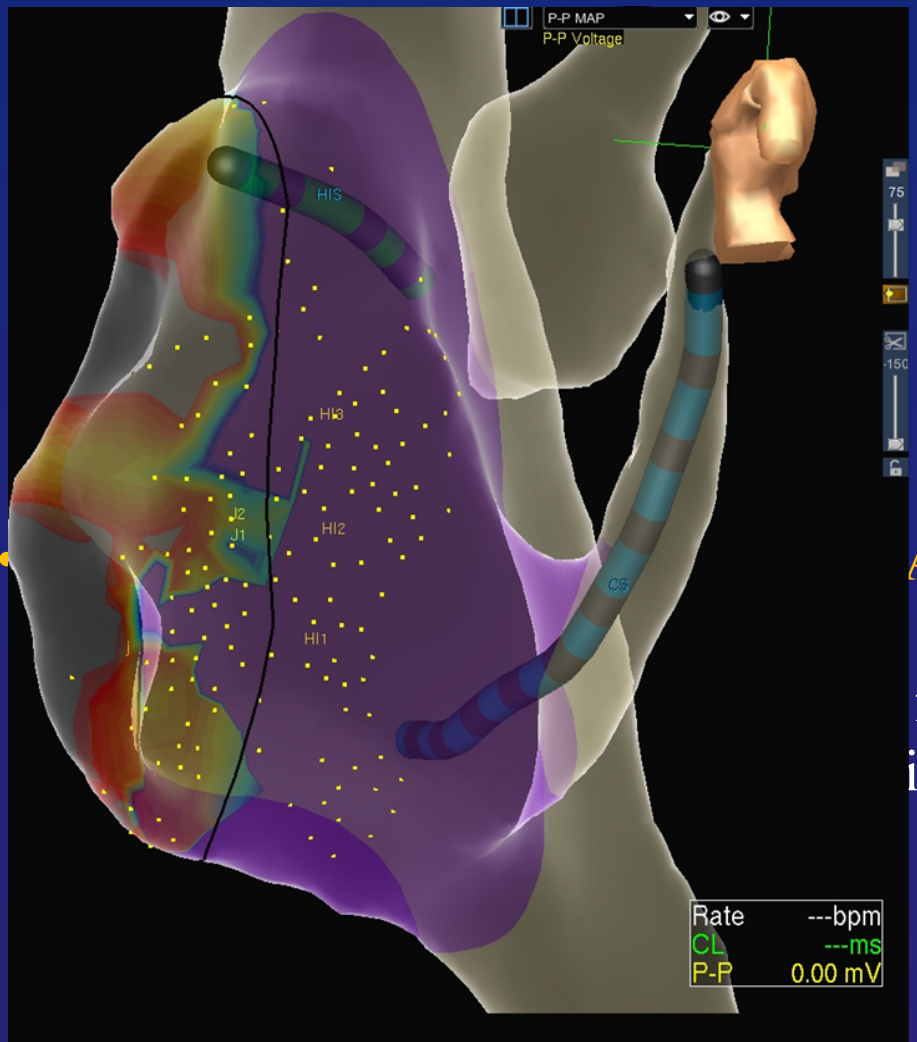
- Focal lesion was performed on a type I low-voltage bridge eliminating both tachycardias

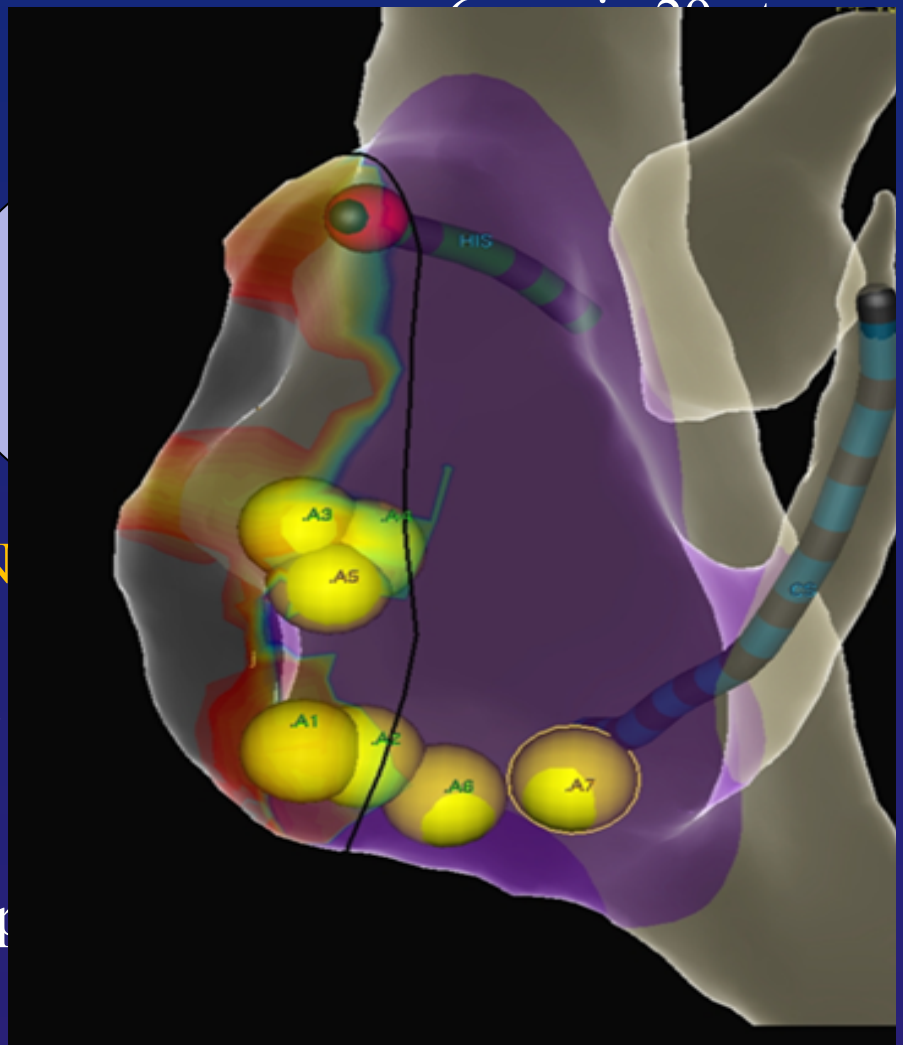
2nd pt: two bridges

- Focal lesion was created on the first bridge
- HDLL was created on the second bridge

RESULTS
Cryoablation Details

CRYOCATHETER TIP:





AVN

first

idge

a typ

TYPICAL ABLATION SUBSTRATES IN CHILDREN

- AVNRT
- ACCESSORY PATHWAYS
- ECTOPIC ATRIAL TACHYCARDIA

SUCCESS RATE OF RFTA

Pediatric Radiofrequency Ablation Registry

PEDIATRIC ELECTROPHYSIOLOGY SOCIETY

(Van Hare, JCE 2004: 2761 pts 0-16 yrs, 1999-2003)

