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Predictors of Successful treatment of Ventricular Arrhythmias in Children: 11 Years Experience in 532 Pediatric patients

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Speaker's name:

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I do not have any potential conflict of interest

Background

The prevalence of ventricular arrhythmias in children without clinical manifestations of cardiac arrhythmias is about 3% and depends on the pts age…

Nagashima M. et al. Pediatr . Cardiol.; 1987

Natural history of idiopathic ventricular arrhythmias can lead to relatively rapid cardiac decompensation and development of arrhythmogenic cardiomyopathy

Hulot J., et al. Circulation. 2004

Possible complications related to radiofrequency current delivery in young patients

- ✓ Atrioventricular block
- ✓ Thromboembolic complications
- ✓ Coronary artery damage
- ✓ Radiation exposure
- ✓ Death

EHRA/AEPC Consensus Statement, 2013

Background

It is very important to minimize patient X-ray exposure, number of radiofrequency applications (RFA) and total time of procedure *Case C. et al. J. Am. Coll. Cardiol. 1992*

Non-invasive topical diagnosis and endocardial mapping protocol optimization during interventional treatment allow to increase the efficacy of RFA and reduce the complications in children with ventricular arrhythmias *S. Termosesov et al. J. of arrhythm. 2015*

The purpose

To determine the efficacy of catheter ablation approach based on a comprehensive evaluation of the endocardial mapping results, arrhythmia substrate localizations, and prediction of the treatment success in children with ventricular arrhythmias.

Methods

In 2003-2014, 532 children with idiopathic ventricular arrhytmias (VA) aged 5 to 18 received radiofrequency or cryo catheter ablation procedures of VA in one hospital.

Inclusion Criteria

- ✓ Focal slow ventricular tachycardia associated with complains and/or arrhythmogenic myocardial dysfunction
- ✓ Fascicular ventricular tachycardia associated with complains and/or arrhythmogenic myocardial dysfunction
- ✓ Monomorphic frequent ventricular premature beats associated with complains and/or arrhythmogenic myocardial dysfunction
- ✓ Frequent early ventricular premature beats
- ✓ Frequent exercise-induced premature ventricular beats.

Exclusion Criteria

- ✓ Structural heart disease;
- ✓ Polymorphic ventricular premature beats /tachycardia;
- ✓ Number of monomorphic ventricular premature beats less than 15000 per 24 hours according to data of 24-hour ECG Holter monitoring;
- ✓ Age of patient less than five years.

Methods: study design

Conventional mapping of ventricular arrhythmia substrate (VAS) ***(Comparison Group)***

Catheter ablation was performed in point with best mapping criteria

Mapping criteria:
Presystolic activation time >25 ms;
Identical or similar pace map.

Mapping protocol optimization:

Calculation of the probability of successful catheter ablation (P) of VAS using statistical model

Activation mapping: $P = \exp 0{,}385 + 0{,}025 * X1 + \exp 0{,}385 + 0{,}025 * X$

Pace mapping: $P = \exp 0{,}693 + 0{,}968 * Y1 + \exp 0{,}693 + 0{,}968 * Y$

Mapping of VAS using «novel» approach **(Main Group)**

Activation mapping

Grade of Probability	Presystolic activation time	Mean of Probability
«Low»	T<29 ms	P<0.75
«Medium»	29 ms<T≤73 ms	0.75<P<0,9
"High"	T>73 ms	P>0.9

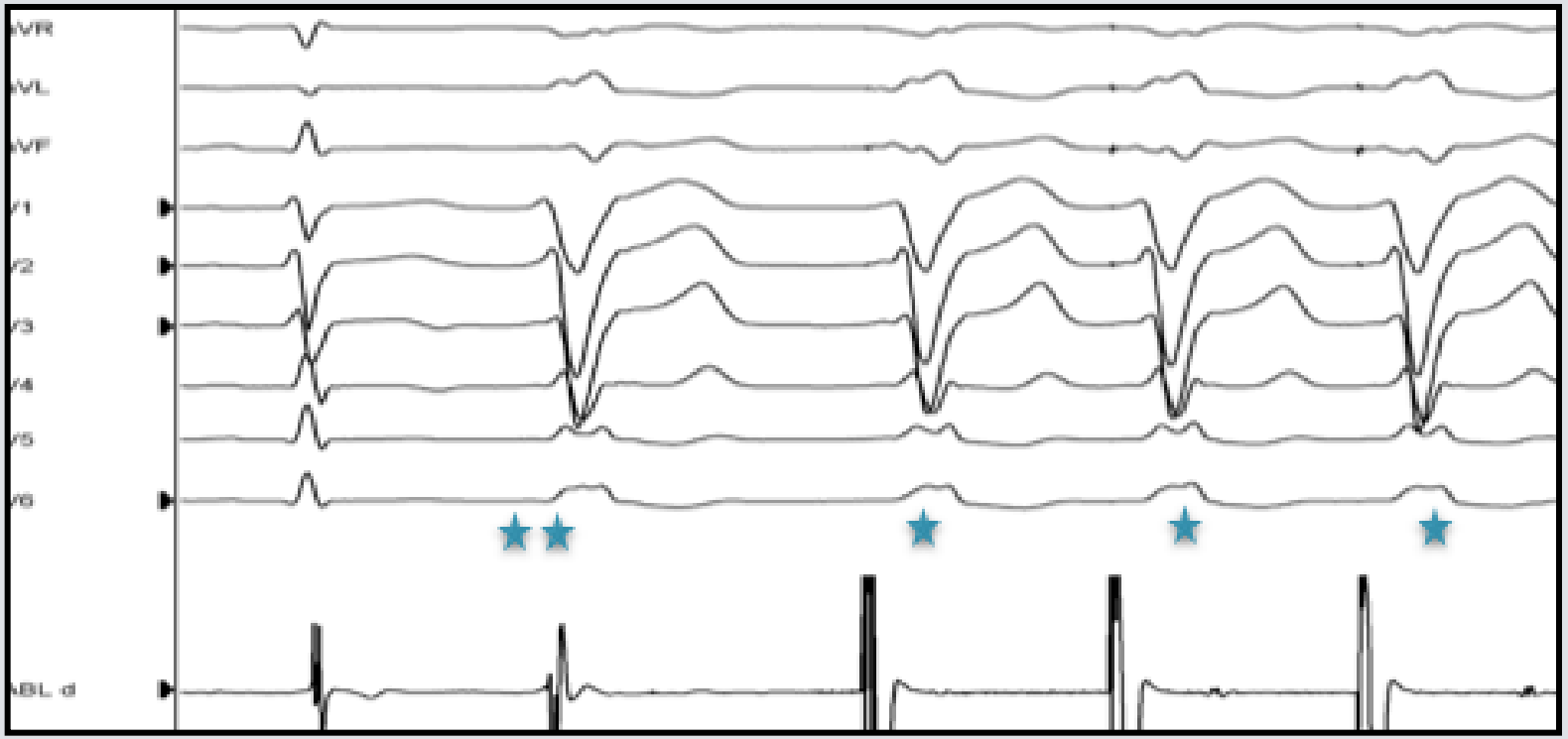
Pace mapping (PM)

