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CARDIOLOGY**  
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## Resistant tachyarrhythmia in a child

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### Clinical Data

- 11 year-old girl.
- No history of chronic illness.
- Presented with palpitation of 1 hour duration, associated with dizziness and near syncope.



## Clinical Data

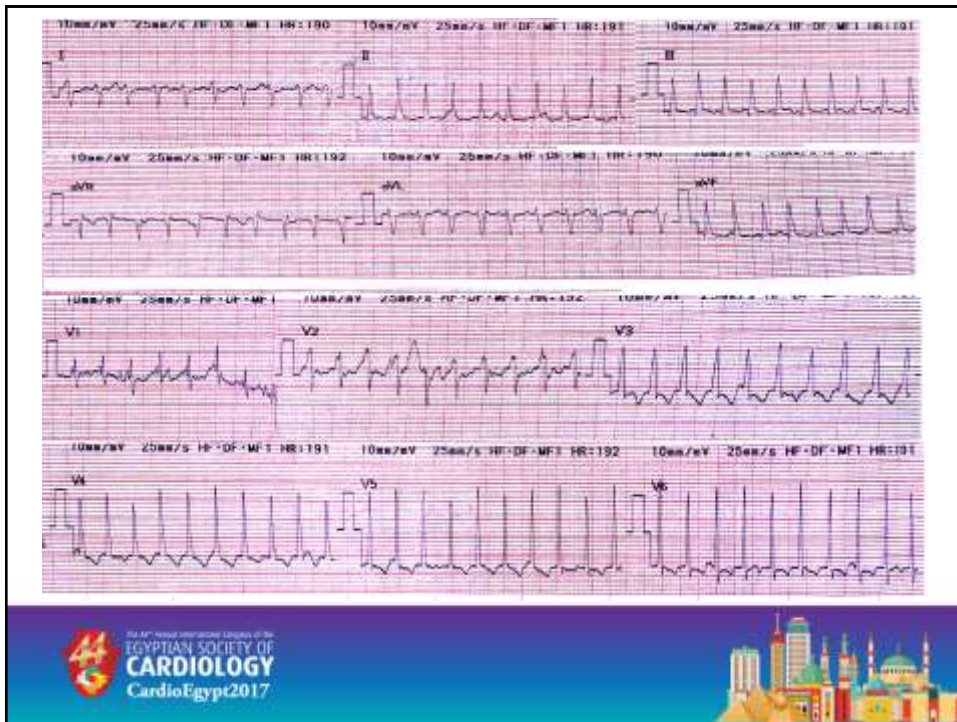
- She reported previous recurrent similar episodes of short duration and sudden onset and offset.
- Prolonged episodes within the last 5 months.
- She started to suffer from easy fatigability and shortness of breath during the past few weeks.



## Physical examination

- The patient was conscious but dizzy
- HR: 190 bpm and regular
- BP: 80/50 mmHg
- Chest: clear
- Heart: tachycardia, no murmurs could be appreciated
- **12 lead ECG:**





## ECG Findings

- Rhythm: regular
- HR: 190 bpm
- QRS width: 100 ms
- No obvious P waves

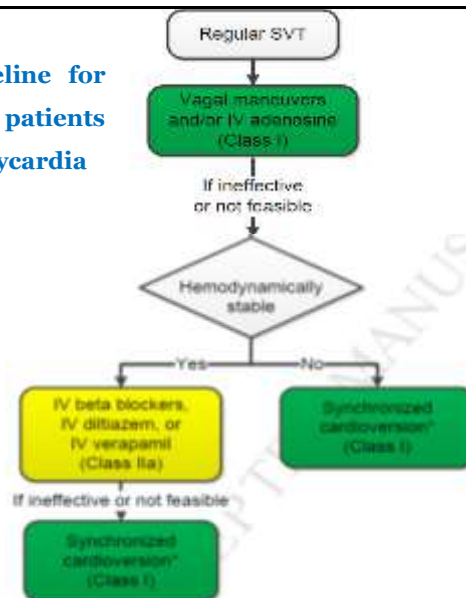


## Acute management

- It was considered that the patient has narrow complex tachycardia most probably supraventricular with hemodynamic instability.
- So, after IV sedation, she received two synchronized DC shocks, 50 joules and 150 joules respectively, with no effect.