All APs in pts with NH : 93%

↑ ***LL 98%*** ***(p<0.001)***

Other locations: 88%

- Left septal 88%
- Right free wall 90%
- Right septal 89%

REASONS OF FAILURE IN APS ABLATION IN CHILDREN

1) Technical difficulties

2) Misdiagnosis, inaccurate AP localization

3) Coexisting cardiac abnormalities

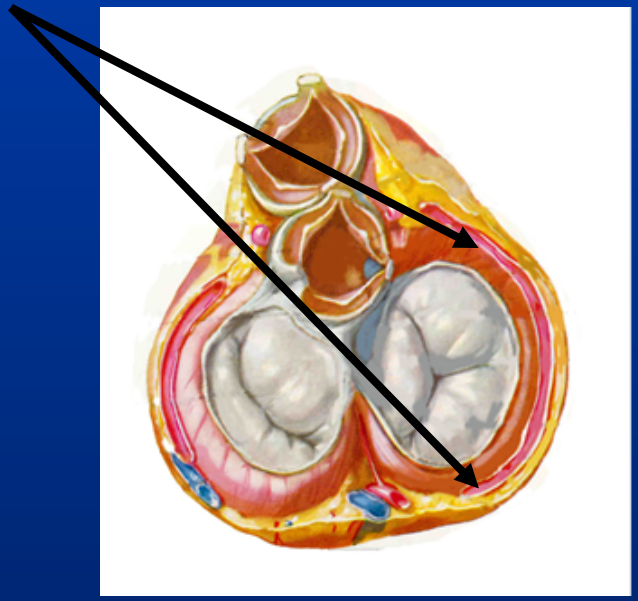
4) High-risk location

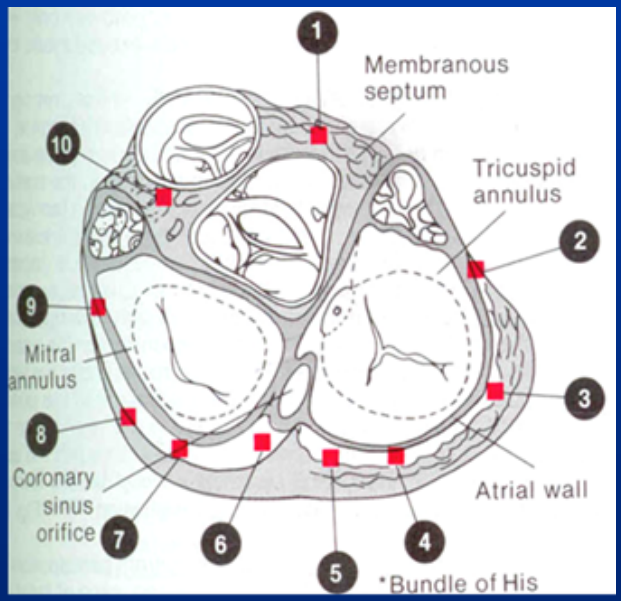
REASONS OF FAILURE IN APS ABLATION IN CHILDREN

1) Technical difficulties

- Catheter instability
- Poor tissue contact

Especially if ablation is performed during tachycardia!!





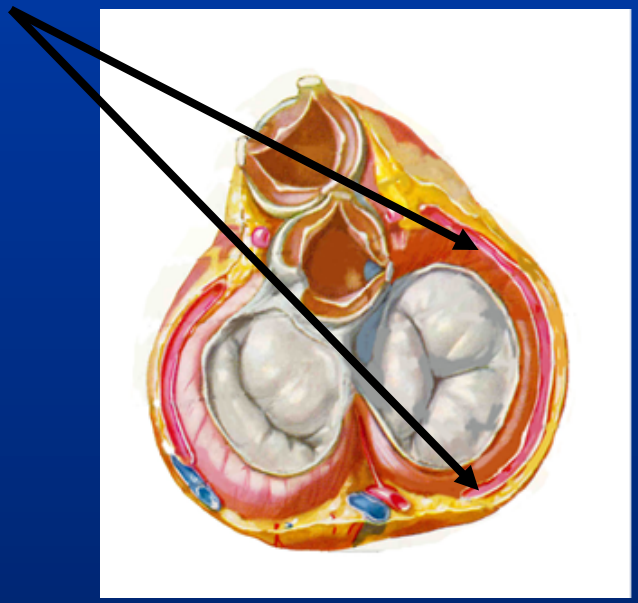
REASONS OF FAILURE IN APS ABLATION IN CHILDREN

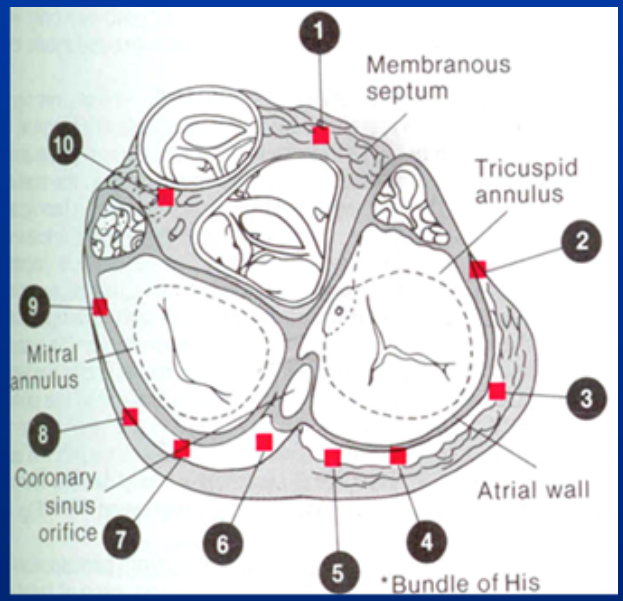
1) Technical difficulties

- Catheter instability
- Poor tissue contact

Especially if ablation is performed during tachycardia!!

Use entrainment during AVRT to prevent dislodgement!!!





REASONS OF FAILURE IN APS ABLATION IN CHILDREN

1) Technical difficulties

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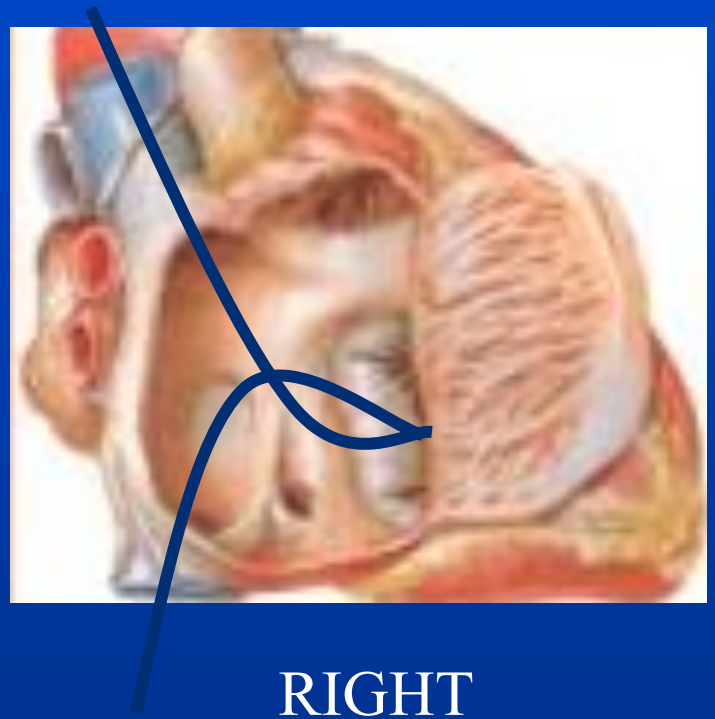
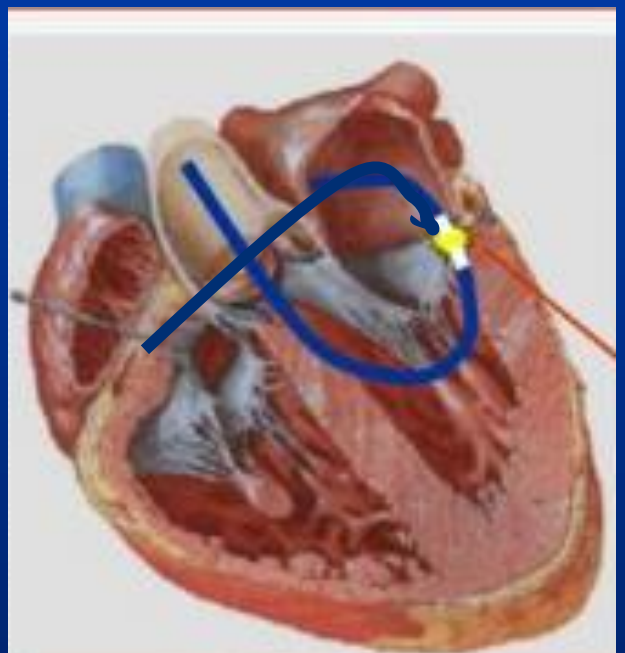
- Poor tissue contact



RIGHT

LEFT

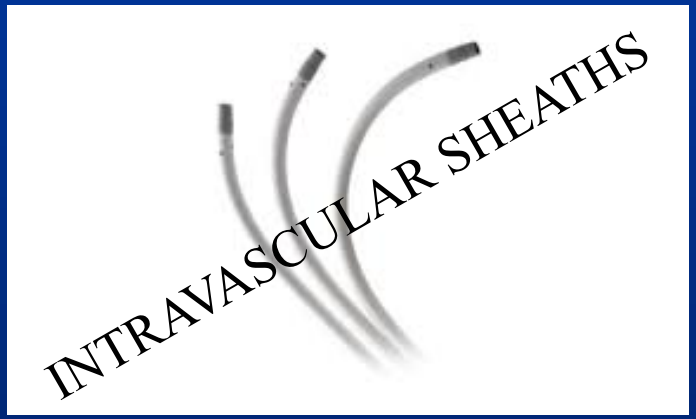


Consider an alternative approach!