$P_{(identical\ PM)} > P_{(similar\ PM)} = 2.6$

OR_i=2,63; CI= 1.31-3.04
p^*=0.00054

* - *probability of incorrectly rejecting a true null hypothesis*

Pace mapping results

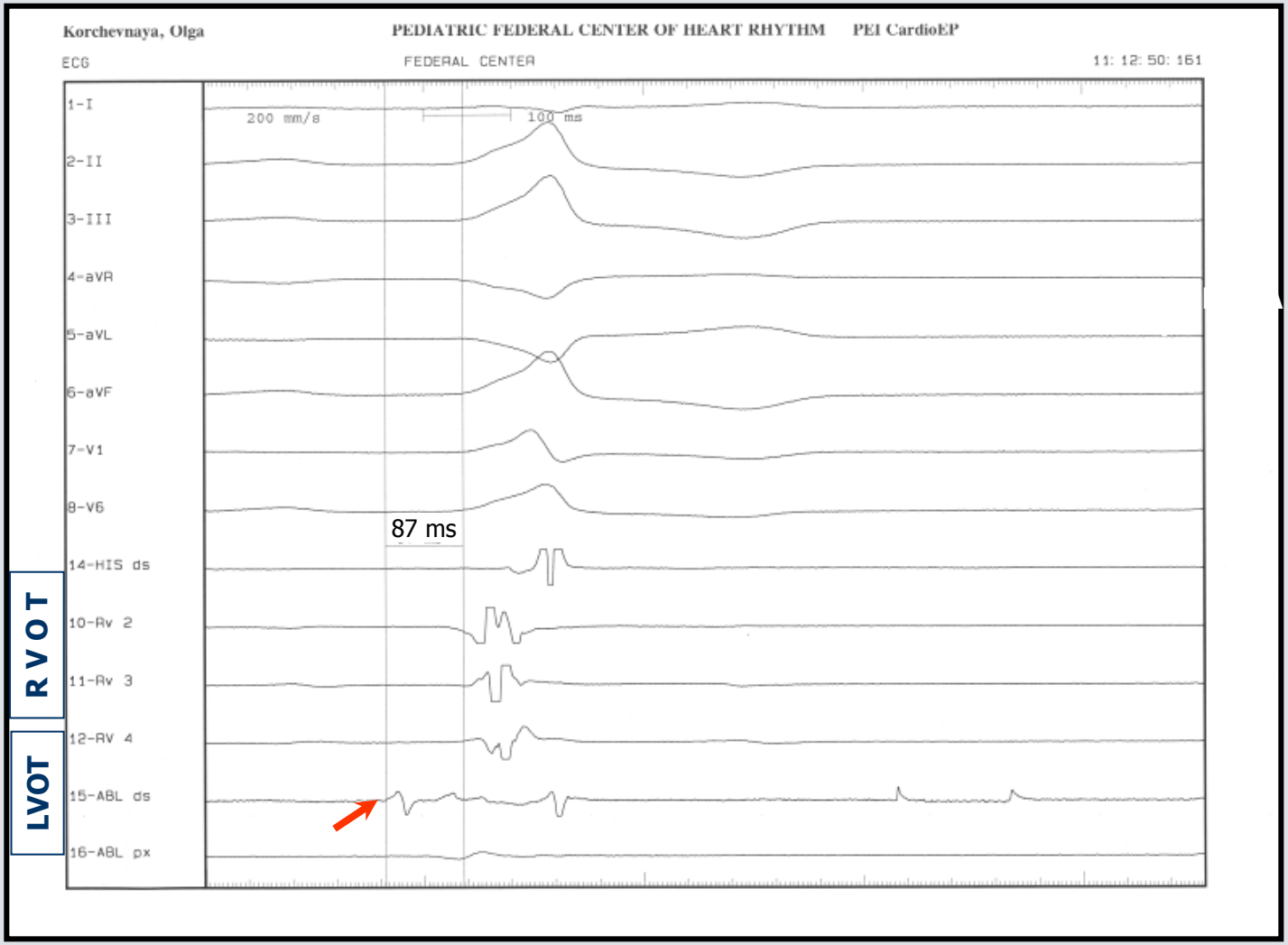


★★ - spontaneous VBP;

★ - artificial QRS complex.

