PEDIRHYTHM VII

Pediatric and Congenital Rhythm Congress VII

4 - 7 February 2017 / Grand Hotel Palace - Thessaloniki, GREECE

Ablation in Infants and Smaller Children
WHEN: Indications and beyond

Alice MALTRET

INSTITUT CARDIOVASCULAIRE PARIS SUD

M3C

Brief history of catheter ablation in infants and smaller children

Brief history of catheter ablation in infants and smaller children

Early 90's

Surgical treatment
<1 year: life threatening arrhythmia
>1 year: medically refractory arrhythmia
Case et al, Am J Cardiol 1989
Crawford et al, J Thorac Cradiovasc Surg 1990

Direct current catheter ablation
Lemery et al, Circ 1992
Perry et al, Am J Cardiol 1992

Comparaison of catheter ablation using radiofrequency versus direct current energy
Huang et al, JACC 1991

Percutaneous Radiofrequency Catheter Ablation for supraventricular Arrhythmias in Children
Van Hare et al, JACC 1991

Brief history of catheter ablation in infants and smaller children

Radiofrequency Catheter Ablation of Incesssant, Medically Resistant Supraventricular Tachycardia in Infants and Small Children
Case et al, JACC 1992

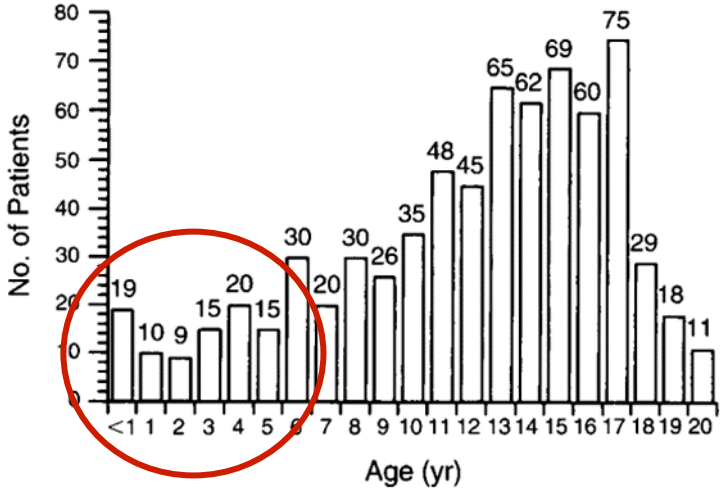
7 pts
3.4 to 13 kg

Brief history of catheter ablation in infants and smaller children

Early 90's 92 1994

Radiofrequency catheter ablation in children and adolescents
Kugler et al, NEJM 1994

625 Patients / 725 procedures
20 centers
10% ≤ 5 years



Brief history of catheter ablation in infants and smaller children

Indications for Radiofrequency Ablation in Pediatric Population
Van Hare, JCE 1997

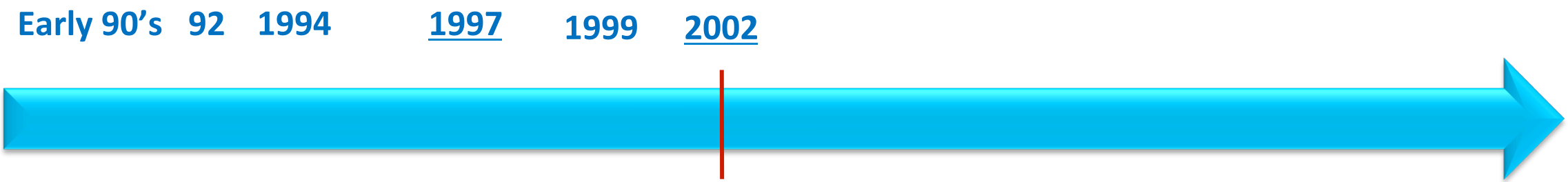
Threshold 4 years

Brief history of catheter ablation in infants and smaller children

Radiofrequency catheter abaltion in a hemodynamically compromised premature neonate with hydrops fetalis
Osborn et al, J Peadiatr Child Health 1999

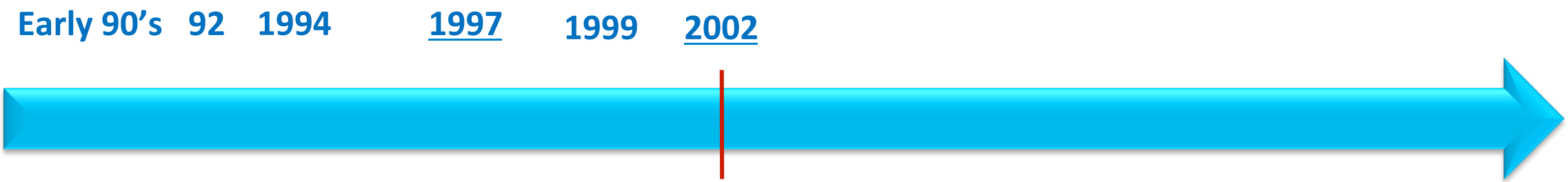
35 WG
3.7 kg

Brief history of catheter ablation in infants and smaller children



Pediatric Radiofrequency Catheter Ablation Registry. Success, Fluoroscopy Time, and Complication Rate for Supraventricular Tachycardia
Kugler et al, JCE 2002

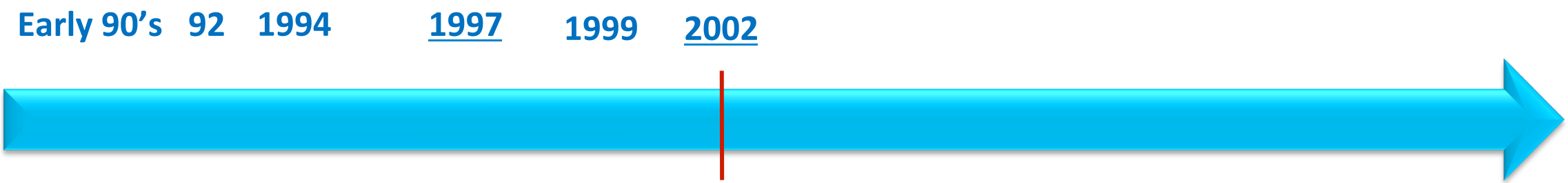
Brief history of catheter ablation in infants and smaller children