REASONS OF FAILURE IN APS ABLATION IN CHILDREN

1) Technical difficulties

- Catheter instability
- Poor tissue contact
- Epicardial location



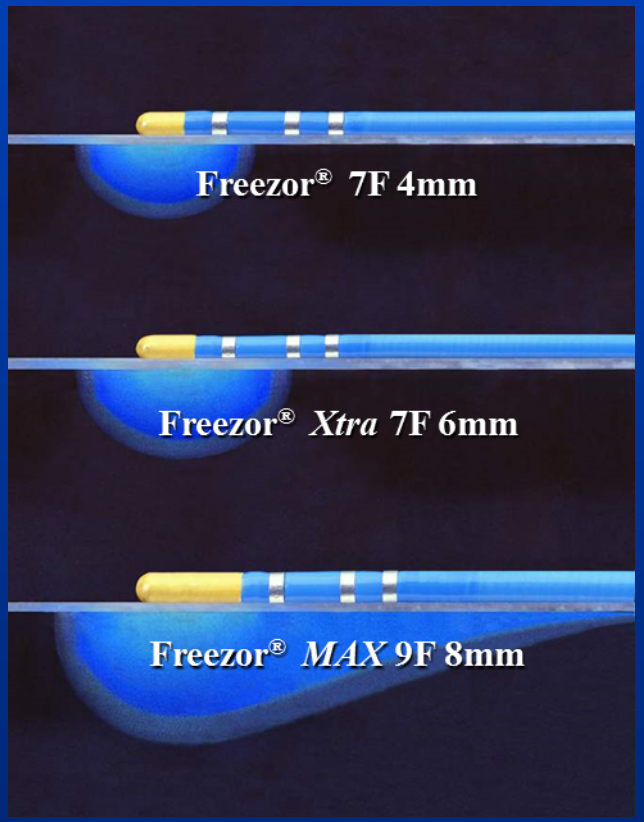
REASONS OF FAILURE IN APS ABLATION IN CHILDREN

1) Technical difficulties

- Catheter instability
- Poor tissue contact

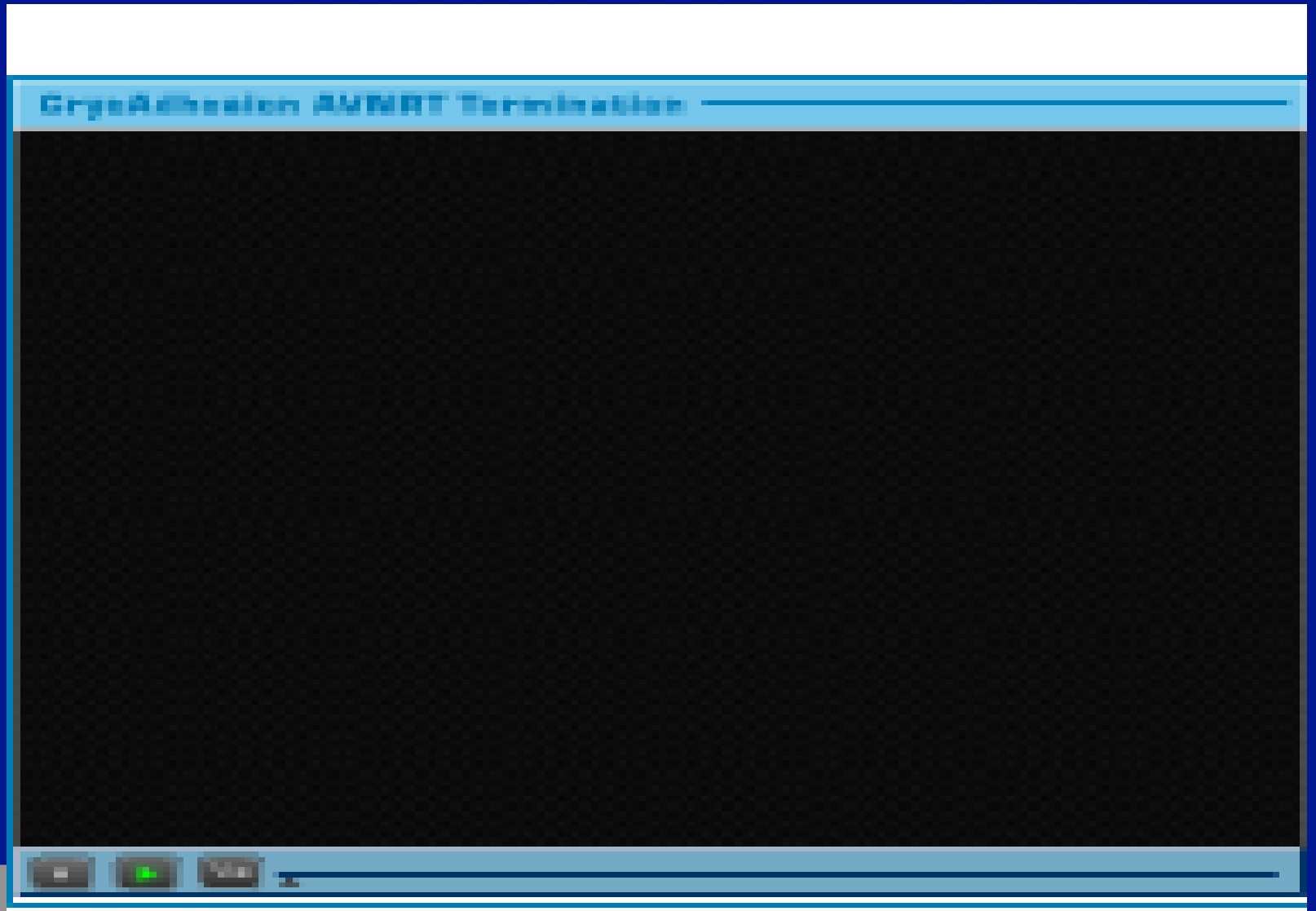
YOU CAN USE CRYO

- No fluoroscopy to check catheter position during ablation
- Pacing maneuvers allowed
- No dislodgement during rhythm changes



CRYOADHESION

AVNRT Termination



REASONS OF FAILURE IN APS ABLATION IN CHILDREN

1) Technical difficulties

2) Misdiagnosis, inaccurate AP localization

3) Coexisting cardiac abnormalities

4) High-risk location

REASONS OF FAILURE IN APS ABLATION IN CHILDREN

2) Misdiagnosis, inaccurate AP localization

- **Multiple AP:**
  Inability to recognize A or V activation sequence + + +
- **Previously unsuccessful attempt:**
  distorted and low voltage EGM
- **Oblique APs:**
  Different A and V insertions + -- ---
- **Unusual AP localization**

MULTIPLE APs

- Incidence 3-15% (generally in RPS-RFW region)
- Important cause of initial ablation failure
- Ablation success rate 86-98% with high recurrence rate: 8-12%

SUGGESTIONS

1. Apparent failure in an optimal site should raise a suspicion

2. Full energy delivery should be undertaken with scrutiny of change in local VA or AV activation time or delta wave morphology

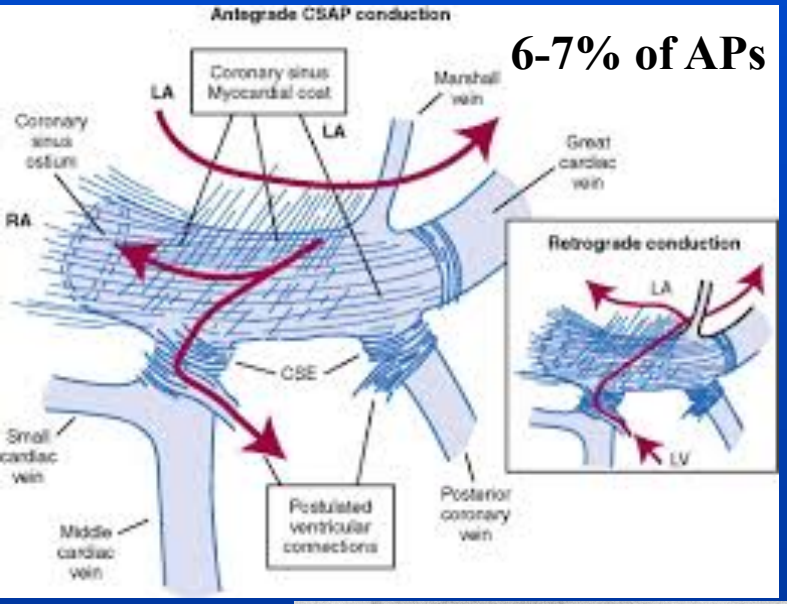
3. Meticulous remapping after RF/CRYO delivery