Activation Mapping Results

(presystolic activation time is 87 ms)



RVOT – right ventricular outflow tract; LVOT - *left ventricular outflow tract*

Methods

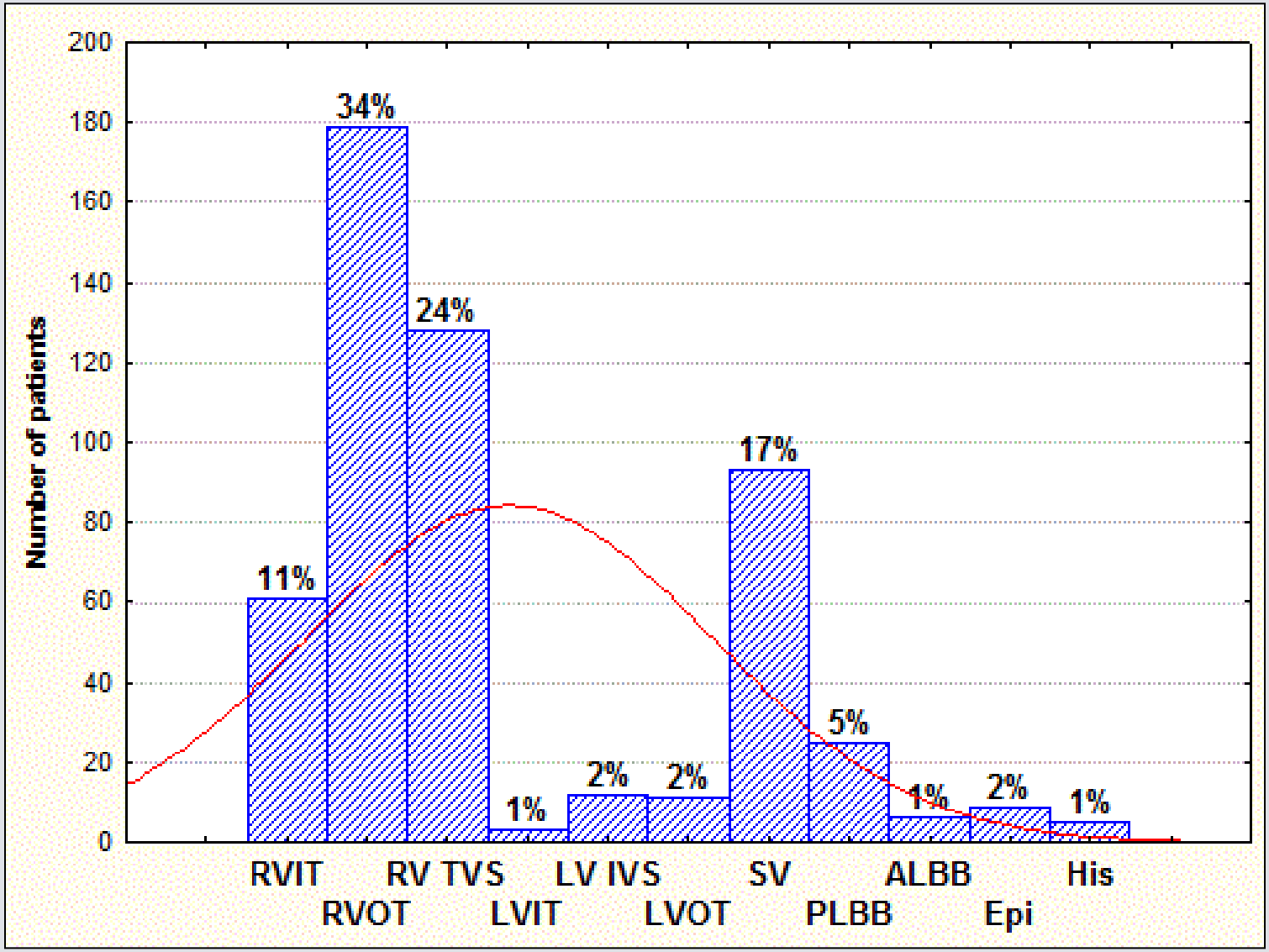
Patients Characteristics		Main Group (n=413 pts)	Comparison Group (119 pts)	P*
Age (years old)	min-max	5-18	8-17	**p=0.012**
	median (IQR)	14 (11-16)	15 (13-16)	
Female sex, n (%)		159 (38.5)	54 (45.4)	p=0.177
VBP + VT, n(%)		157 (38.2)	46 (38.7)	P=0.899
Arrythmogenic ventricular dysfunctionn, n(%)		376 (91)	108 (90,7)	p=0.924
Structural heart diseases		0	0	–
Approach for mapping		Calculation of the probability for successful treatment	Conventional criteria	–

*VBP – ventricular premature beats (>15000 per day); VT – ventricular tachycardia; IQR – interquartile range; * - probability of incorrectly rejecting a true null hypothesis*