NASPE Expert Consensus Conference
Friedman et al, PACE 2002

Threshold 5 years or 15 kg

Brief history of catheter ablation in infants and smaller children



Radiofrequency Catheter Ablation of an Incessant Supraventricular Tachycardia in a Premature Neonate
Brugada et al, PACE 2002

31 WG
1840 g

Brief history of catheter ablation in infants and smaller children

Technology Breakthroughs

Brief history of catheter ablation in infants and smaller children

EHRA and AEPC-Arrhythmia Working Group joint consensus statement
Brugada et al, EUROPACE 2013

Threshold 5 years

Brief history of catheter ablation in infants and smaller children

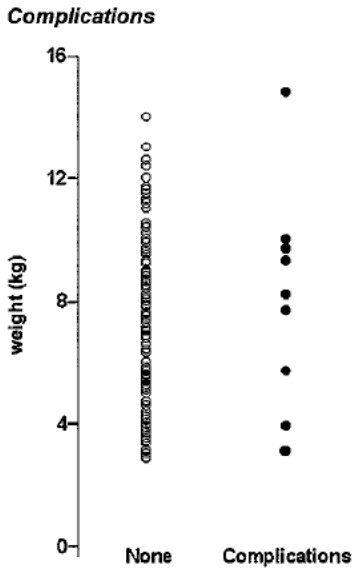
PACES/HRS expert consensus statement on the use of catheter ablation in children and patients with congenital heart disease
Saul et al, HR 2016

Threshold 15 kg

What’s behind those indications for « smaller » children ?

Higher Complication rate

- Higher immediate complication rate and severity
  - #10% before 2000
  - Less nowadays



- 4.6% major complication/infant
  2.9%/non infant (NS)

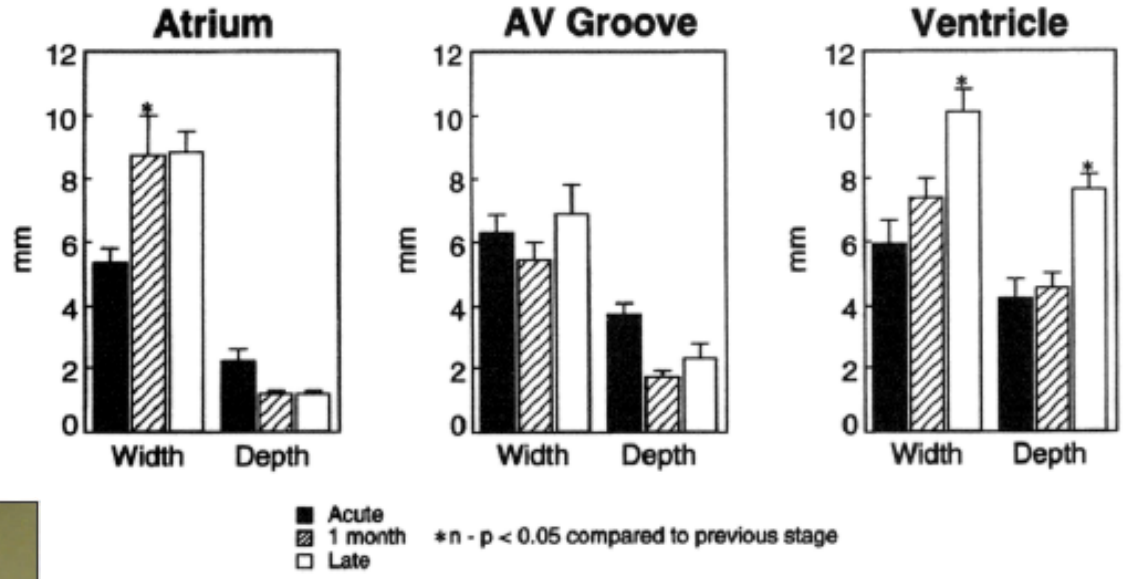
Blaufox et al, Circ. 2001

	Complications/Attempts		
	Late Era		
Pathway/Mechanism	**All Ages**	**< 5 Years**	**5–21 Years**
Left free wall	32/1,074 (3%)	5/58 (9%)	27/1,016 (3%)
Right free wall	8/410 (2%)	3/32 (9%)	5/378 (1%)
Anterior septal	15/322 (5%)	3/29 (10%)	12/293 (4%)
Posterior septal	9/431 (2%)	3/49 (6%)	6/382 (2%)
AV nodal reentry	29/977 (3%)	2/11 (18%)	27/966 (3%)
Atrial ectopic tachycardia	7/194 (4%)	2/26 (8%)	5/168 (3%)
Total	100/3,407 (3%)	18/205 (9%)	82/3,202 (3%)

Kugler et al, JCE 2002

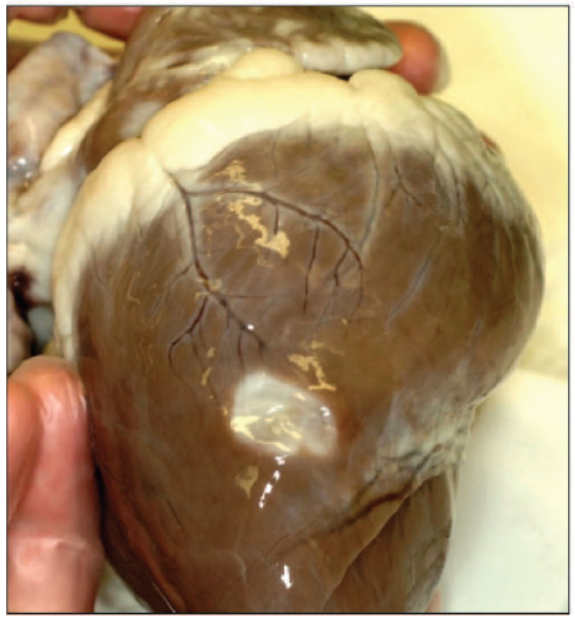
Immature myocardium

- Long-term lesion growth and invasion of scar tissue into the surrounding myocardium