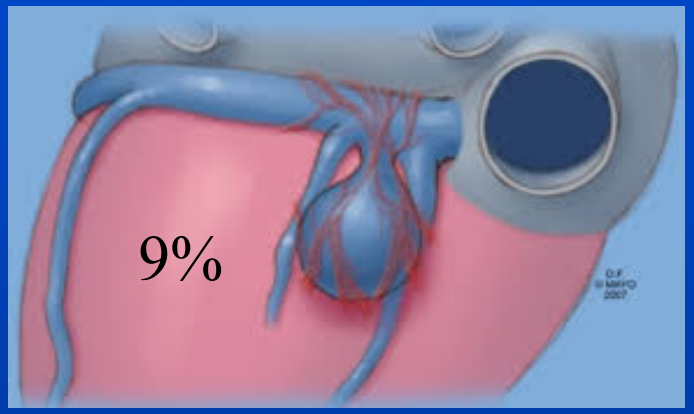
MULTIPLE APs

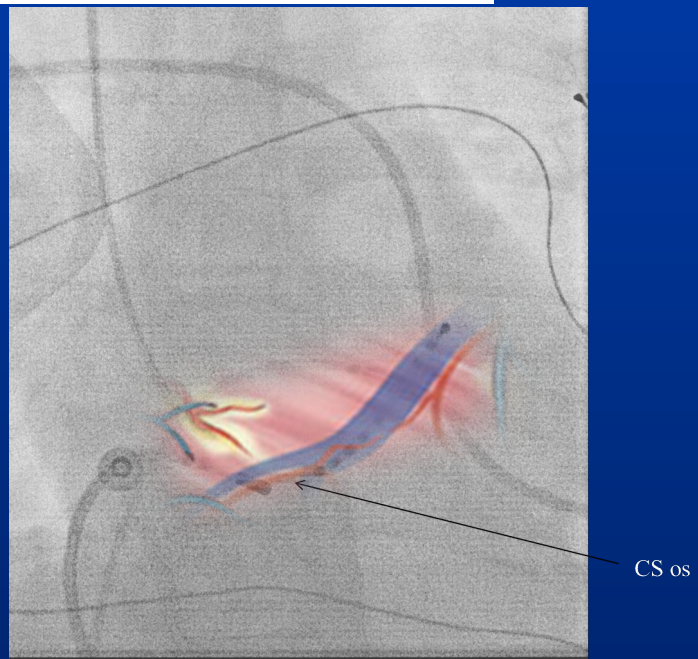
I LAL AP

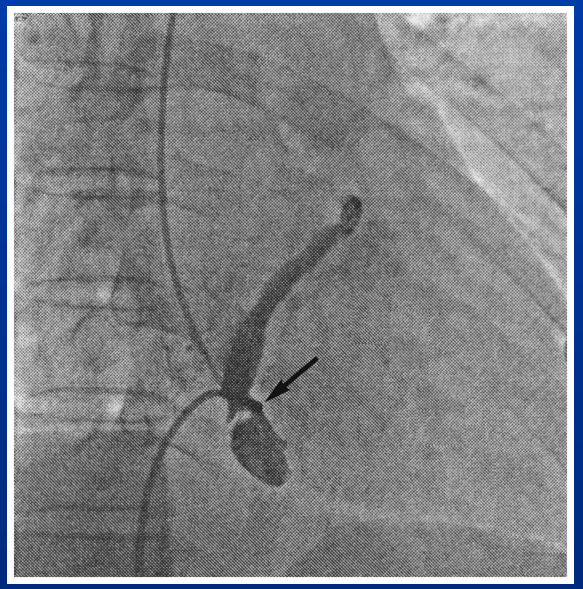
II LL AP

EPICARDIAL APs







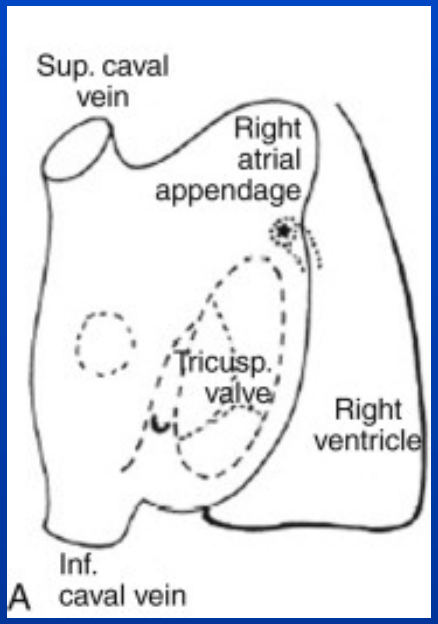


EPICARDIAL APs

negative δ wave in II,
positive δ in aVR
V6 with deep S wave
(R<S)

- Evaluate carefully the ECG before.
- If you have a strong suspicion try to delay the ablation procedure when Pt weight >40 Kg (to avoid failure and/or complication)
- Use irrigated tip catheter
- Use Cryo when possible

ATRIAL APPENDAGE TO VENTRICULARE APs



Epicardial left atrial appendage and biatrial appendage accessory pathways

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BACKGROUND Acute success rates of accessory pathway ablation for Wolff-Parkinson-White (WPW) syndrome can exceed 95%, with rare failures attributed to anatomically complex epicardial connections. Right atrial appendage to right ventricle pathways have been reported, but their left-sided counterparts have only recently been described.

OBJECTIVE The purpose of this study was to report three unique cases of WPW syndrome in children with left atrial appendage and biatrial appendage connections.

RESULTS Three young patients with high-risk accessory pathways (accessory pathway effective refractory period ≤ 190–240 ms) had unsuccessful endocardial ablations despite aggressive efforts with various catheter techniques. One patient had a left atrial appendage to left ventricular connection; the other two had biatrial appendage pathways connected to their respective ventricu-

operating room, where the appendages were noted to be diffusely adherent to their ventricles by fibrofatty connections. Dissection of the appendages led to loss of preexcitation and no further tachycardia.

CONCLUSION Surgical management of atrial appendage accessory pathways should be considered if aggressive attempts at endocardial ablation have failed.

KEYWORDS Accessory pathway; Arrhythmia surgery; Atrial appendage; Catheter ablation; Pediatrics; Wolff-Parkinson-White syndrome

ABBREVIATIONS AP = accessory pathway; **ERP** = effective refractory period; **LAA** = left atrial appendage; **LV** = left ventricle; **ORT** = orthodromic reciprocating tachycardia; **RAA** = right atrial ap-

First described in a child in 2000 (EUROPACE)