Control Points

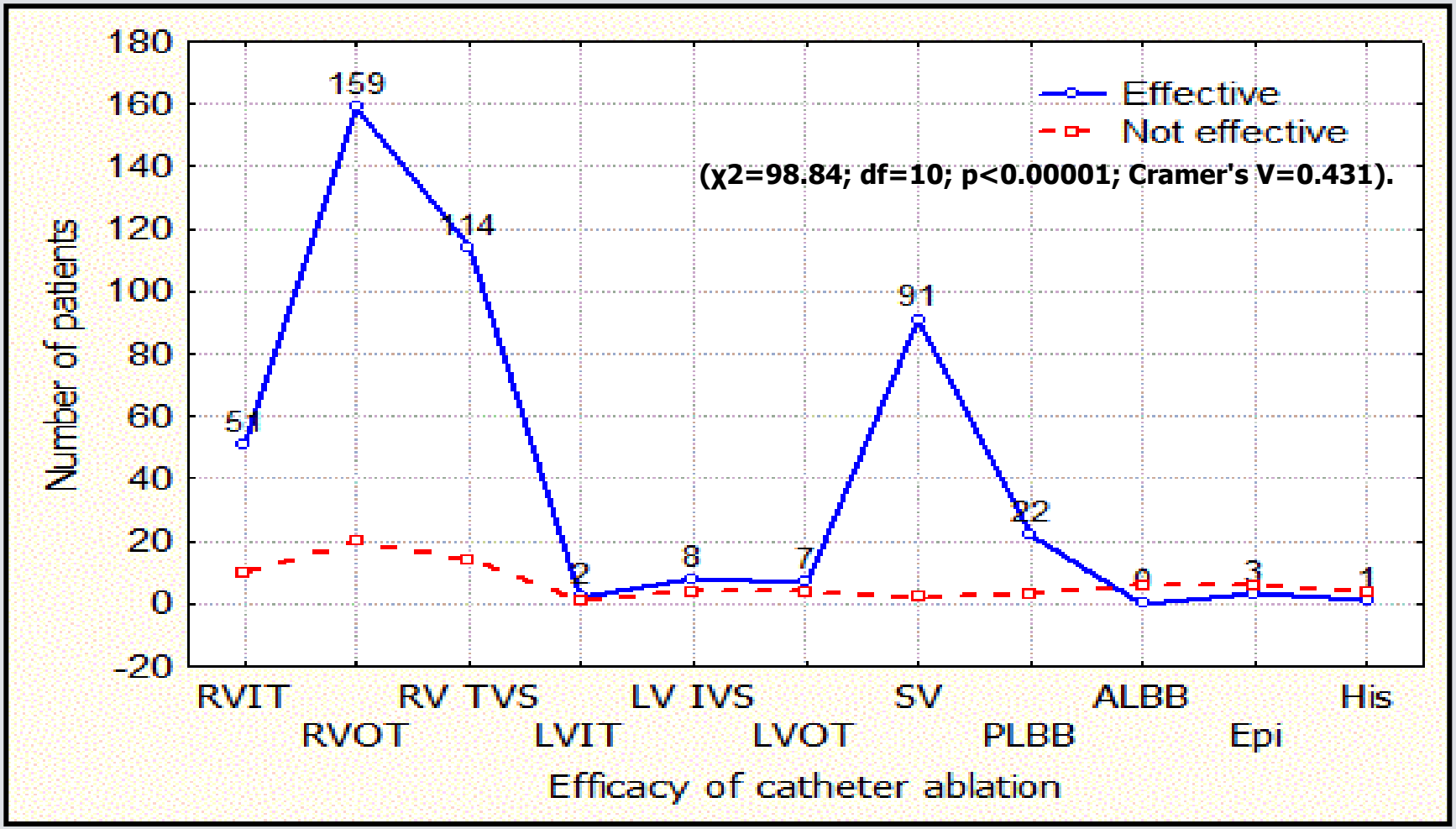
- ✓ Localization of ventricular arrhythmias (VA) substrate
- ✓ Efficacy of catheter ablation in different origins of VA
- ✓ The impact of the endocardial mapping approach on radiation exposure of patients and total ablation time
- ✓ Relationships between the approaches to endocardial mapping and total efficacy of CA
- ✓ Complications

Arrythmogenic substrate localization (n=532)



RVIT - right ventricular inflow tract; RVOT - right ventricular outflow tract; RV TIVS - trabecular part of the interventricular septum on the side of right ventricle; LVIT - left ventricular inflow tract; LV IVS - left ventricular part of the interventricular septum; LVOT - left ventricular outflow tract; SV - Sinuses of Valsalva; PLBB - posterior part of the left bundle branch; ALBB - anterior part of the left bundle branch; EPI - epicardial localization.

Catheter ablation efficacy and arrhythmogenic substrate localization dependence (n=532)