Saul et al, Circ. 1994

RF



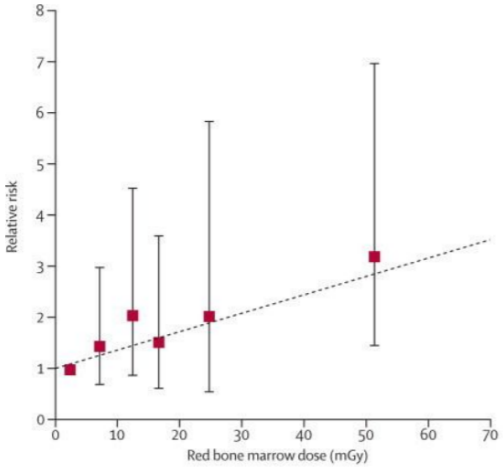
Cryo

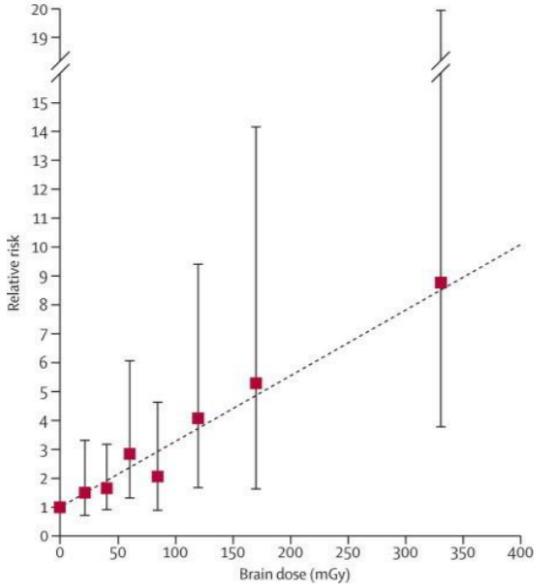
- No significant lesion growth on AV groove with either energy

Khairy et al, Circ Arrhyth Electrophysiol 2011

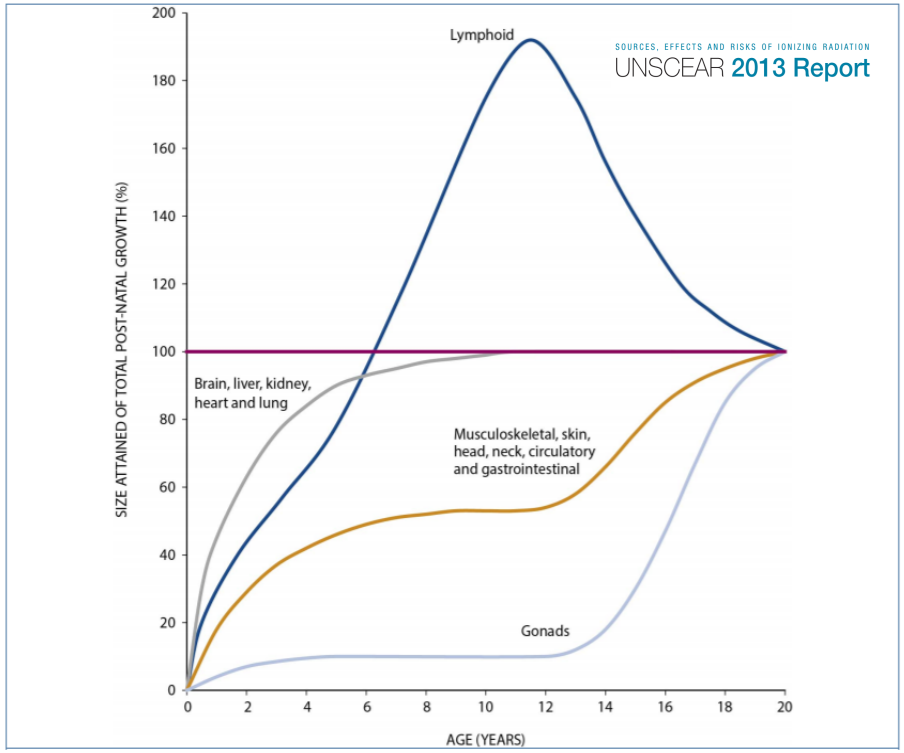
Radiation Exposure

- Risk of Leukaemia X3 for cumulative radiation dose > 30mGy
- Risk of Brain Tumor X2 for cumulative radiation dose > 60mGy





Pearce et al, Lancet 2012

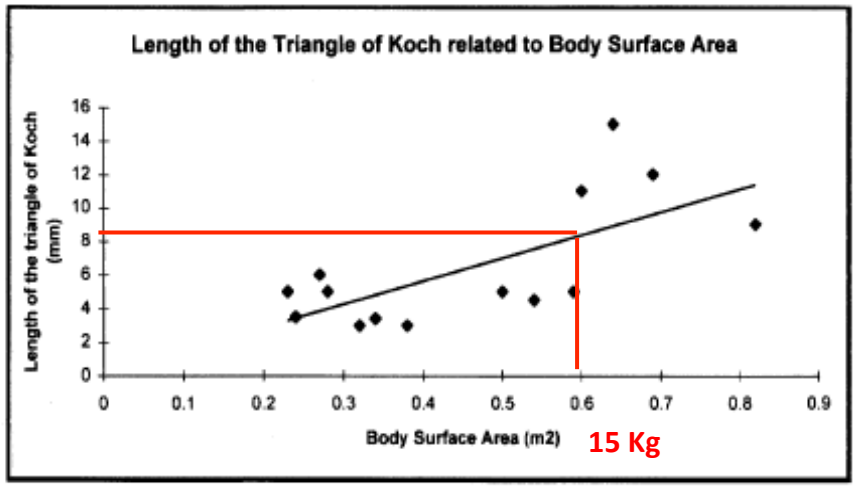


- Cancer incidence rate + 24% after CT scan exposure (4.5 mSv)