1. Use 3D mapping
2. Use irrigated catheter
3. Use surgery or epicardial approach

REASONS OF FAILURE IN APS ABLATION IN CHILDREN

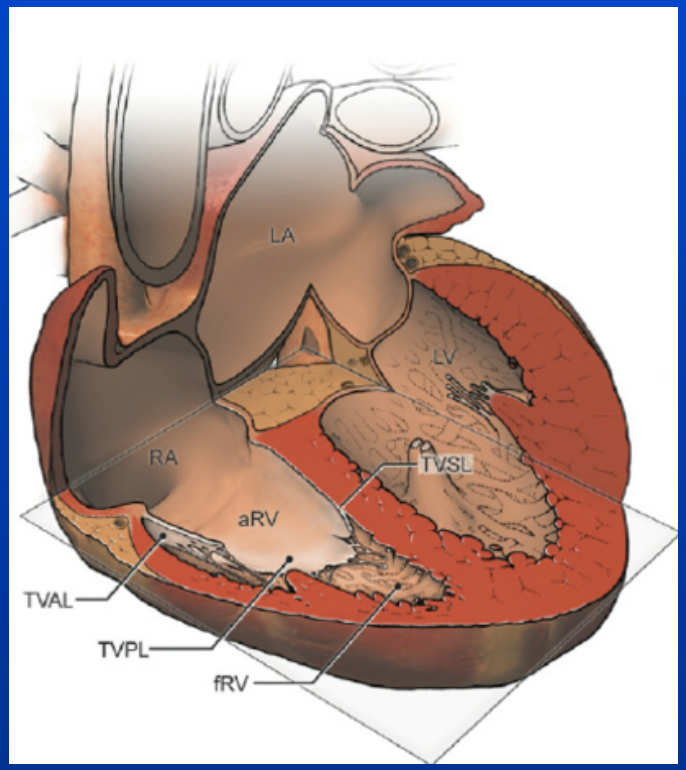
1)Technical difficulties

2) Misdiagnosis, inaccurate AP localization

3) Coexisting cardiac abnormalities

4)High-risk location

EBSTEIN'S ANOMALY



1. **Apical displacement of the TV into the RV**
2. **Atrialization of the RV between the true TA and anomalous attachment of the septal and posterior leaflets**
3. **Atrialized RV thinned and dilated**
4. **TV regurgitation**
5. **20-30% associated to Aps , generally right sided!**

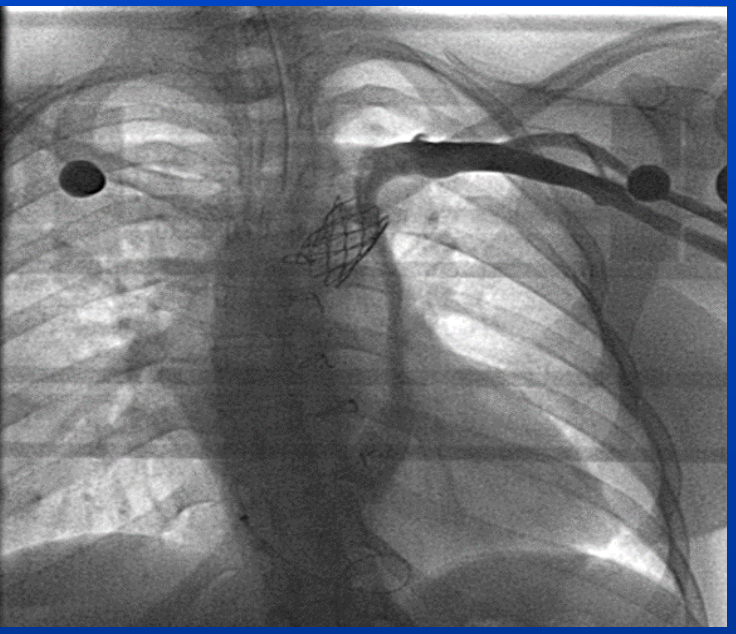
PROBLEMS RELATED TO ABLATION FAILURE:

- Poor catheter stability
- Poor tissue contact
- Difficult pathway localization

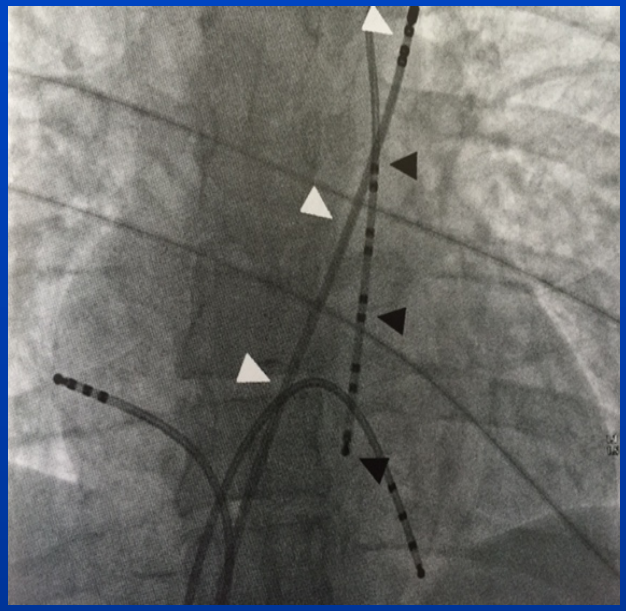
SOLUTIONS:

- Use 3D mapping
- Use irrigated catheter
- Use long sheaths or force sensor

PERSISTENT LSVC



- **4.7%% associated to APs**
- **Anastomosis with CS results in CS dilated**



PROBLEM RELATED TO ABLATION FAILURE:
Impossibility to map MV annulus for left sided AP with the CS catheter

SOLUTIONS:

- Use 3D mapping
- Retrograde approach to MV with point by point mapping

REASONS OF FAILURE IN APS ABLATION IN CHILDREN

1)Technical difficulties

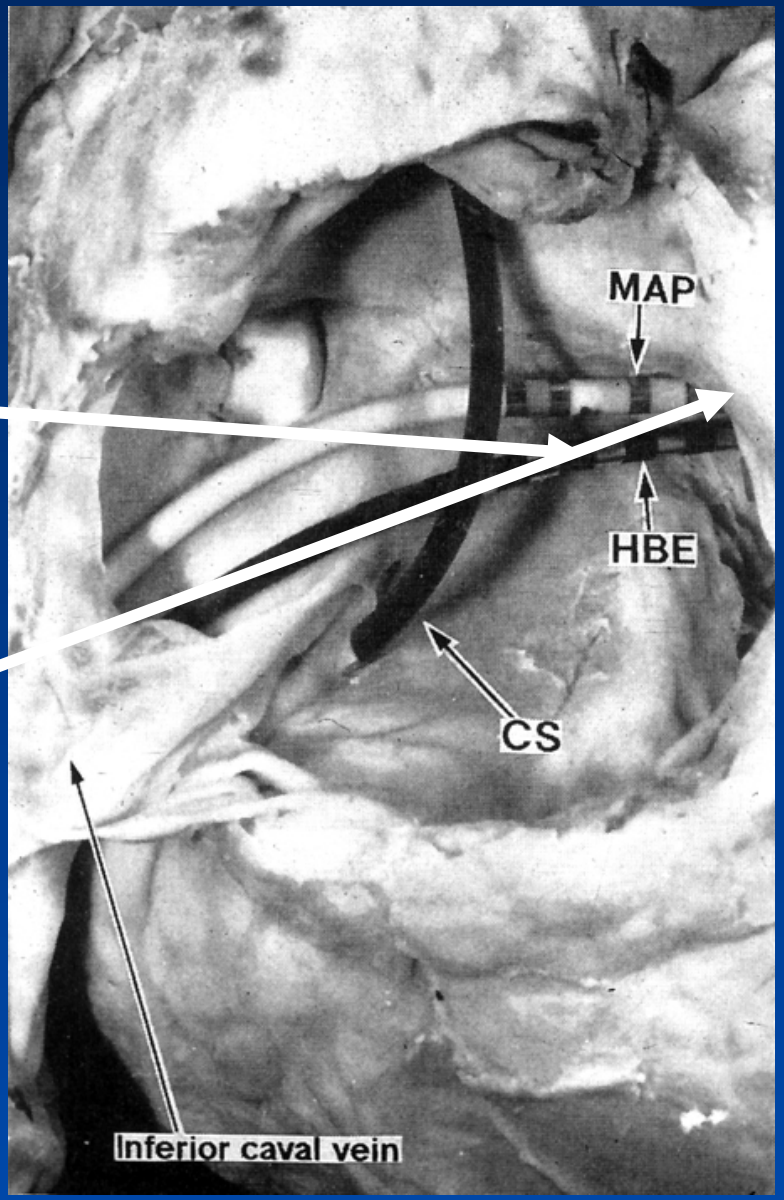
2) Misdiagnosis, inaccurate AP localization

3) Coexisting cardiac abnormalities

4) High-risk location

WHAT ARE WE TALKING ABOUT?