- *Synchronized cardioversion in children: Begin with 0.5-1 J/kg and, if ineffective, increase to 2 J/kg*

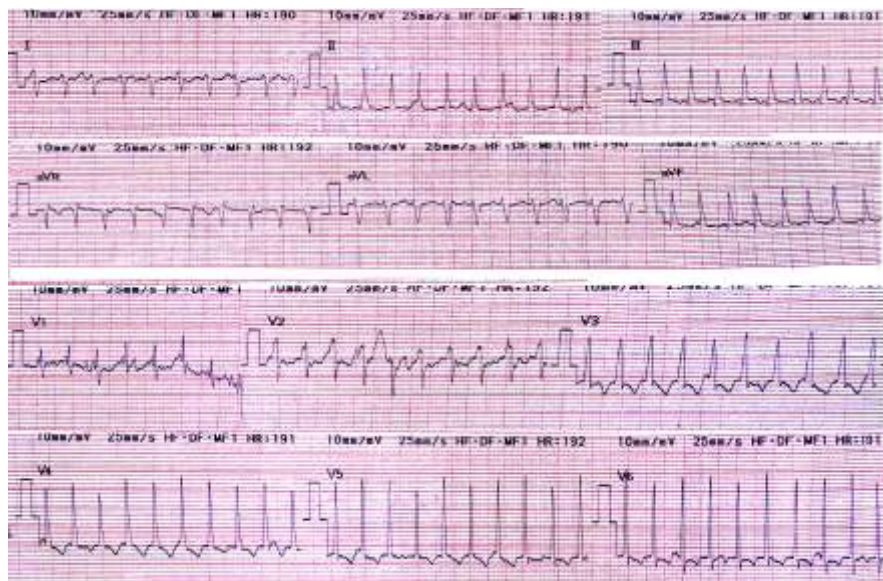
### 2015 ACC/AHA/HRS Guideline for the Management of Adult patients With Supraventricular Tachycardia



*Acute Treatment of Regular SVT of Unknown Mechanism*

## Acute management

- Oxygen was administered and IV access was obtained.
  - Adenosine rapid IV bolus with weight adjusted dose was then tried:
    - first dose 4.5 mg with no effect.
    - followed by second dose 9 mg, also with no effect (no change in the rate or the rhythm).
- *Adenosine dose in children: 0.1 mg/kg rapid IV push (maximum: 6 mg).  
If SVT persists, give a second dose after 2 minutes (double the first dose with maximum dose of 12 mg)*



## Fact 1:

European Heart Journal (2001) 22, 702-711

doi:10.1053/euhj.2000.2399, available online at <http://www.idealibrary.com> on IDEAL®

### New normal limits for the paediatric electrocardiogram

P. R. Rijnbeek<sup>1</sup>, M. Witsenburg<sup>2</sup>, E. Schrama<sup>2</sup>, J. Hess<sup>3</sup> and J. A. Kors<sup>1</sup>

- ECGs from 1912 healthy Dutch children (age 11 days to 16 years) were recorded and analyzed. The normal limits of all clinically relevant ECG measurements were determined for nine age groups.



**Table 2 Lead-independent ECG measurements for boys (upper row) and girls (lower row): median (2nd percentile, 98th percentile)**

Lead	0-1 months	1-5 months	5-9 months	9-12 months	1-3 years	3-5 years	5-8 years	8-12 years	12-16 years
Heart rate (beats min <sup>-1</sup> )	100 (120, 102)	112 (126, 107)	119 (132, 109)	120 (136, 104)	119 (97, 100)	99 (75, 123)	88 (62, 11)		80 (62, 11)
P axis (°)	76 (13, 90)	52 (10, 73)	40 (- 8, 70)	49 (9, 67)	40 (- 42, 70)	43 (- 13, 60)	43 (- 9, 56)	8-12 years	41 (- 9, 56)
P duration (ms)	52 (24, 80)	48 (20, 77)	51 (16, 80)	50 (14, 69)	47 (11, 60)	44 (- 6, 30)	42 (- 13, 1)		42 (- 13, 1)
PR interval (ms)	79 (64, 97)	79 (65, 89)	81 (64, 103)	80 (60, 94)	80 (63, 113)	87 (67, 107)	92 (75, 10)		92 (75, 10)
QRS axis (°)	79 (60, 100)	79 (62, 100)	78 (63, 100)	80 (64, 97)	81 (62, 100)	84 (60, 101)	89 (71, 10)		89 (71, 10)
QRS duration (ms)	101 (91, 121)	99 (78, 133)	100 (84, 127)	100 (88, 133)	113 (78, 147)	123 (89, 153)	124 (92, 19)	78 (55, 101)	124 (92, 19)
QTc interval (ms)*	47 (75, 100)	47 (37, 139)	46 (- 6, 107)	49 (14, 127)	49 (- 4, 110)	50 (5, 117)	50 (- 10, 112)	80 (58, 110)	50 (- 10, 112)
QTc duration (ms)	110 (63, 159)	80 (38, 121)	79 (37, 100)	87 (1, 102)	89 (2, 121)	89 (13, 104)	79 (27, 11)	39 (- 17, 76)	79 (27, 11)
QTc interval (ms)*	47 (36, 83)	44 (12, 77)	46 (14, 80)	49 (7, 86)	49 (7, 86)	49 (7, 86)	49 (7, 86)	42 (- 15, 82)	49 (7, 86)
QTc interval (ms)*	47 (36, 79)	43 (19, 77)	44 (20, 78)	44 (22, 80)	46 (24, 85)	49 (24, 85)	49 (24, 85)	98 (78, 117)	49 (24, 85)
	429 (179, 403)	424 (180, 434)	419 (190, 440)	414 (181, 440)	417 (191, 447)	413 (180, 442)	409 (175, 4)	94 (75, 114)	409 (175, 4)