Mathews et al, BMJ 2012

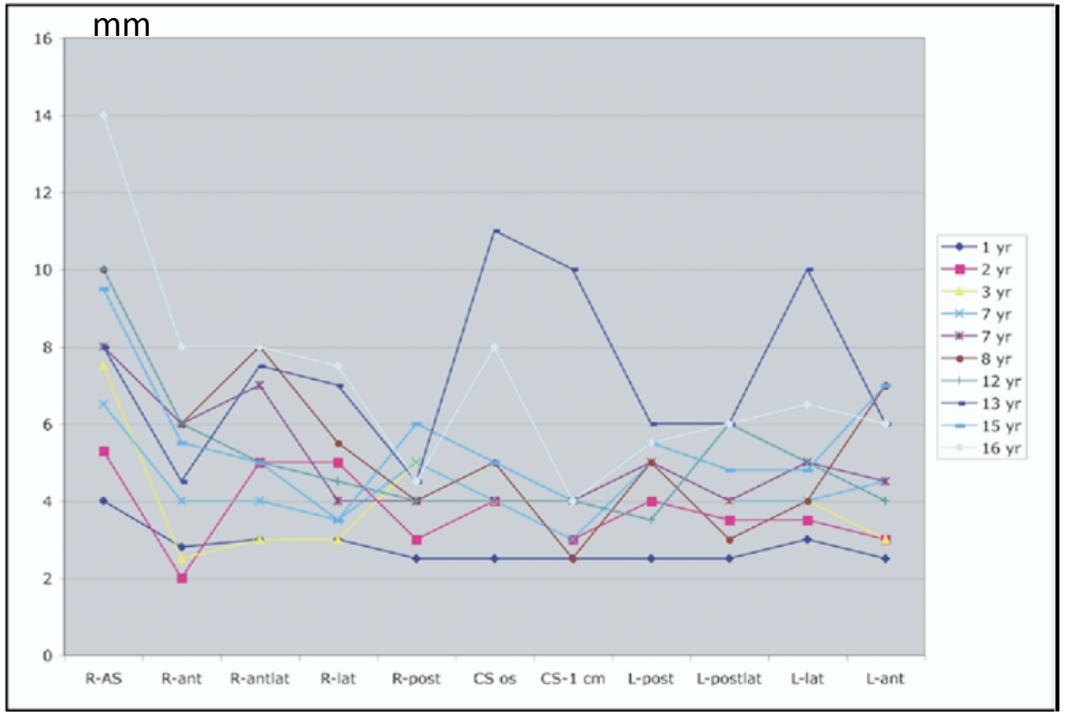
Heart Dimension and limited vascular access

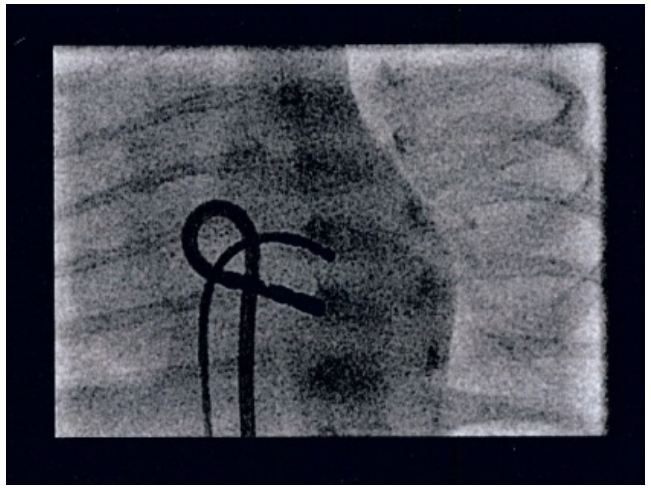
- Triangle of Koch
- Proximity Coronary A/Endocardium
- Vascular adverse event/pediatric cardiac catheterization (3.8%)
  - limited number of catheter
  - limited RF application



Goldberg et al, Am J Cardiology. 1999

Al Ammouri. Am J Cardiol 2006





What is a « smaller » children ?

< 4 years old ?

4 years (11 to 24 kg)