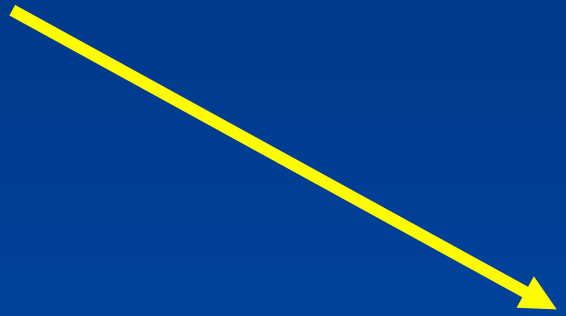
- Parahisian AP
- Anteroseptal AP



PH and SPS Accessory Pathways

Which access for the ablation catheter?

- Femoral vein
- Jugular vein
- Subclavian vein



Additional help?

- Long sheath
- Long stearable sheath

Increase stability

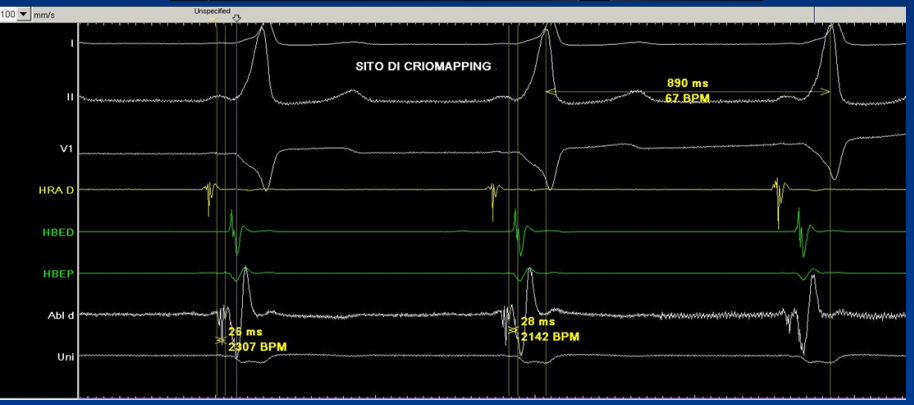
CRYOABLATION OF APs VERY CLOSE AV NODE IN PEDIATRIC PATIENTS

RFTA vs CRYO

ENERGY	Acute Success	Recurrence	Chronic Success	cAVB (RBBB)
RF North American Pediatric RFTA Registry PAPCA study 2003	89%	24,6%	63%	2.5% (4%)
RF 3 Czech Republic centers 2014	76.9%	14.1%	62.8	0.7%
CRYO ALL RECENT PAPERS 2013-2015	94.8%	11.9%	92.9%	0% (0.18%)

3D CRYO!


400 ms
200 ms
0 ms
-200 ms
-400 ms
HIS


SITO DI CRIOMAPPING
890 ms
67 BPM
I
II
V1
HRA d
HBED
HBEP
Abl d
Uni
28 ms
2307 BPM
28 ms
2142 BPM


400 ms
200 ms
0 ms
-200 ms
-400 ms
HIS
HIS
REF ECG I (62)
ROV ABL - D-2

RF ENERGY DELIVERY
Manifest preexcitation

- Use a 4mm tip RF ablation catheter
- Begin at relatively low power (25-30 W)
- Set low temperature (50-60° C)
- Keep the RF catheter in contact with endocardium
- Stop after 15” if VP does not disappear
  ….and……
- Check AV conduction

TROUBLESHOOTING IN DIFFICULT CASES

Problem	Causes	Possible Solutions
Pathway block during mapping	**Catheter trauma of superficially located pathway**	• Careful catheter manipulation. If catheter remains in same location that caused block, ablate. Wait up to 1 hour to recovery
Accelerated Junctional rhythm during RF application	Heating of AV node	• Stop RF application immediately • Reposition catheter
Right bundle branch block during application	Catheter positioned too distally	• Reposition catheter
Unable to successfully ablate at earliest site of RA activation in SVT	Poor catheter contact Incorrect location on right side left-sided atrial or ventricular pathway insertion	• Vascular sheath; alter approach (switch to SVC femoral vein) • Continue mapping • Map LA/LV septum LVOT; non coronary sinus of Valsalva
Large His potential in best ablation recording	True parahisian pathway	• Use cryomapping to test sites before ablation • Advance His catheter so that insulated shaft ‘shields’ His bundle from ablation energy.

ABLATION AFTER BUMP MAPPING

SVT or ventricular pre-excitation accidentally interrupted by bump mapping is non-reinducible

↓

RealReview/Replay function of the EnSite Velocity™ System/ CARTO™ 3 detects the catheter position and pre-recorded portions of the procedure can be reviewed.

↓

ABLATION IN THE EXACT SITE OF BUMP MAPPING

TROUBLESHOOTING IN DIFFICULT CASES

Problem	Causes	Possible Solutions
Pathway block during mapping	Catheter trauma of superficially located pathway	• Careful catheter manipulation. If catheter remains in same location that caused block, ablate. Wait up to 1 hour to recovery
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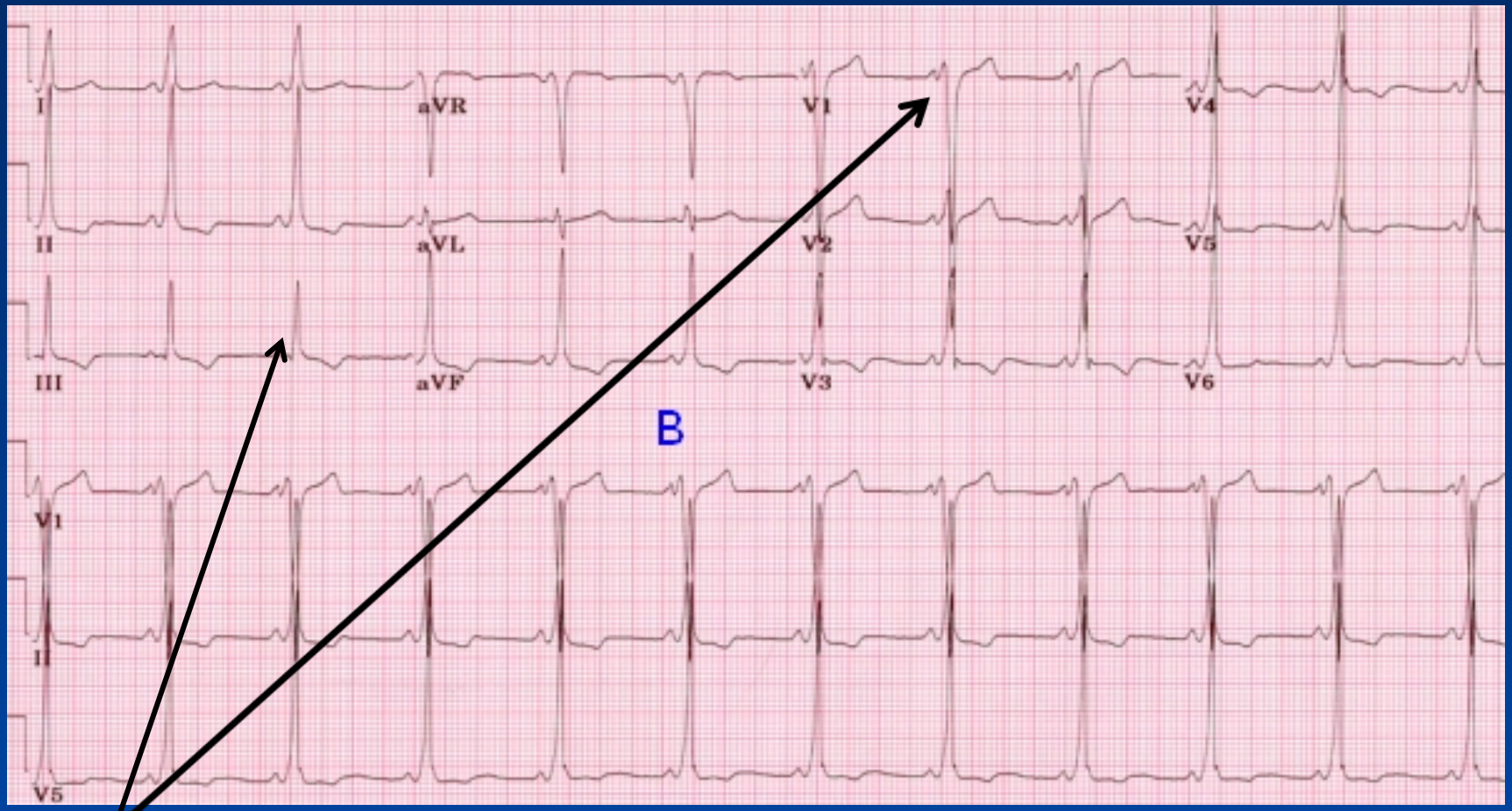
Large His potential in best ablation recording	True parahisian pathway	• Use cryomapping to test sites before ablation • Advance His catheter so that insulated shaft 'shields' His bundle from ablation energy.

