

Ventricular premature beats in children – natural history and clinical evaluation

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Ventricular ectopy in children

- Ventricular ectopy in children is quite common
 - Usually an incidental finding
- Prevalence varies with age
 - Neonates nearly 20%
 - Toddlers and school age 10%
 - Teenagers 20-30%
- Frequent ventricular ectopy is rare
 - < 5% with more than 50 PVCs/24h
 - < 2% with multiform PVC's, couplets or NSVT
- Ventricular ectopy in children mostly has benign course

Idiopathic VT in pediatric patients

- VT is a rare condition in the pediatric age group
 - 1.8% of children undergoing EPS
 - NSVT or sustained VT: 0.2-0.8/10 000 children
 - More than half resolved spontaneously
 - Sustained VT 1.1 episodes/100 000 children
 - 50% no structural heart disease
 - Mortality only in patients with heart disease (36%)
- Idiopathic VT in patients with normal hearts carries a good prognosis

Iwamoto et al. Circ J 2005;69:273-276

Roggen et al. Am J Cardiol 2008;101: 852-854

Ventricular ectopy in children

- Benign vs. sign of cardiac disease?
 - RVOT PVC vs. ARVC?
 - Developing cardiomyopathy?
 - Very frequent PVCs can lead to LV dysfunction
 - Cutoff 20 - 30%

Ventricular ectopy in children

– natural history

- 163 children with V arrhythmias, no heart disease
 - PVCs 78, V couplets 39, VT 46
 - Age at diagnosis 9-10 years
 - Follow-up 5.5-7 years
- Disappearance of V ectopy
 - PVC's 23%
 - Couplets 38%
 - VT 65%

Ventricular ectopy in children

– natural history

- 59 children with ventricular ectopy
 - 35 male, 24 female
 - Age at first visit 7.1 +/- 4.3 years, follow-up 3.1 +/- 3.1 years
 - ECG, Holter, exercise test
- PVCs
 - LBBB 36%
 - 83% inferior axis, 17% superior axis
 - RBBB 41%
 - Indeterminate 23%
 - Uniform 69%
 - Couplets 47%

Ventricular ectopy in children

– natural history

- PVCs in children – natural history
 - PVCs total group 14.8%...4.2% (1-3 yrs and > 16 yrs)
 - PVCs of RV origin persist (LBBB)
 - 12.3% ... 11.7% (1-3 yrs and > 16 yrs)
 - PVCs of LV origin resolve (RBBB)
 - 16.3% ... 0.6% (1-3 yrs and > 16 yrs)
 - No repetitive monomorphic or sustained VT
- Echocardiography remained normal
- Exercise test
 - PVCs suppressed by exercise in 51/59

Idiopathic Ventricular Tachycardia in Infancy and Childhood

A Multicenter Study on Clinical Profile and Outcome

Jean-Pierre Pfammatter, MD, Thomas Paul, MD, on behalf of the Working Group on Dysrhythmias and Electrophysiology of the Association for European Pediatric Cardiology

Berne, Switzerland

- 98 pediatric patients
- Age at presentation 5.4 yrs (0.1-15.1)
- Symptoms or LV dysfunction in 36%
- Heart failure or syncope 12 %
- Proportion of symptomatic patients increased with increasing VT heart rate