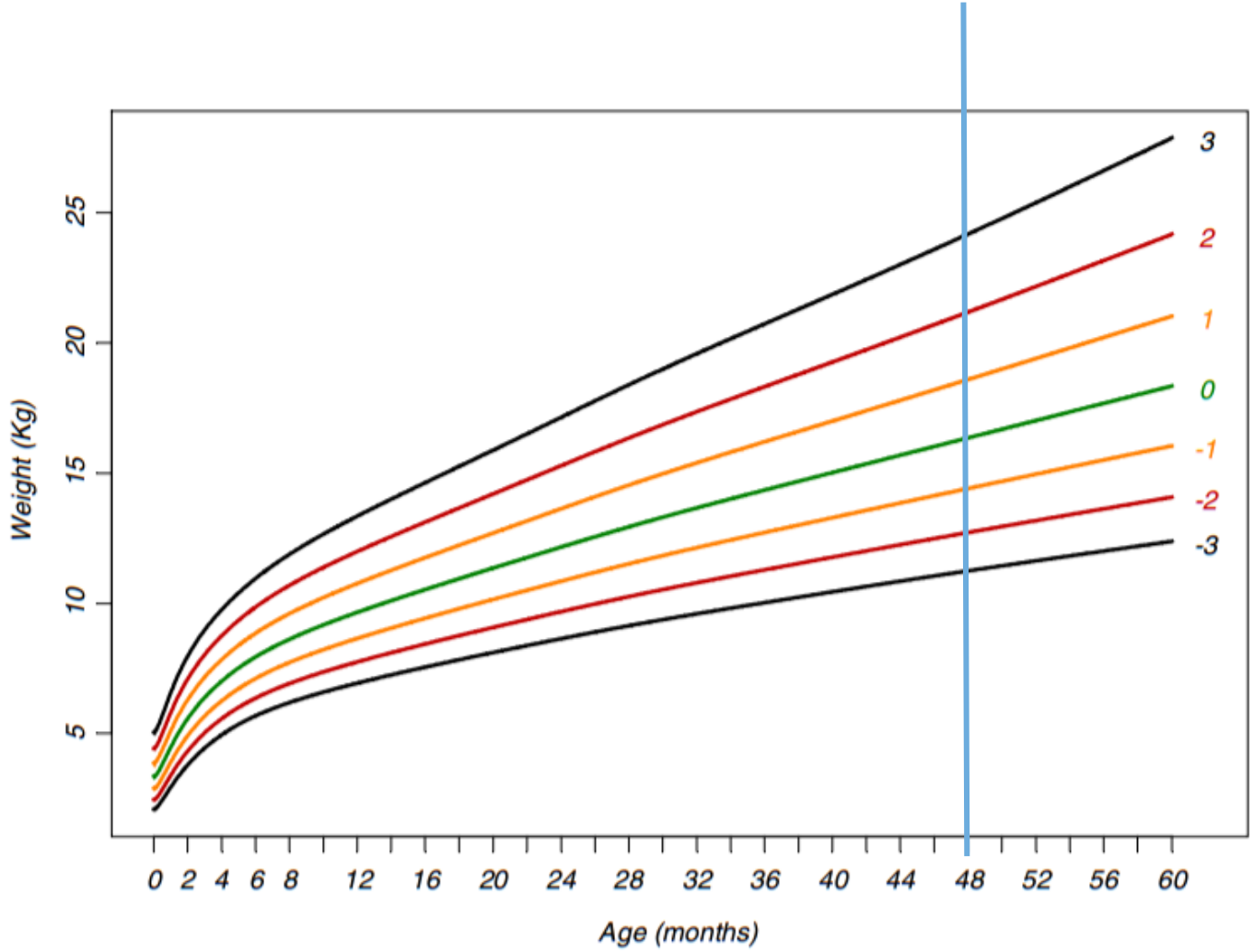


Figure 43 WHO weight-for-age z-scores for boys from birth to 60 months

< 5 years old ?

5 years
(12 to 27 kg)

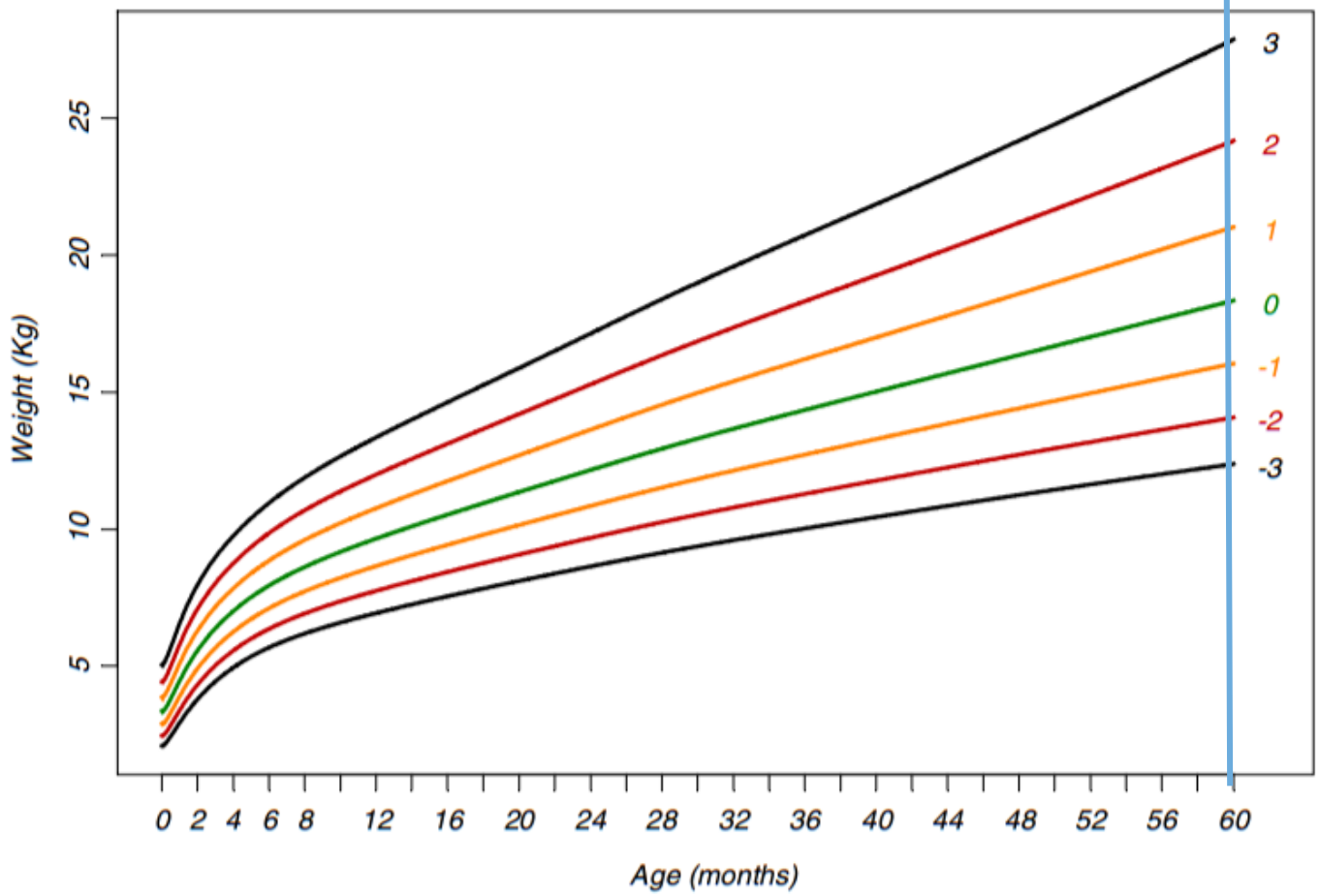


Figure 43 WHO weight-for-age z-scores for boys from birth to 60 months

< 15 kg ?