THE NONCORONARY CUSP ABLATION OF ACCESSORY PATHWAYS

Suleiman M JCE 2011



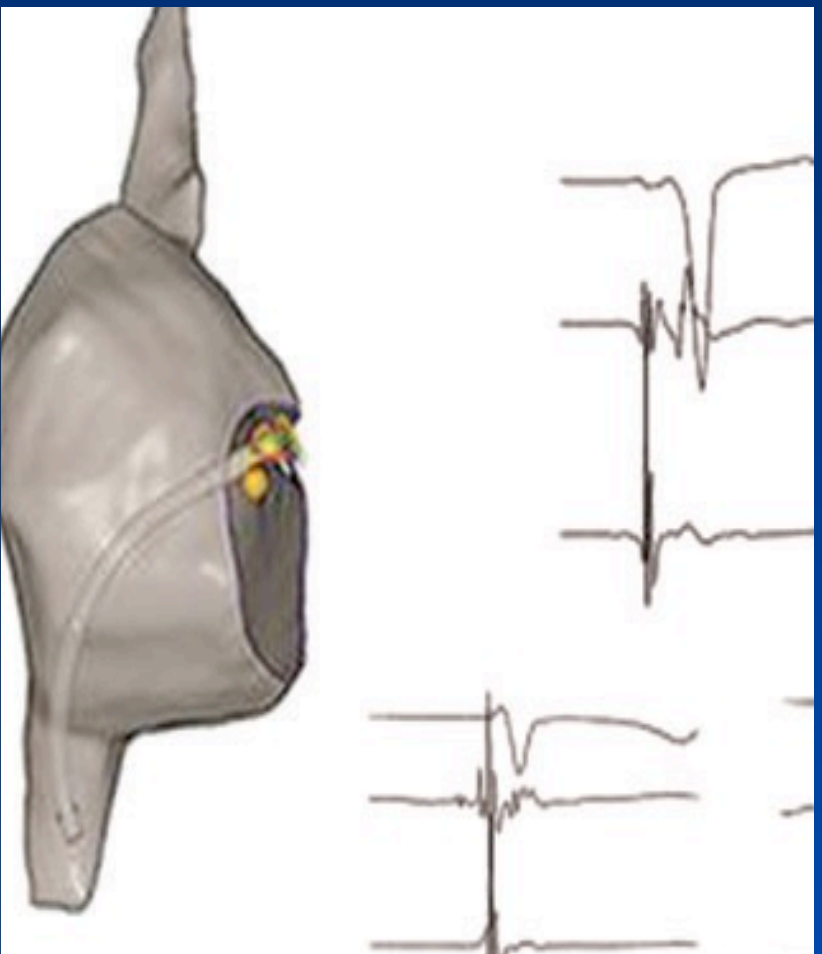
Small positive delta wave is seen in lead V1 and the delta wave in lead III is less positive than the delta wave in lead II

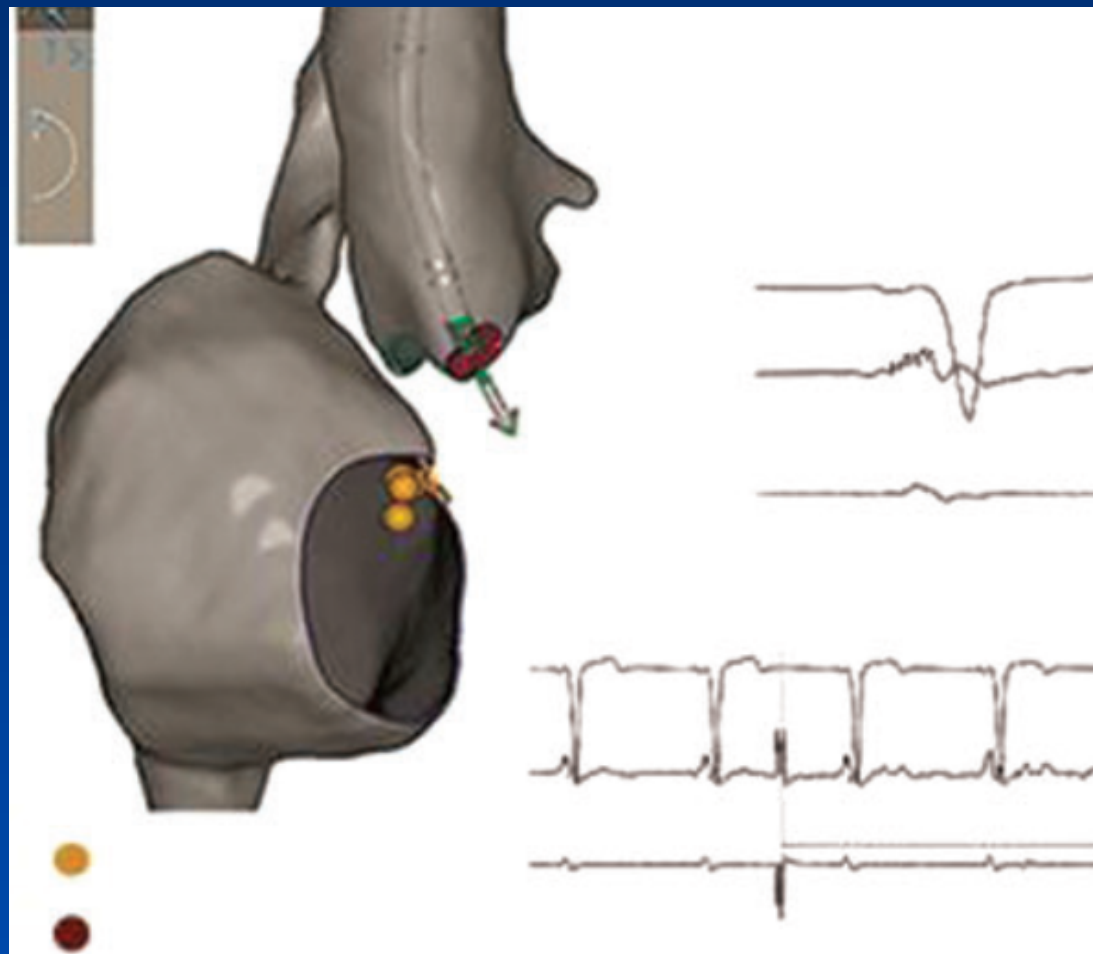
SUCCESSFUL RFTA OF AN AS AP FROM THE RIGHT CORONARY CUSP

Teresa Oloriz, Simone Gulletta and Paolo Della Bella*

EUROPACE 2014

13 year-old boy





TYPICAL ABLATION SUBSTRATES IN CHILDREN

- AVNRT
- ACCESSORY PATHWAYS
- ECTOPIC ATRIAL TACHYCARDIA

REASONS OF FAILURE IN EAT ABLATION IN CHILDREN

1) Inability to induce tachycardia

2) EAT non-sustained enough for mapping

3) Technical difficulties

4) High-risk or difficult location

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REASONS OF FAILURE IN EAT ABLATION IN CHILDREN

1) Inability to induce tachycardia

2) EAT non-sustained enough for mapping

SOLUTIONS

- **Use isoproterenol (evaluate inducibility even during wash-out) or other adrenergic drugs (aminophylline /norepinephrine)**
- **Use 3D mapping waiting ns episodes or pace-mapping (?)**
- **Use "balloon 3D mapping " in older children or adolescents**
- **Try to ablate in the site of bump-mapping**

REASONS OF FAILURE IN EAT ABLATION IN CHILDREN

1) Inability to induce tachycardia

2) EAT ns long enough for mapping

3)Technical difficulties (poor catheter stability/failure despite precise mapping)

SOLUTIONS

- **Try alternative catheter or CRYO (necessity of irrigated /force sensor catheter is very rare!)**
- **Use preformed sheaths**
- **Try to ablate in SR**