Idiopathic Ventricular Tachycardia in Infancy and Childhood

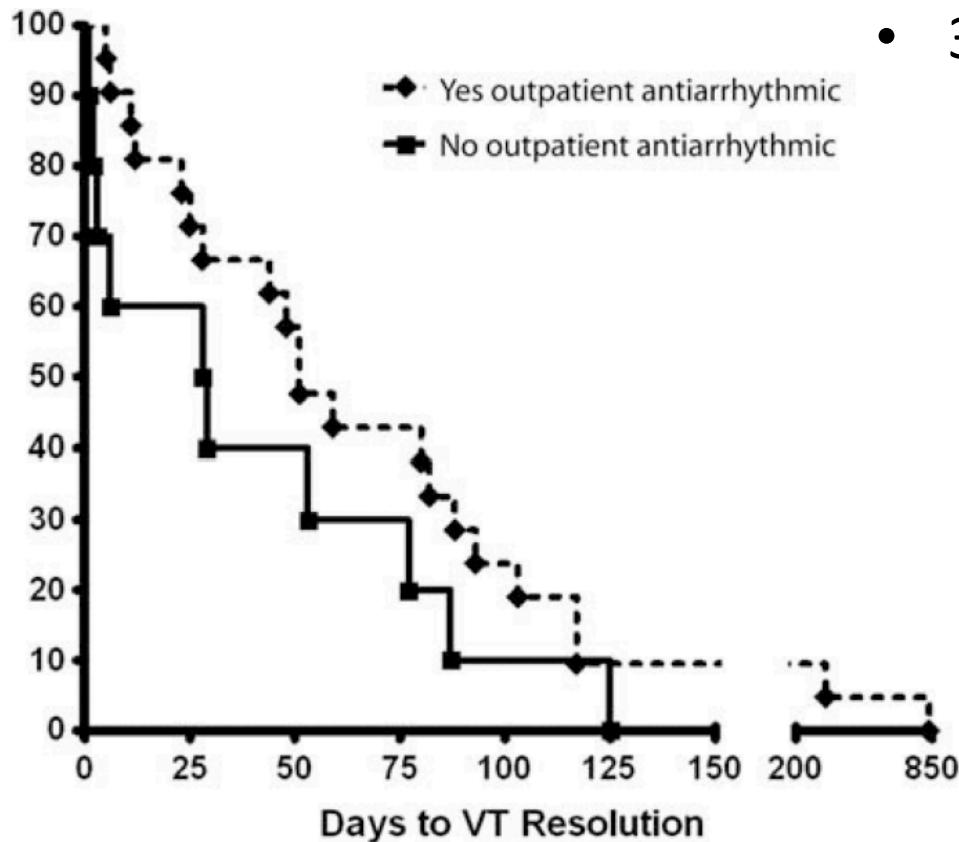
A Multicenter Study on Clinical Profile and Outcome

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Berne, Switzerland

- Presentation in the first year of life
 - spontaneous resolution in 89%
- Presentation later in life
 - Spontaneous resolution in 56%

Idiopathic VT - infants



- 31 infants with VT
 - No heart disease
 - Presentation: median 1 day (1-255 days)
 - VT: mean 213 bpm (171-280 bpm)
 - Treatment: median 13 mos (3-105 mos)
 - Last VT: median 59 d (1-836 d)
 - Spontaneous resolution in all

Pediatric idiopathic VT

Table. Clinical Studies on Idiopathic Ventricular Tachycardia in Children

Study	Patients (n)	Age group (years)	Sustained VT (n)	Symptoms (% patients)	Mortality (n)	VT free in follow-up (% patients)
Pfammatter et al, 1999 ⁵	98	0–16	36	36	0	65
Tsuji et al, 1995 ⁶	46	9.4±3.1	14	28	1	65
Iwamoto et al, 2005 ²	46	5–15	3	5	0	60
Song et al, 2010 ⁷	37	0–15	27	76	1	46

VT, ventricular tachycardia.

RVOT-VT in children

- 48 patients
 - Median age at diagnosis: 8.2 yrs (0.1-17)
 - Incidental finding 81%
 - Near syncope or syncope 15%
 - Other 4%
 - Median follow-up 22 mos (1-210)
- Decreased LV function in 1 patient (2%)
- Medical treatment 54%
 - Frequent ectopy and symptoms
- Medical treatment and observation equally associated with reduction in ectopy
 - Observation: 13% ... 0.1%
 - Medication: 19% ... 0.9%
- No deaths