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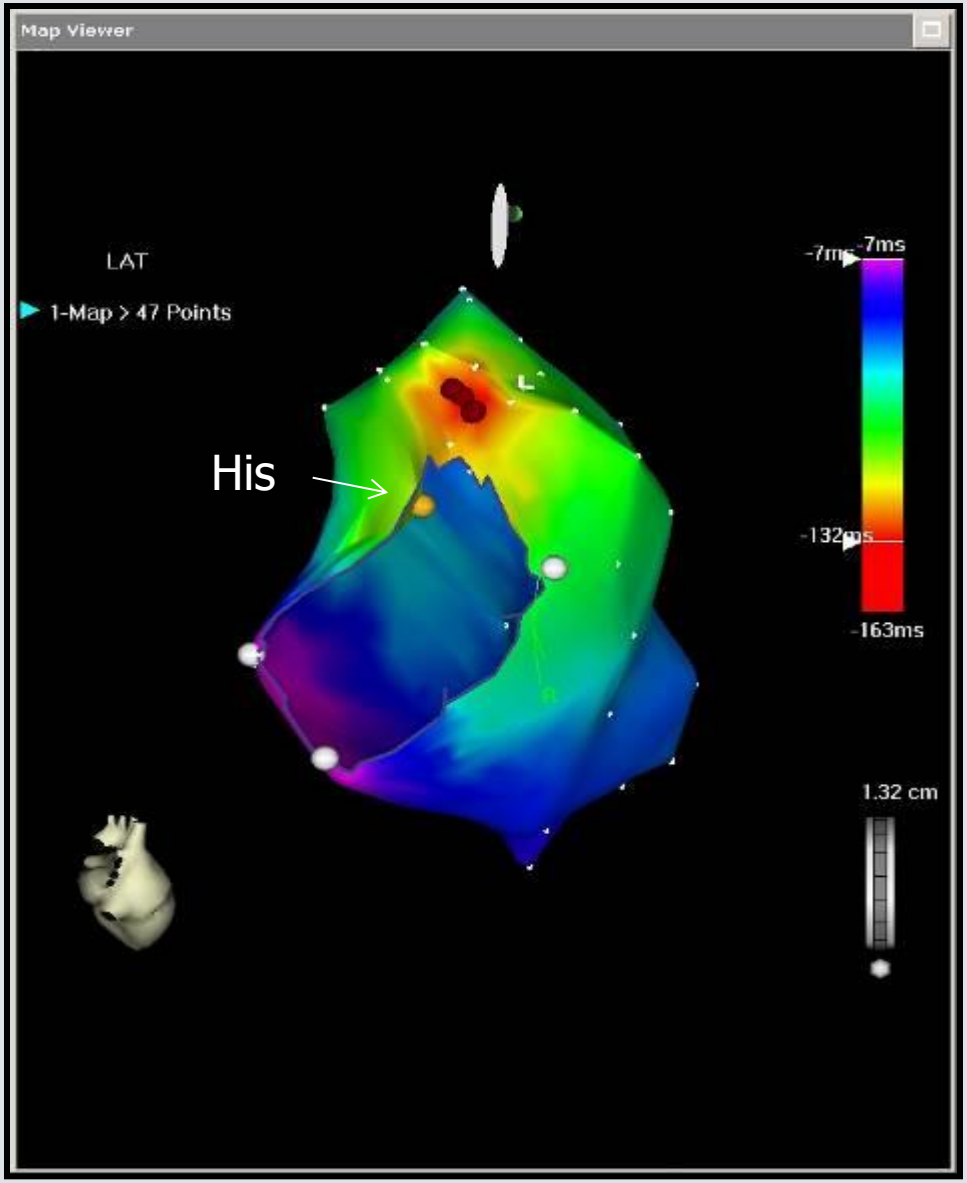
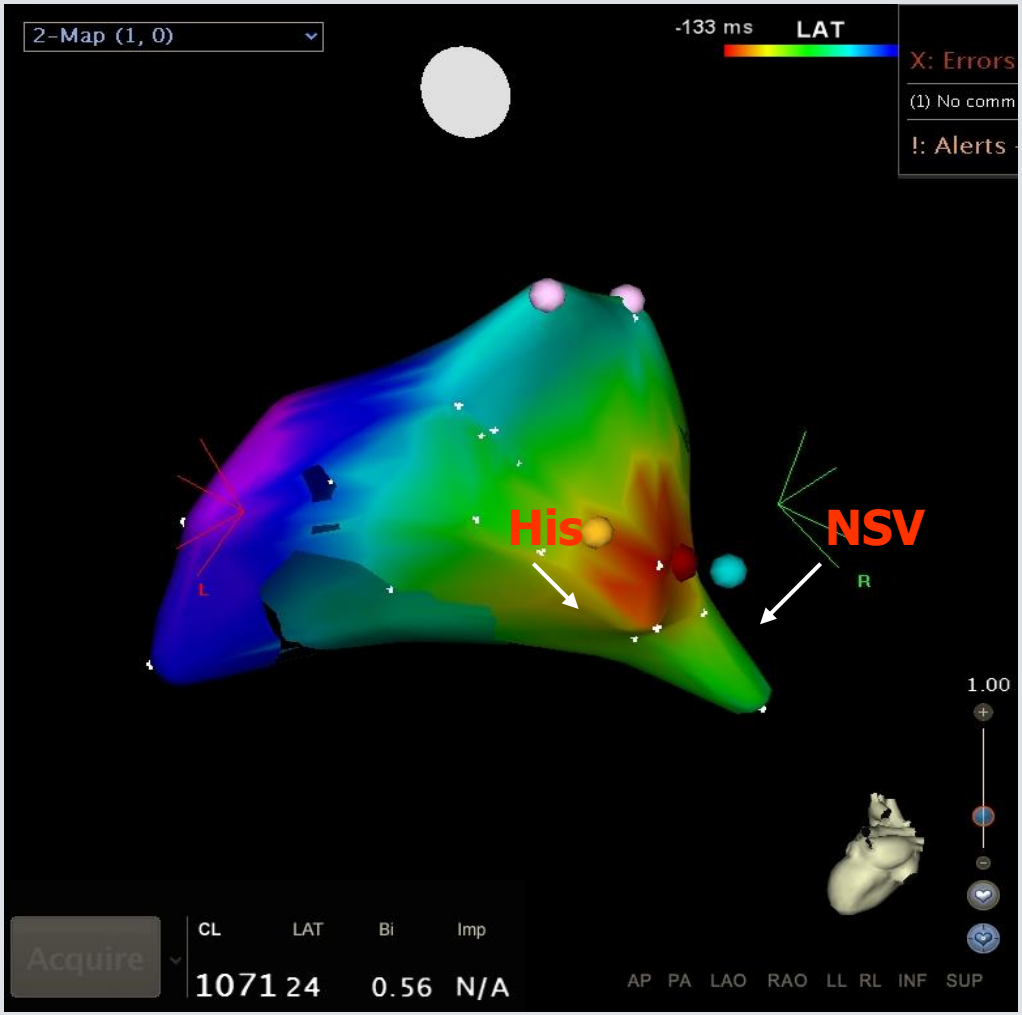
Cather ablation in anterobasal part of interventricular septum