Bold values indicate that the 95% confidence intervals of the percentile estimates for boys and girls do not overlap.

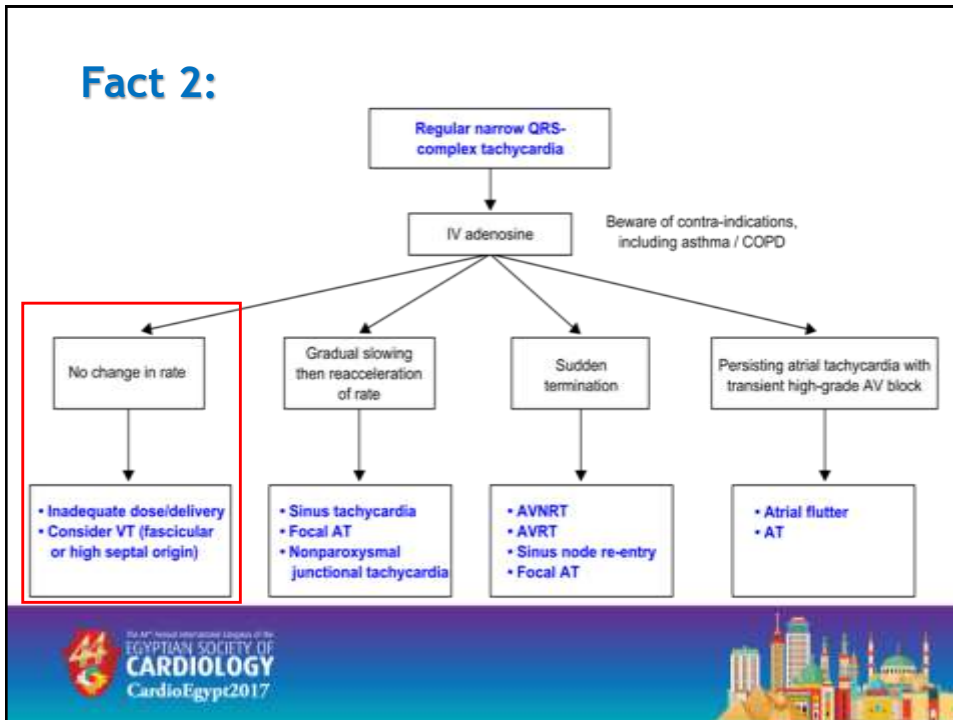
\*Corrected QT interval, according to Bazett's formula:  $QTc = QT \times \sqrt{\frac{1000}{RR}}$

QRS duration (ms) for girls 8-12 years

82 (66, 99)  
411 (373, 440)  
410 (365, 447)



## Fact 2:

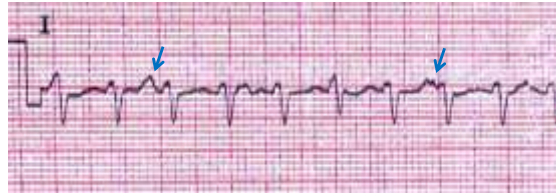


## Fact 3:

- It should be remembered that VT does not always present as a wide QRS complex tachycardia, especially in infants.
- Idiopathic VT :
  - Narrower QRS than other forms of VT (100 – 140 ms).
  - Short RS interval (onset of R to nadir of S wave) of 60-80 ms.
  - RBBB Pattern.