PVC induced cardiomyopathy

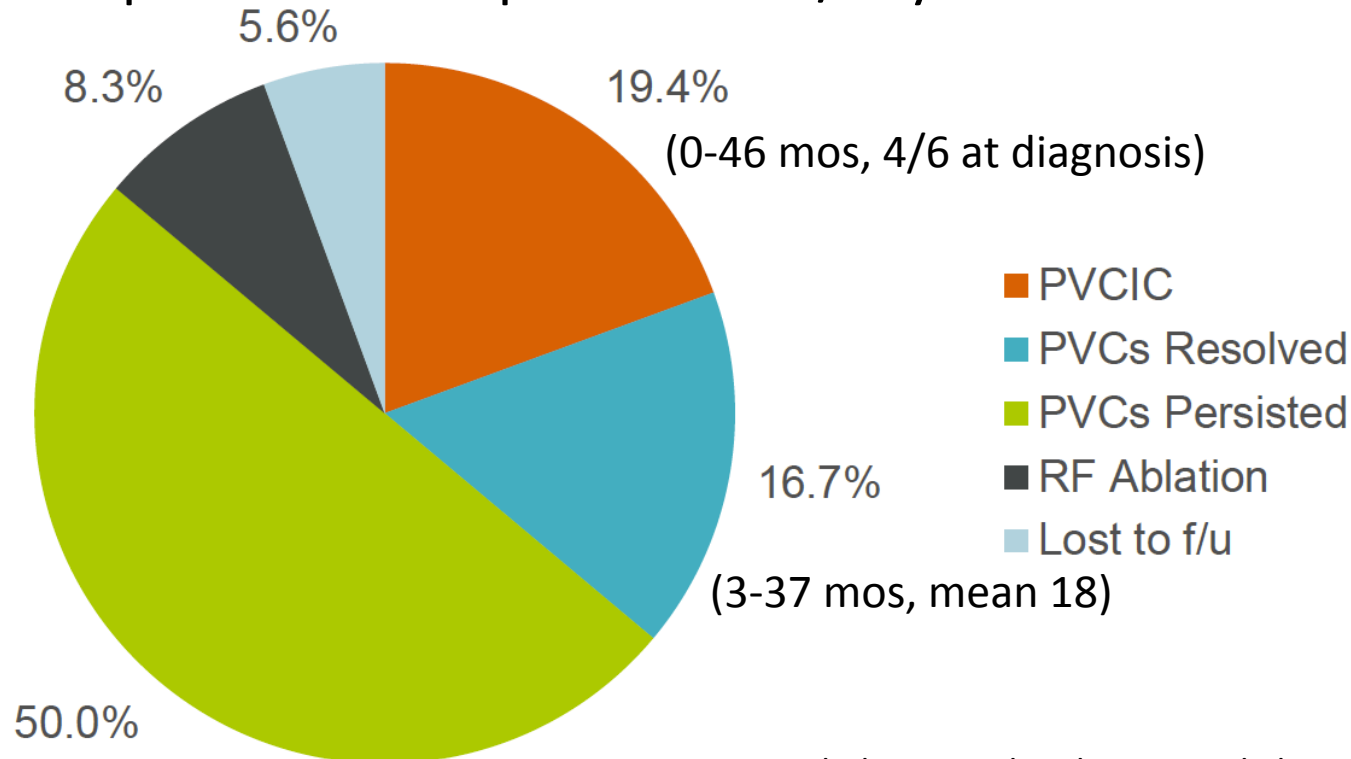
- In adults 8 – 37% of pts with frequent PVCs
- LV dilation and dysfunction cured with catheter ablation
- Significant change in LV parameters at 20% PVC burden
 - LVEF, LVEDD, LVESD, MR

Adult Literature

Paper	n	%PVCIC	Outcome of Ablation
Yarlagadda, <i>et al.</i> <i>Circulation</i> 2005	27	30%	EF 39% → EF 62%
Bogun, <i>et al.</i> <i>Heart Rhythm</i> 2007	60	37%	EF 34% → EF 59%
Baman, <i>et al.</i> <i>Heart Rhythm</i> 2010	174	33%	EF 35% → EF 54%
Yokokawa, <i>et al.</i> <i>Heart Rhythm</i> 2013	264	33%	EF 39% → EF 59%
Hasdemir, <i>et al.</i> <i>PACE</i> 2013	348	8.6%	EF 41% → EF 59%

PVC induced cardiomyopathy - children

- 36 patients with PVC burden > 20%
 - Mean/median age 11 yrs
 - 75% LBBB
 - No patient developed VT > 1%/day