- from 18 months to…
- mean: 3.5 years

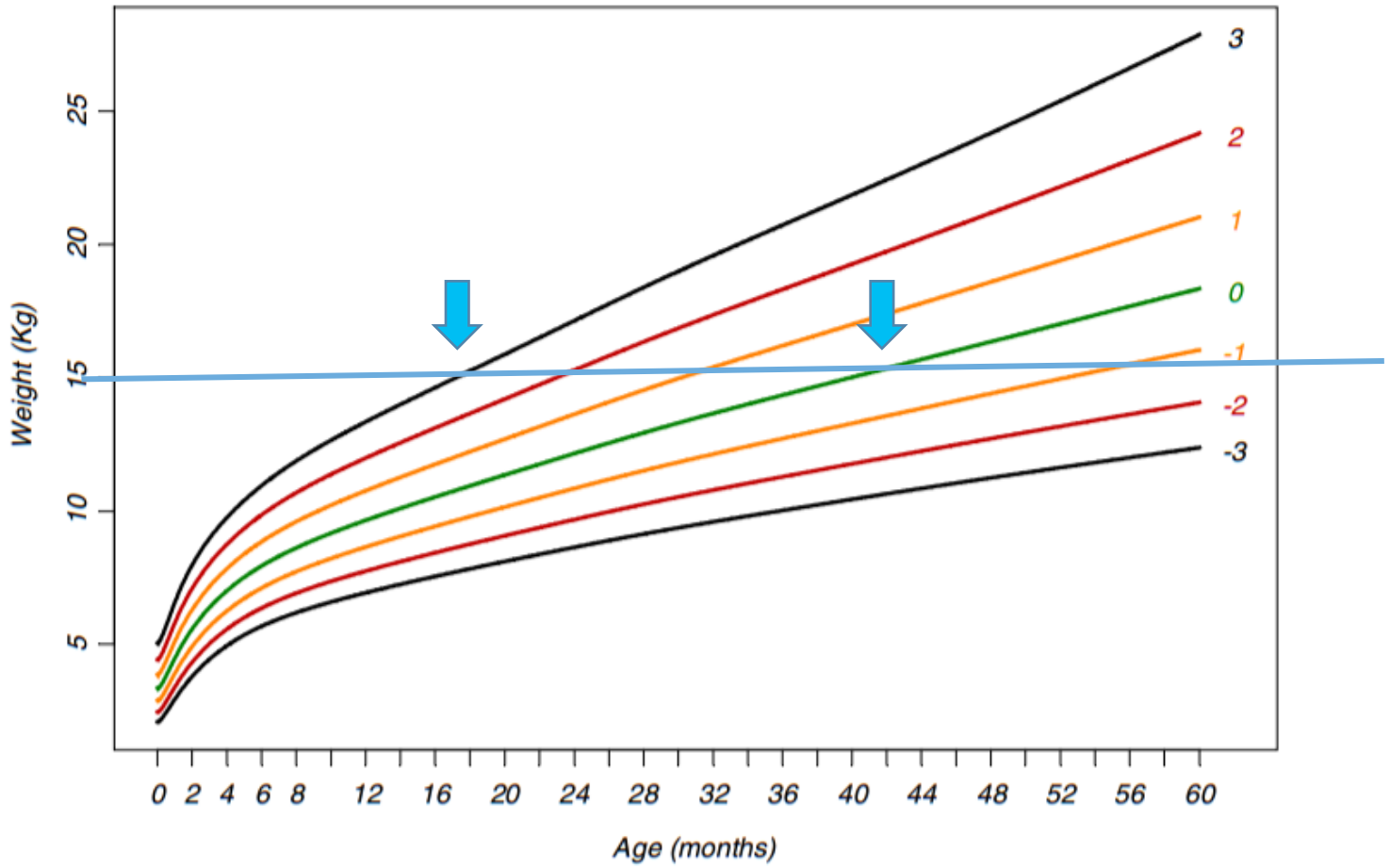
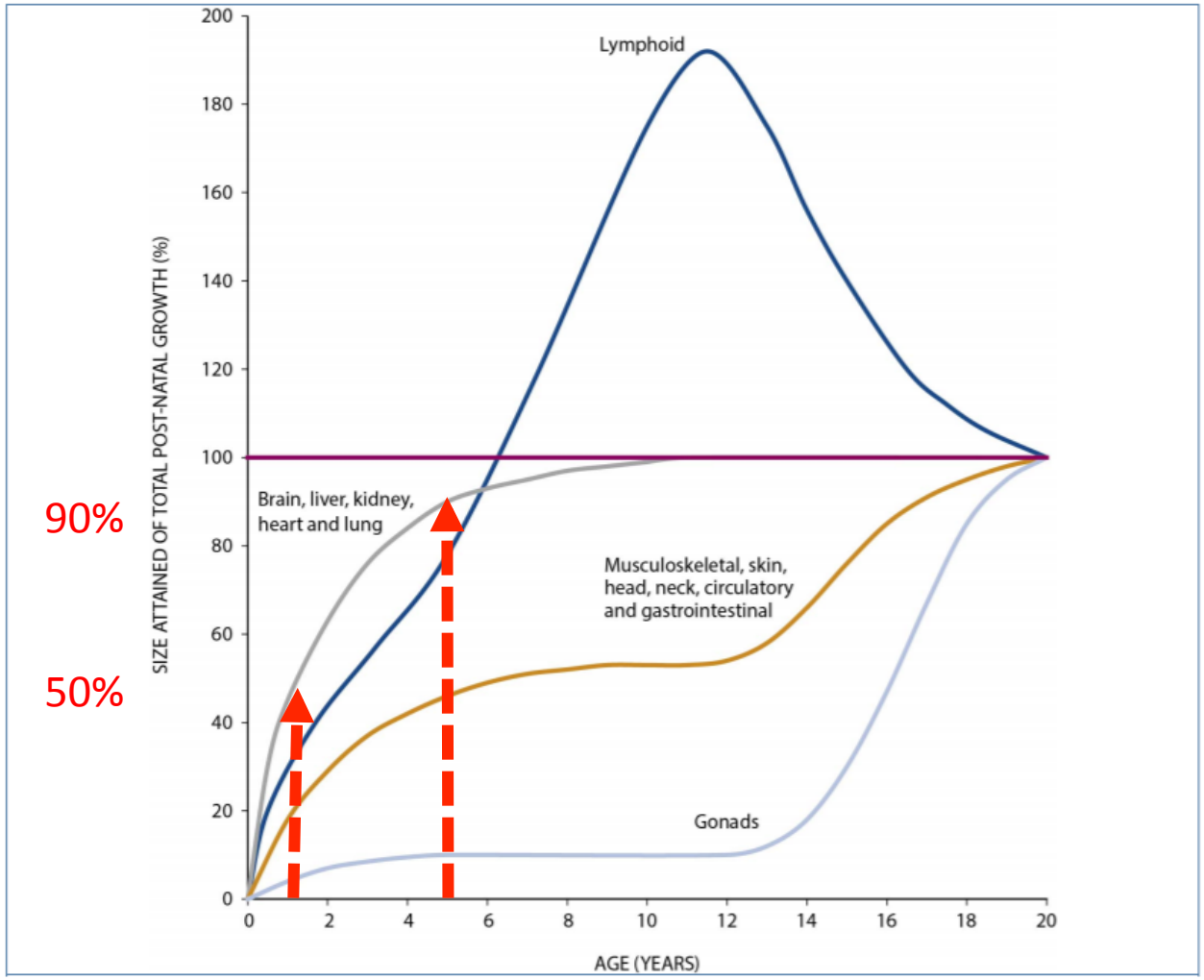