3D Reconstruction of
the Right Ventricular (right oblique projection)

Site of cryoablation in noncoronary sinus of Valsalva (NSV)

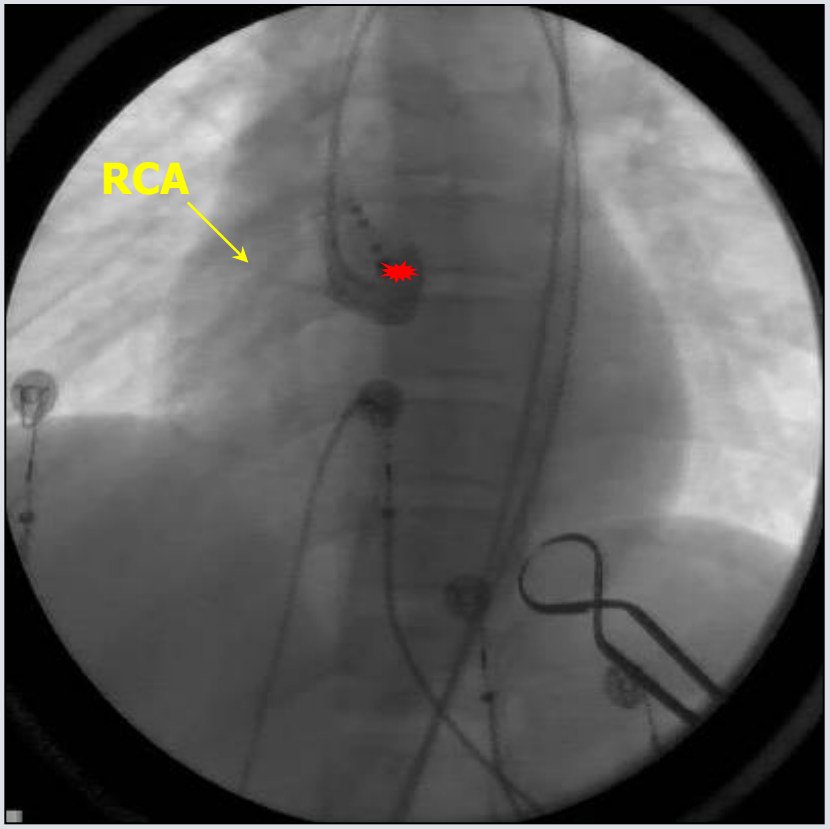


3D Reconstruction of
the Right Ventricular (posterior-anterior projection)

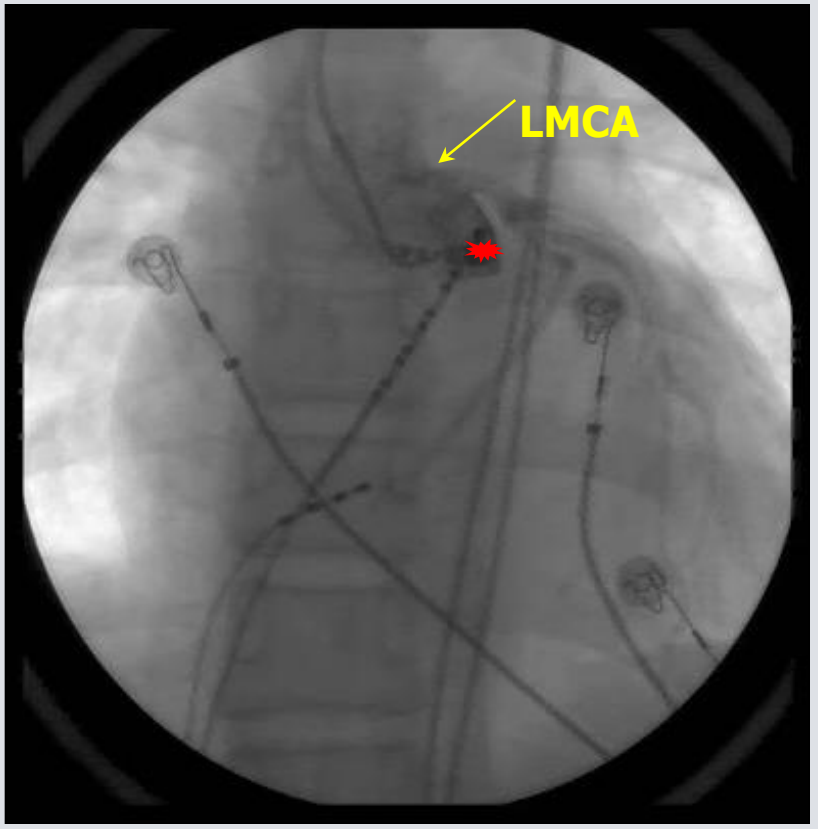
Cather ablation in Sinuses of Valsalva

(Fluoroscopy, Anterior-Posterior projection)