The banner at the bottom of the slide features the logo of the Egyptian Society of Cardiology (ESC) on the left, which includes the number '44' and the text 'The 44th Annual International Congress of the EGYPTIAN SOCIETY OF CARDIOLOGY CardioEgypt2017'. To the right of the logo is a colorful illustration of a city skyline with various buildings and domes.

### Fact 4:



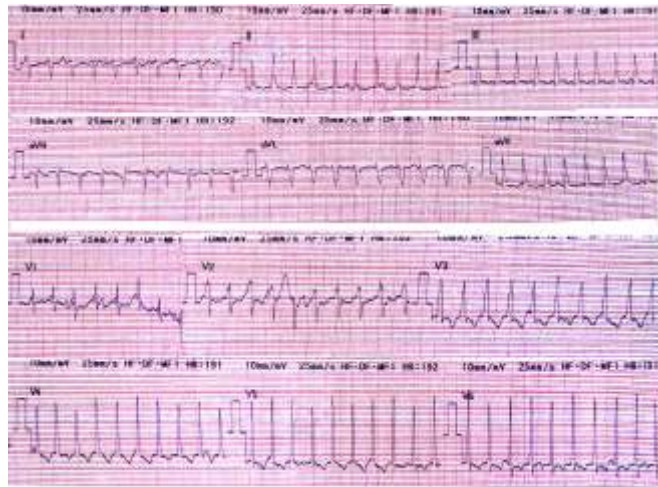
**VT is possible**





## What type of VT?

- Monomorphic VT
- RBBB
- Right inferior axis



## Types of Idiopathic Ventricular Tachycardia

Type of VT	QRS morphology/axis	Pharmacotherapy sensitivity	Entrainment	Treatment
RVOT VT and monomorphic extrasystoles	LBBB/inferior axis	Adenosine, $\beta$ -blocker, verapamil (or diltiazem)	No	$\beta$ -Blocker, verapamil, RF ablation
LVOT VT	S wave in Lead I, R-wave transition in V1 or V2	Adenosine, $\beta$ -blocker, verapamil (or diltiazem)	No	$\beta$ -Blocker, verapamil, RF ablation
ILVT, focal reentry	RBBB/left superior axis (exit, posterior fascicle), RBBB/right inferior axis (exit, anterior fascicle)	Verapamil	Yes	Verapamil, RF ablation
IPVT	RBBB or LBBB (monomorphic or polymorphic)	Propranolol	No	$\beta$ -Blocker

ILVT: idiopathic left ventricular tachycardia, IPVT: idiopathic propranolol-sensitive ventricular tachycardia