PVC induced cardiomyopathy - children

- A subset of patients with high PVC burden have LV dilation and/or dysfunction consistent with PVCIC
 - Importance of echocardiographic changes unclear
 - Subclinical in all children in this study
- High PVC burden tends to persist during childhood
- PVCs in children with the highest burdens may not be an entirely benign condition

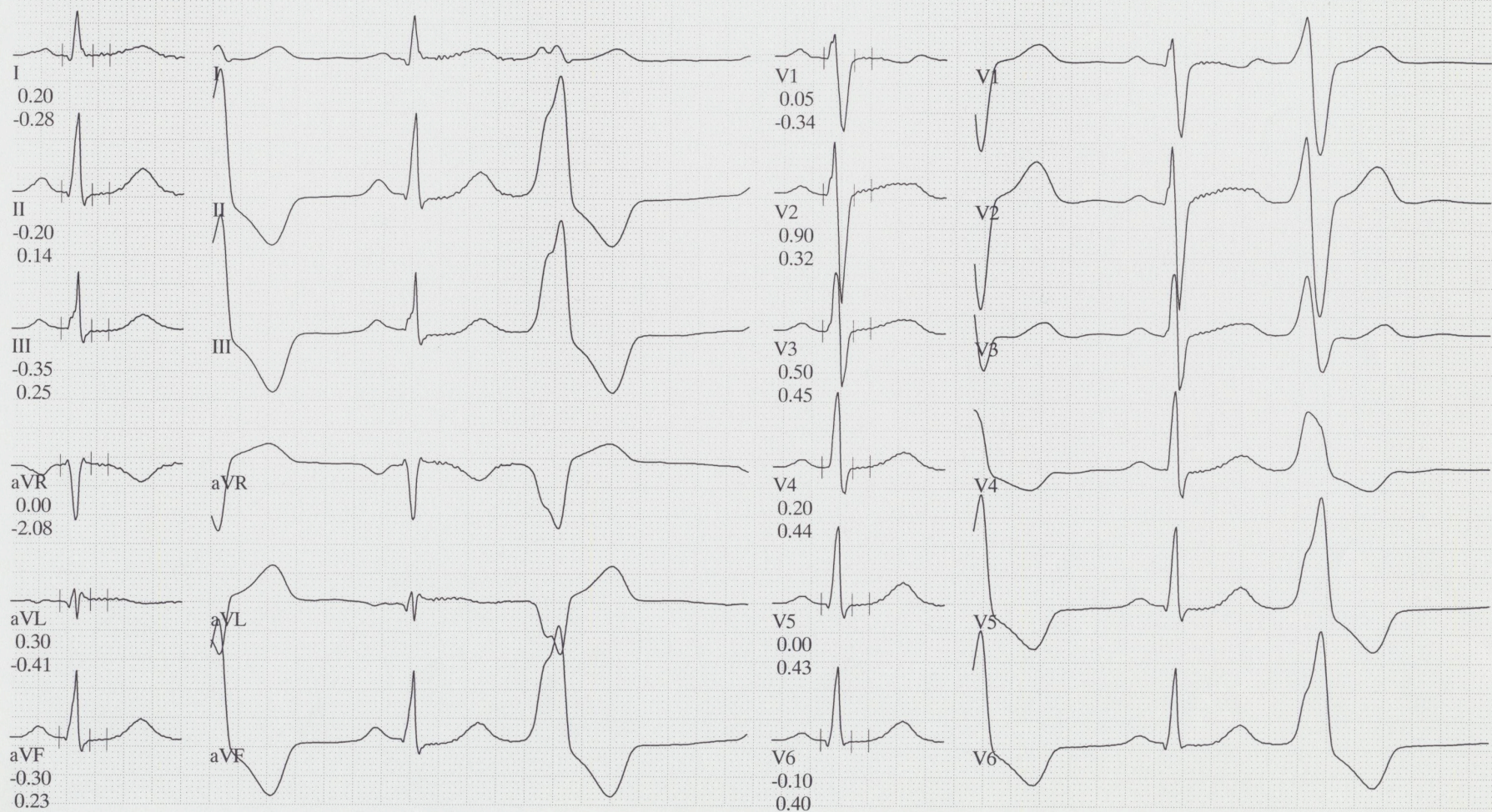
Clinical investigations

- ECG
- Holter
 - Amount of V ectopy (PVCs and VT)
 - QRS morphology
 - Monomorphic vs. polymorphic
 - Origin of ectopic beats
 - Heart rate during possible VT runs, presence of close coupled PVCs, R-on-T
 - Attenuation/disappearance or increase of V ectopy with higher sinus rates