REASONS OF FAILURE IN EAT ABLATION IN CHILDREN

1) Unable to induce tachycardia

2) EAT ns long enough for mapping

3)Technical difficulties

4)High-risk or difficult location

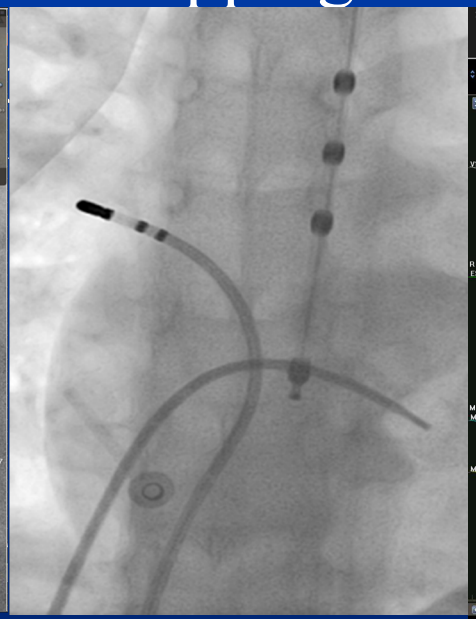
EAT origin in:

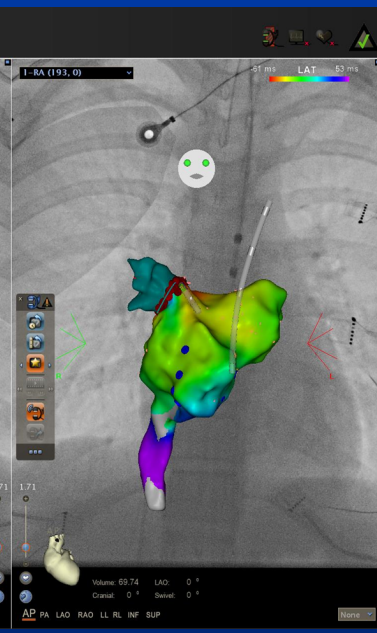
1. CS (no early atrial site)
2. VVPP
3. Parahisian

REASONS OF FAILURE IN EAT ABLATION IN CHILDREN

HIGH-RISK OR DIFFICULT LOCATION

1. The location of RRPP veins and near septal foci may be not discernible, necessitating mapping both in left and the right atrium
2. Use always 3D mapping



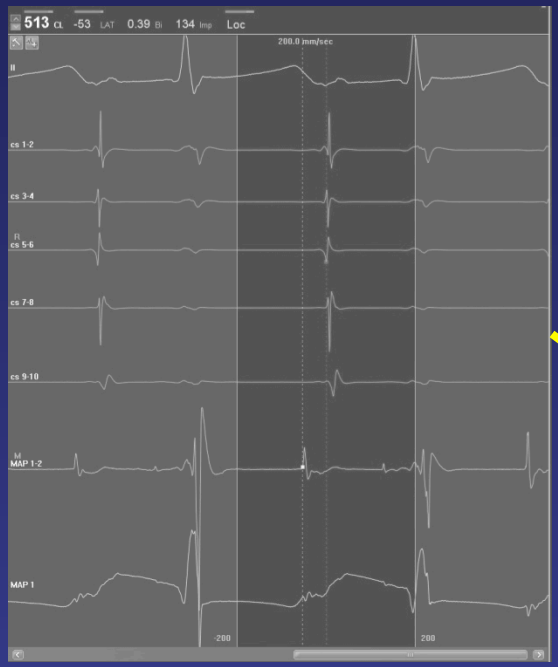


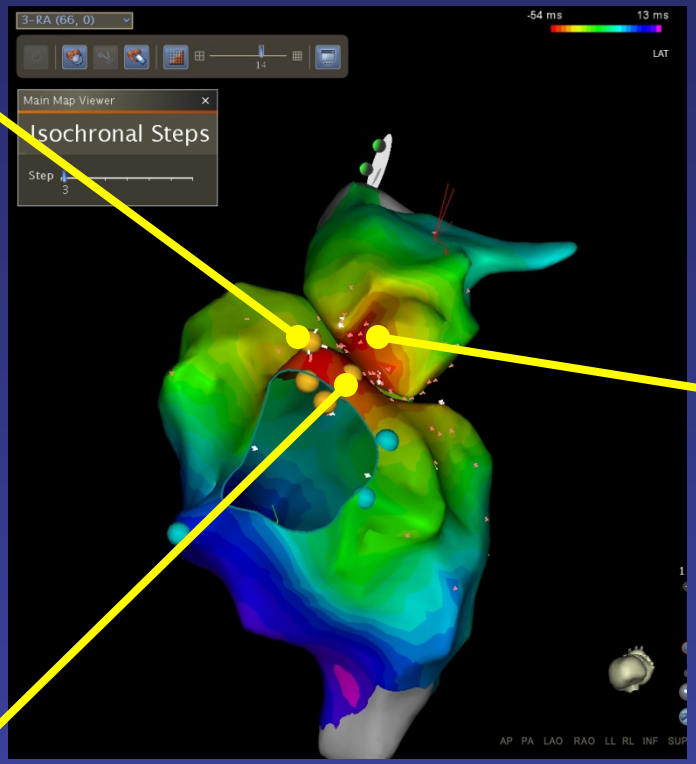
REASONS OF FAILURE IN EAT ABLATION IN CHILDREN

HIGH-RISK OR DIFFICULT LOCATION

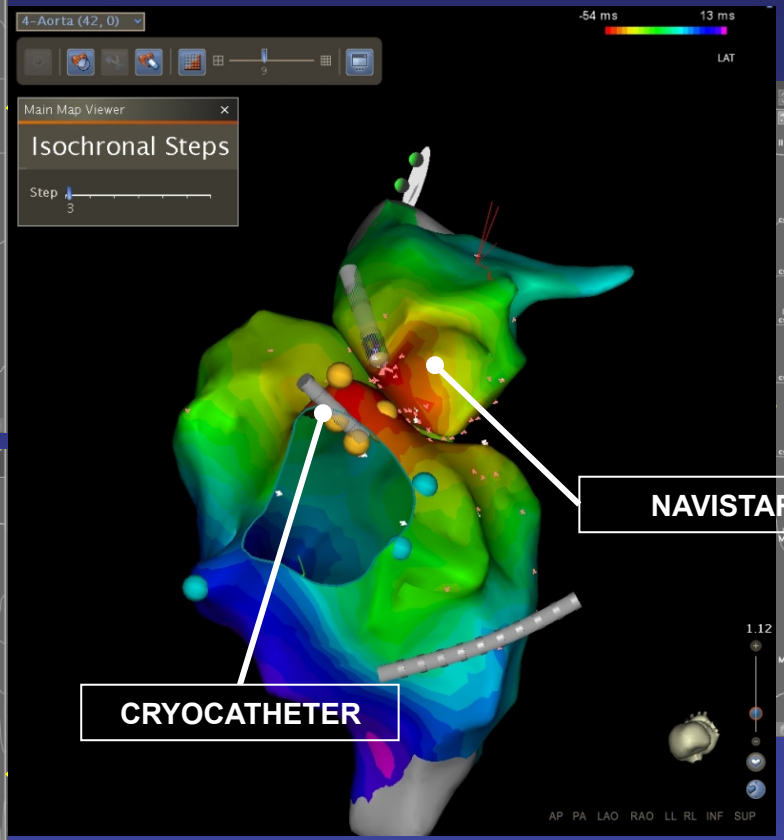
- FOR PARAHISSIAN LOCATION
- USE 3D MAPPING
- MAP HIS CLOUD
  BEFORE ABLATION
- USE CRYO!

PARAHISSIAN EAT





PARAHISSIAN EAT



IN CONCLUSION…..

Failures can always happen even in the best Institution…..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Rome, September 2017

www.EPteachingAEPC2017.it

First Announcement

PAEDIATRIC ARRHYTHMIAS

6th TEACHING COURSE OF THE ASSOCIATION FOR EUROPEAN PAEDIATRIC AND CONGENITAL CARDIOLOGY

September 22/23, 2017

Organized by the AEPC Working Group of Cardiac Dysrhythmias and Electrophysiology

Auditorium San Paolo – Ospedale Pediatrico Bambino Gesù
Viale Ferdinando Baldelli, 38 - Rome, Italy

Bambino Gesù
OSPEDALE PEDIATRICO