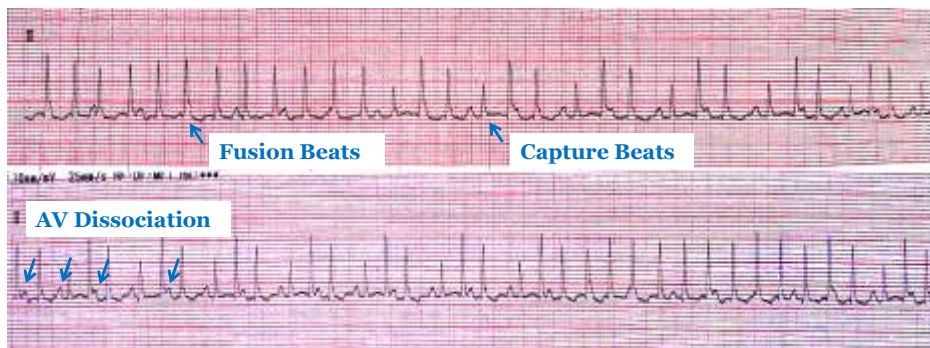
## Acute management

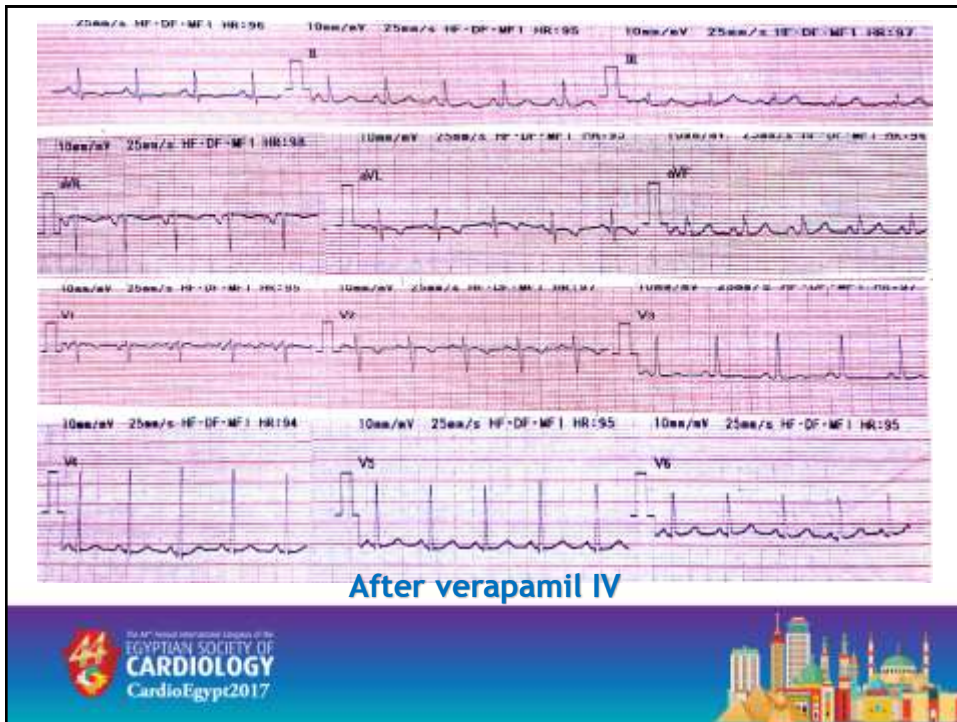
- Verapamil 5 mg IV was given slowly over 2 minutes.

- *Verapamil pediatric dose (1-15 years): 0.1 – 0.3 mg/kg (not to exceed 5 mg) IV over 2 minutes, second dose (not to exceed 10 mg) may be given after 30 minutes.*



## During verapamil administration





## Investigations

- Lab. Workup: unremarkable.
- Echocardiography: mildly dilated LV cavity, estimated LVEF: 45% (possibly tachyarrhythmia induced), mild MR.

## In-hospital management

- The patient was admitted to the CCU for rhythm monitoring.
- Oral verapamil was initiated.
- Her hospitalization was uneventful and she was subsequently discharged home.



## Chronic management

- The patient was kept on verapamil 40 mg PO q8hr (pediatric dose: 4-8 mg/kg/day divided q8hr).
- Cardiac MRI was requested as part of the evaluation of possible myocarditis or cardiac tumors.
- RF ablation was discussed.
- Follow up visit: no recurrence of tachyarrhythmia and the patient is well controlled on oral verapamil.



## Ventricular tachycardia

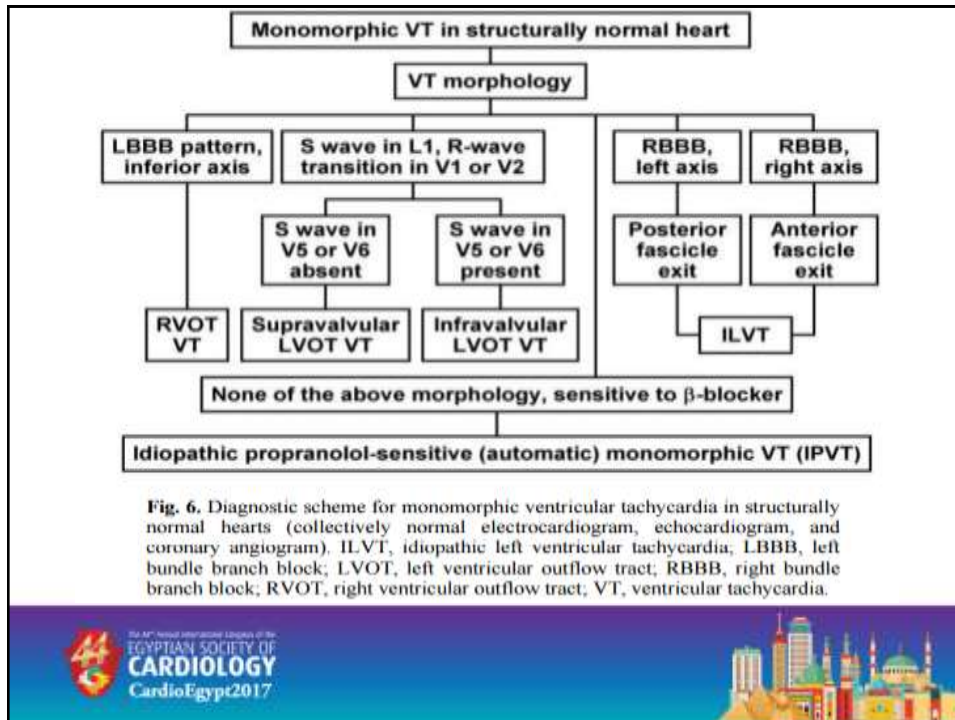
- VT is rare in children and accounts for about 6% of patients followed for tachycardias.
- Etiology is widely variable and includes idiopathic, drug toxicity, cardiomyopathy, myocarditis, cardiac tumors and metabolic abnormalities.