Right sinus of Valsalva



Left sinus of Valsalva



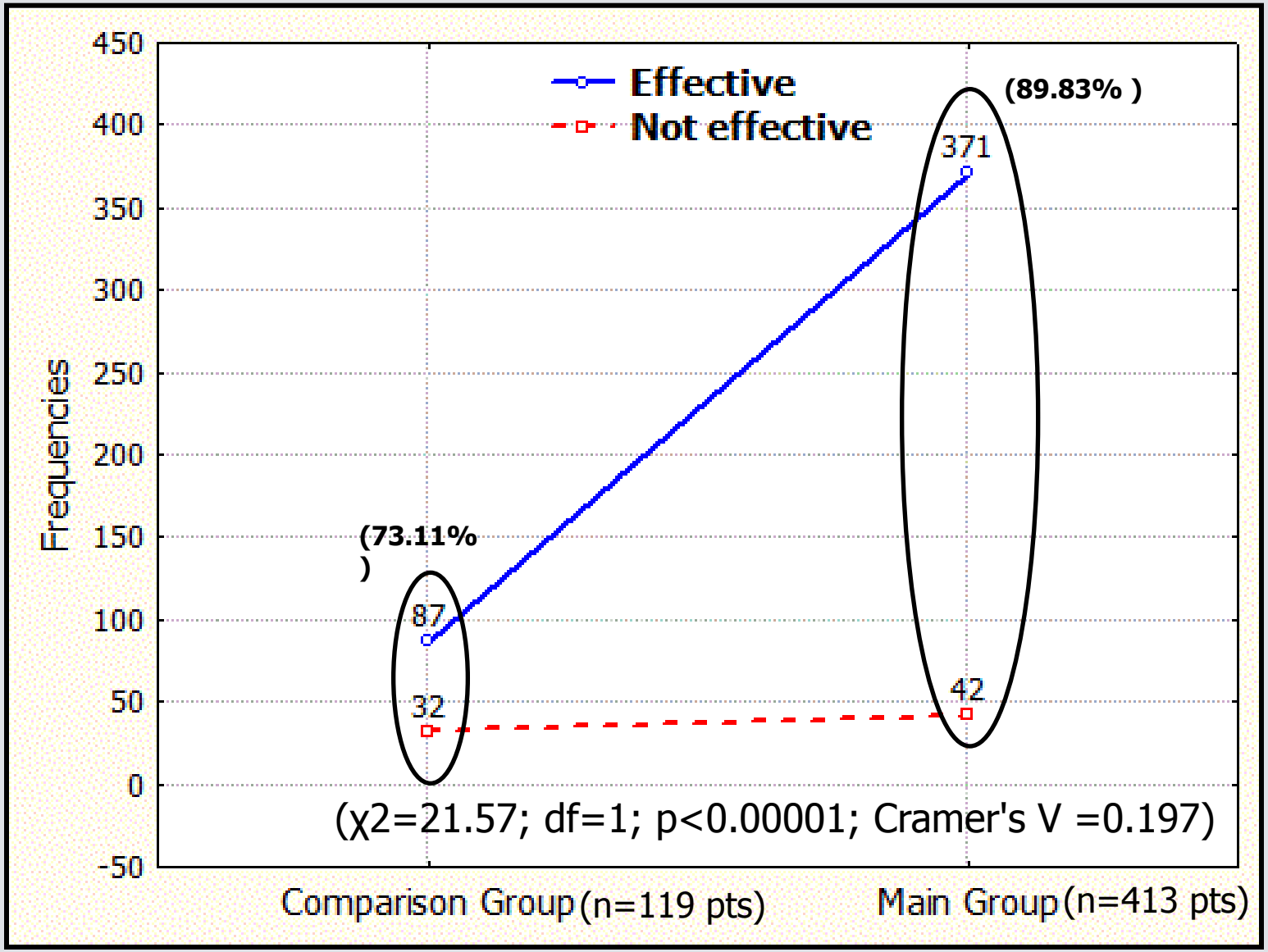
RCA – right coronary artery; LMCA – left main coronary artery

The impact of the endocardial mapping approach on results of ablation (radiation exposure of patients, total ablation time, complications)

Patients Characteristics		Main Group (n=413 pts)	Comparison Group (119 pts)	P*
Fluoroscopy times	min-max	1-37	2-101	p<0.00001
	median (IQR)	3(2-6)	12 (7-20)	
Effective doses	min-max	0.06-4.95	0.176-17.6	p<0.00001
	median (IQR)	0.325 (0.176-0.616)	1.23(0.7-2.2)	
Catheter ablation time	min-max	1-27	1-35	p=0,000035
	median (IQR)	4(2-7)	6(3-16)	
There were no any complications				

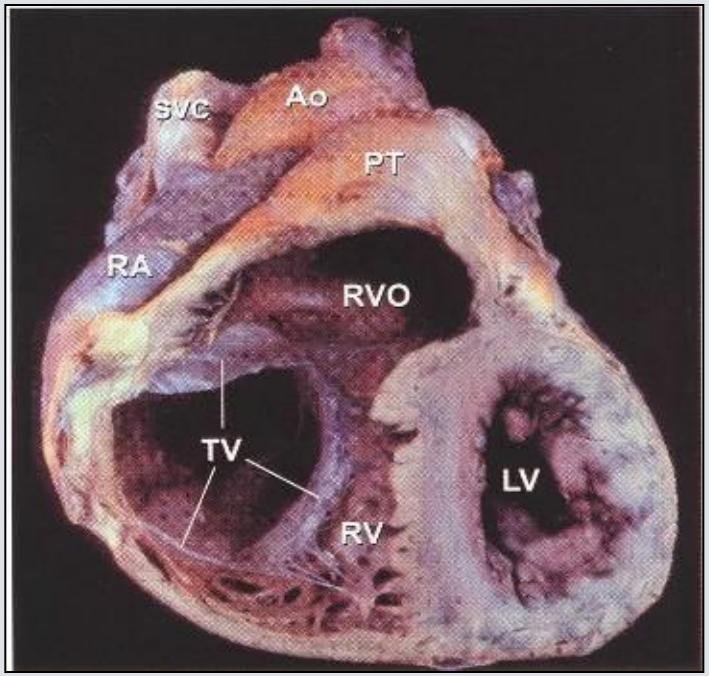
** - probability of incorrectly rejecting a true null hypothesis*