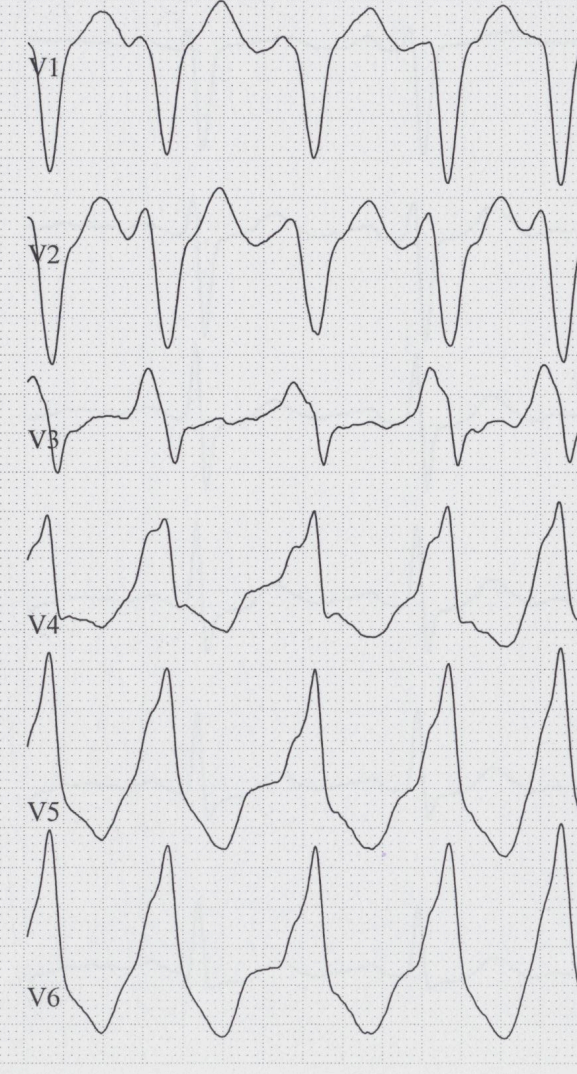
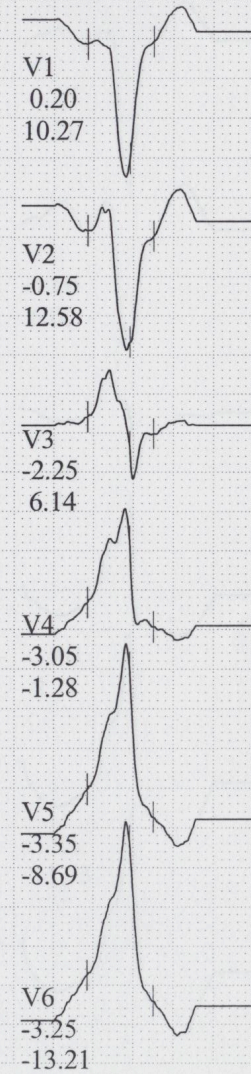
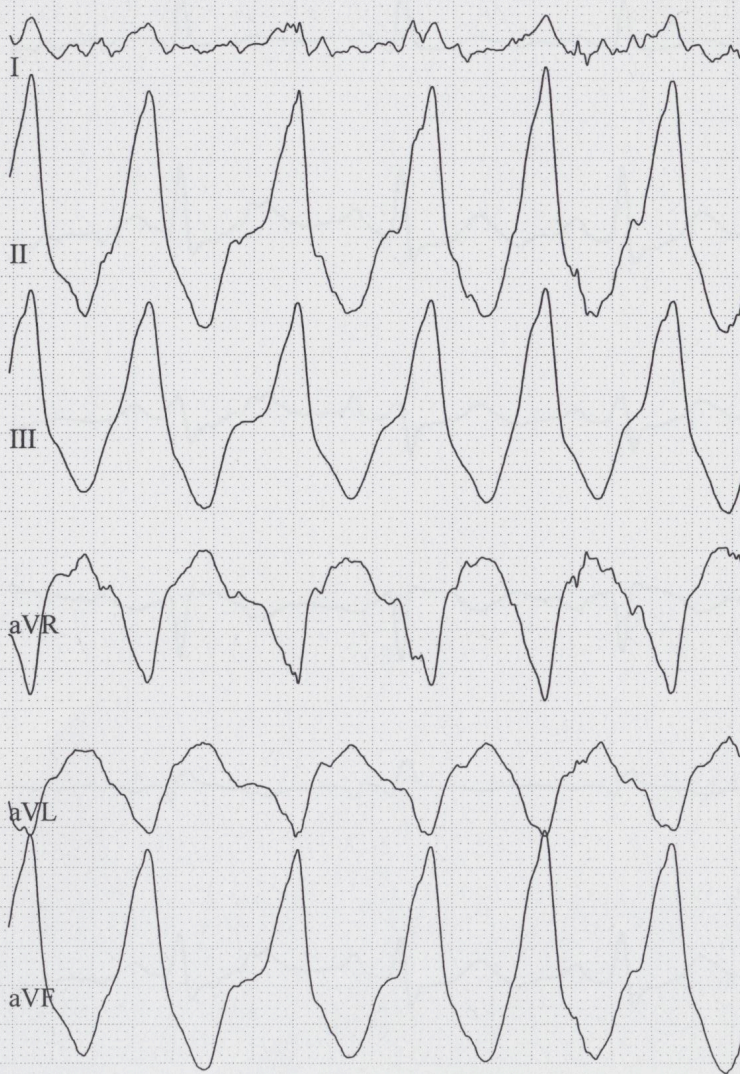
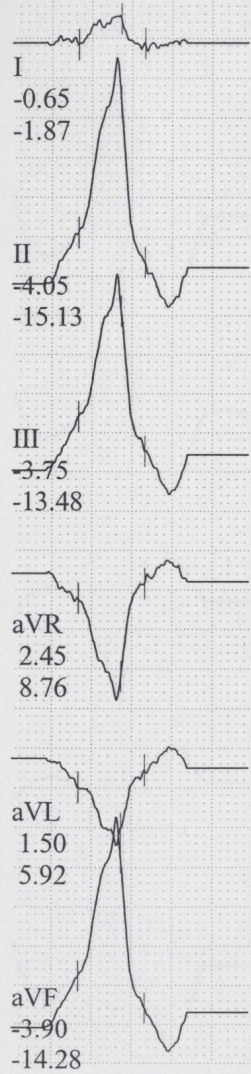
Clinical investigations