## Idiopathic Ventricular tachycardia

- Observed Ventricular tachycardias (VT) are usually related to structural heart disease.
- However in 10% of patients with VT, no structural heart disease, metabolic/electrolyte abnormalities or long QT syndrome can be found.
- These arrhythmias have been called idiopathic VT.





## Idiopathic Ventricular tachycardia

- The majority of idiopathic VTs (75-90%) arise from the right ventricle – e.g RVOT tachycardia.
- Fascicular VT is the most common type of idiopathic VT arising from the left ventricle (10-15% of all idiopathic VTs).
- Fascicular VT was first described by Zipes et al in 1979.
- In 1981, Belhassen et al showed that this form of VT could be terminated by verapamil.

## Idiopathic Ventricular tachycardia

- The most likely mechanism of ILVT is reentry with an excitable gap and a zone of slow conduction.
- Most of the episodes occur at rest, although can be triggered by exercise and emotional stress.
- Tachycardia-induced cardiomyopathy due to incessant tachycardia has been described.



## Idiopathic Ventricular tachycardia

- Diagnosis can be difficult and this rhythm is often misdiagnosed as SVT with RBBB.
- The diagnosis is made by observing specific features of VT, e.g. fusion/capture beats, AV dissociation.
- Idiopathic fascicular tachycardia may prove difficult to treat as it is often unresponsive to adenosine, vagal maneuvers, and lignocaine. However, it characteristically responds to verapamil.



## Idiopathic Ventricular tachycardia

- Long-term therapy with verapamil is useful in mild cases and RF ablation is highly effective (85%-90%) in those with severe symptoms.
- Patients generally tolerate the tachycardia and sudden cardiac death is rare in this patient population.
- The prognosis of these patients remains excellent.



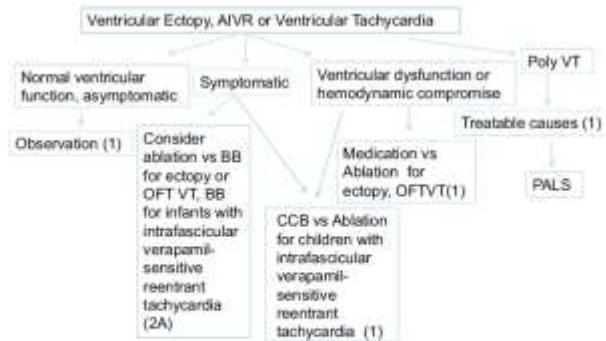
### **PACES/HRS Expert Consensus Statement on the Evaluation and Management of Ventricular Arrhythmias in the Child With a Structurally Normal Heart**

*Heart Rhythm, Vol 11, No 9, September 2014*





## Treatment algorithm



See text for details. Numbers in parentheses refer to level of recommendation. Abbreviations not in text: AAD= antiarrhythmic drug; BB= beta blockers; CCB= calcium channel blocker; OFT VT= outflow tract tachycardia; PALS= pediatric advanced life support guideline.

Figure 5 Treatment algorithm. See text for details. Numbers in parentheses refer to the level of recommendation. AIVR = accelerated idioventricular rhythm; BB =  $\beta$ -blocker; CCB = calcium-channel blocker; OFT VT = outflow tract tachycardia; PALS = Pediatric Advanced Life Support; VT = ventricular tachycardia.

## Indications for catheter ablation in children with idiopathic ventricular arrhythmias

### Class I

- Catheter ablation is recommended in children with:
  1. *Ventricular dysfunction or hemodynamic compromise* presumed to be due to ventricular ectopy or tachycardia, either as primary therapy or in patients not controlled medically (Level of evidence: C).
  2. *Intrafascicular verapamil-sensitive reentrant tachycardia*, either as primary therapy or if not controlled by calcium-channel blockers (Level of evidence: C).

*Thank  
you*