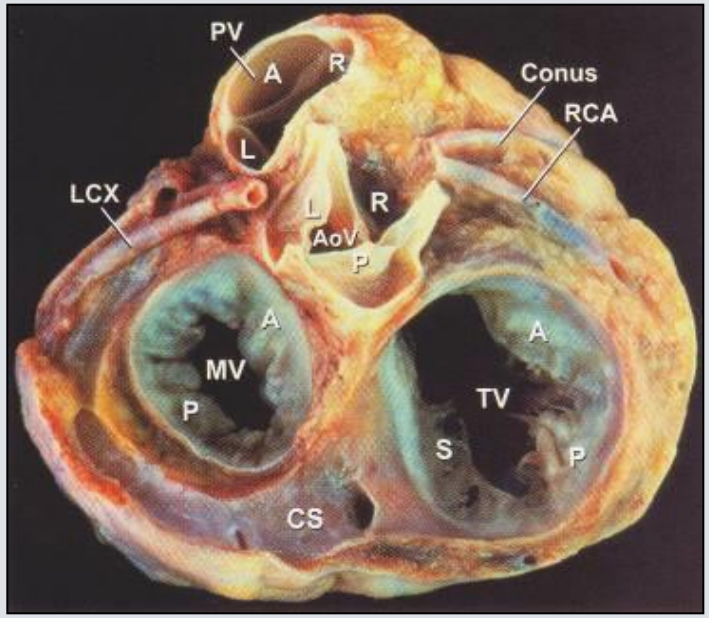
Catheter Ablation Efficacy
After Mapping Protocol Optimization



The most frequent localizations of the ventricular arrhythmia substrates in children:

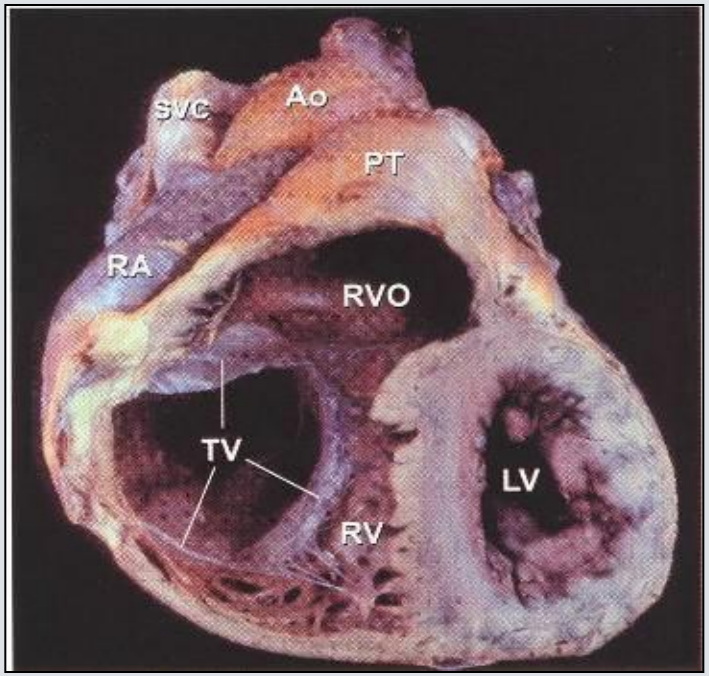
- ✓ *Right ventricular outflow tract*
- ✓ *Right ventricular inflow tract*
- ✓ *Trabecular part of the interventricular septum on the side of right ventricle*
- ✓ *Sinuses of Valsalva.*

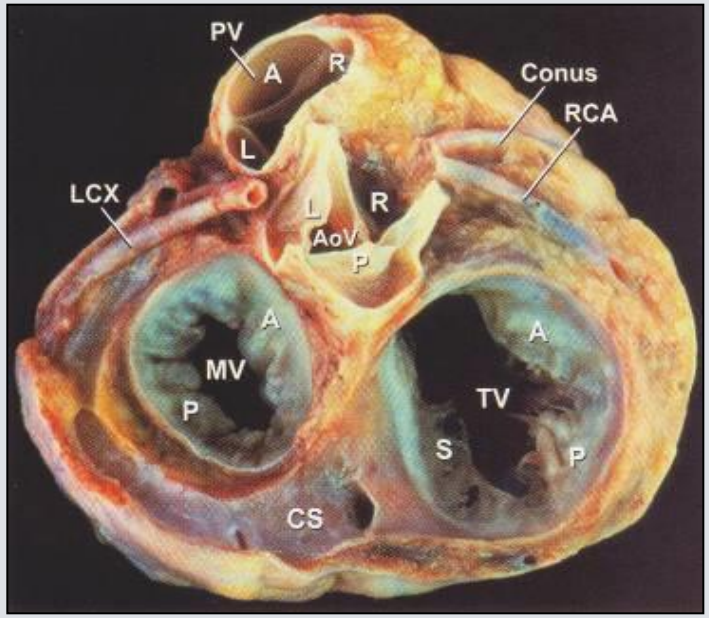




Efficacy of catheter ablation in different origins of ventricular arrhythmias (VA)

Origin of VA	Efficacy in Main Group
Right ventricular inflow tract	**85.7%**
Right ventricular outflow tract	**92,6%**
Trabecular part of the interventricular septum on the side of right ventricle	**93%**
Sinuses of Valsalva	**98,7%**





Mapping protocol optimization

Increase the efficacy

Reduce fluoroscopy time, effective doses and total ablation time

Increase the safety

Thank You for Your attention!