- Exercise test
 - Behaviour of V ectopy during exercise
 - Increase or attenuation of ectopy with increasing sinus rate
 - Appearance of monomorphic VT (OT VT, fascicular VT, ARVC) or polymorphic VT (CPVT)

60 ms post J



60 ms post J



Clinical investigations

- Cardiac imaging
 - Echocardiography
 - Wall thickness assessment
 - Systolic and diastolic function
 - Exclusion of valvular lesions, coronary artery anomalies, and cardiac tumors
 - Serial follow-up in patients with high arrhythmia burden
 - MRI – in selected cases (VT, high PVC burden, complex V ectopy)
 - Structure, function, presence of fibrosis
 - LGE
 - Use established criteria when making ARVC diagnosis!
- Electrophysiologic study
 - Indicated for ablation only

Follow up

- High PVC burden ($> 10-15\%$)
 - Echocardiography, Holter +/- exercise test
 - Interval 12-24 months

Ventricular ectopy in children

- Ventricular ectopy in children is mostly benign
 - Tendency to decrease/disappear with time
- Idiopathic VT in patients with normal hearts carries a good prognosis
 - Tendency to resolve with time
- Thorough evaluation to exclude cardiac disease
 - Especially with high PVC burden or VT

Ventricular ectopy in children

- Small subset of patients with high PVC burden may develop LV dysfunction
 - Follow up appropriate, especially with RBBB morphology