Figure 43 WHO weight-for-age z-scores for boys from birth to 60 months

Age matters…

- Heart residual growth

- Natural history of arrythmia
  - 40% of AP will involute
  - 78% of AET regression if diagnosed before 3 years old



CA Indications

Indications for Radiofrequency Ablation in the Pediatric Population

GEORGE F. VAN HARE, M.D.

JCE, 1997

Class I Indications for Pediatric Radiofrequency Ablation (Structurally Normal Heart)

(1a) Incessant tachycardia, decreased EF, age < 4 years, unresponsive to amiodarone
(1b) Incessant tachycardia, decreased EF, age > 4 years
(2) Paroxysmal symptomatic tachycardia, unresponsive to all antiarrhythmic medications
(3a) Wolff-Parkinson-White syndrome, status post cardiac arrest
(3b) Wolff-Parkinson-White syndrome, syncope, short accessory pathway ERP, age > 4 years

Class II Indications for Pediatric Radiofrequency Ablation (Structurally Normal Heart)

(1a) Incessant tachycardia, reduced EF, age < 4 years
(1b) Incessant tachycardia (other than junctional ectopic tachycardia), normal EF, age > 4 years
(1c) Incessant tachycardia, normal EF, age < 4 years, responsive to amiodarone
(2a) Paroxysmal symptomatic tachycardia, age > 4 years
(2b) Paroxysmal symptomatic tachycardia, age < 4 years, unresponsive to medications (except amiodarone)
(3a) Wolff-Parkinson-White syndrome, symptomatic, age > 4 years
(3b) Wolff-Parkinson-White syndrome, asymptomatic, age > 4 years, with short RR in atrial fibrillation

NASPE Expert Consensus Conference: Radiofrequency Catheter Ablation in Children with and without Congenital Heart Disease. Report of the Writing Committee

PACE, 2002

Class I

1. WPW syndrome following an episode of aborted sudden cardiac death.
2. The presence of WPW syndrome associated with syncope when there is a short preexcited RR interval during atrial fibrillation (preexcited R-R interval < 250 ms) or the antegrade effective refractory period of the AP measured during programmed electrical stimulation is < 250 ms.
3. Chronic or recurrent SVT associated with ventricular dysfunction.
4. Recurrent VT that is associated with hemodynamic compromise and is amenable to catheter ablation.

Class II A

1. Impending congenital heart surgery when vascular or chamber access may be restricted following surgery.
2. Chronic or frequent recurrences of intraatrial reentrant tachycardia.
3. Palpitations with inducible sustained SVT during electrophysiological testing.

Class II B

1. SVT, age < 5 years (including infants), when antiarrhythmic medications, including sotalol and amiodarone, are not effective or associated with intolerable side effects.
2. IART, one to three episodes per year, requiring medical intervention.
3. AVN ablation and pacemaker insertion as an alternative therapy for recurrent or intractable intraatrial reentrant tachycardia.
4. One episode of VT associated with hemodynamic compromise and which is amenable to catheter ablation.

Pharmacological and non-pharmacological therapy for arrhythmias in the pediatric population: EHRA and AEPC-Arrhythmia Working Group joint consensus statement

Europace, 2013

- Class I

WPW syndrome and episode of aborted SCD

WPW syndrome and syncope combined with preexcited RR interval during AF <250 ms or antegrade APERP during PES <250 ms

Incessant or recurrent SVT associated with ventricular dysfunction

Recurrent monomorphic VT with haemodynamic compromise and amenable to catheter ablation

- Class IIa

SVT, age <5 years (including infants), when AA medications, including Classes I and III are not effective or associated with intolerable side effects

- Class IIb

WPW syndrome and recurrent and/or symptomatic SVT and age <5 years

PACES/HRS expert consensus statement on the use of catheter ablation in children and patients with congenital heart disease

HR, 2016

Infants and Small Children < 15 Kg

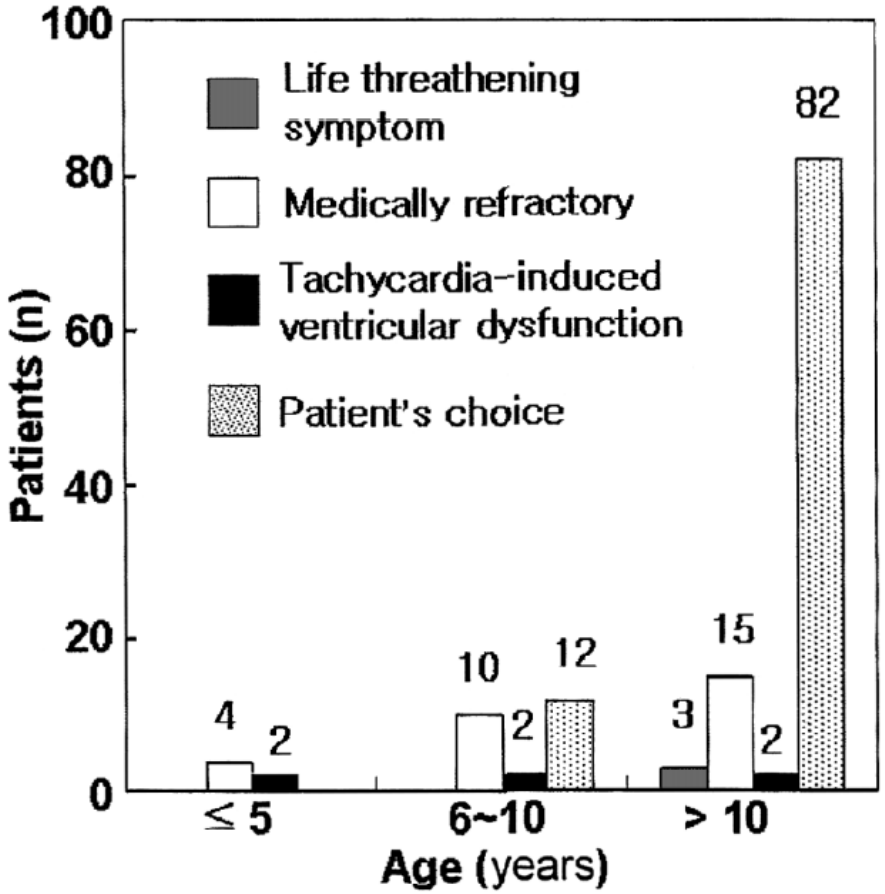
Class I Ablation is recommended for the following:

1. Documented SVT, recurrent[#] or persistent[^], when medical therapy is either not effective or associated with intolerable adverse effects (LOE: C).
2. WPW pattern following resuscitated cardiac arrest (LOE: B).
3. WPW pattern with syncope when there are predictors of high risk for cardiac arrest[§] (LOE: B).
4. Persistent[^] or recurrent[#] idiopathic JET, or congenital JET associated with ventricular dysfunction, when medical therapy is either not effective or associated with intolerable adverse effects[+] (LOE: C).
5. Ventricular ectopy or tachycardia with ventricular dysfunction, when medical therapy is either not effective or associated with intolerable adverse effects (LOE: C).
6. Recurrent[#] or persistent[^] SVT related to accessory AV connections or twin AV nodes in patients with CHD when medical therapy is either not effective or associated with intolerable adverse effects (LOE: B).
7. Ablation is effective for recurrent symptomatic atrial tachycardia occurring outside the early postoperative phase (less than three to six months) in patients with CHD, when medical therapy is either not effective or associated with intolerable adverse effects (LOE: B).
8. Pediatric cardiovascular surgical support should be available in-house during ablation procedures for smaller patients[*] (LOE: E).

Over 25 years indications didn’t change much…

- **Life threatening arrhythmia**
  - Ventricular dysfunction
  - Aborted cardiac arrest or high risk of cardiac arrest
- **Faillure of medical therapy**
  - Not effective
  - Intolerable side effect
- **Restriction of access**
  - Vascular or to chamber
  - To medical care…

Kantoch et al. Can J Cardiol 2011



Young et al. Circ J 2006

What is drug refractoriness ?

- Failure of ≥ 4 medication *Erikson et al, Am J Cardiol 1994*
- Unresponsiveness to amiodarone *Van Hare et al, JCE 1997*
- Amiodarone or Sotalol not effective *Friedman et al, PACE 2002*
- Class I and III AA medication not effective *Brugada et al, EUROPACE 2013*
- Medical Therapy not effective *Saul et al, HR 2016*

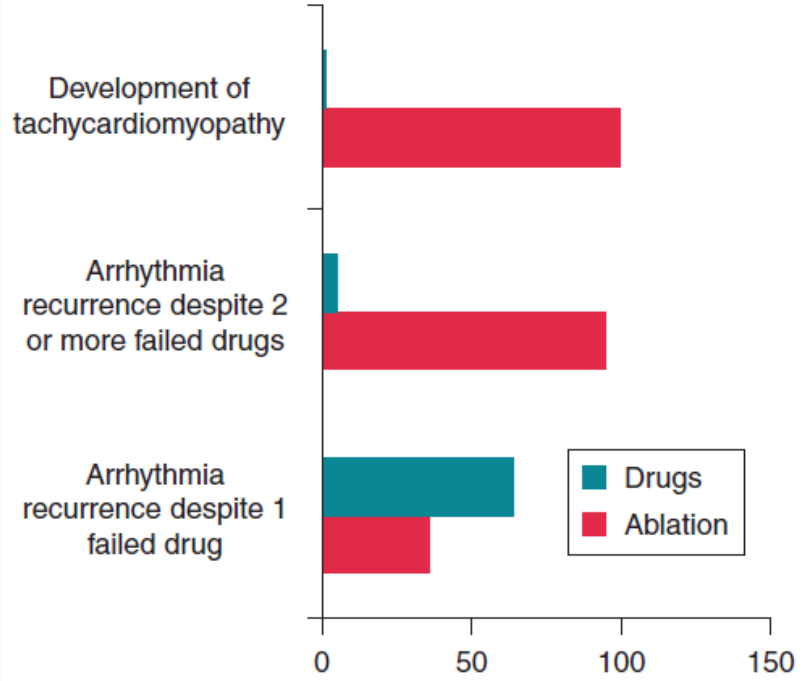
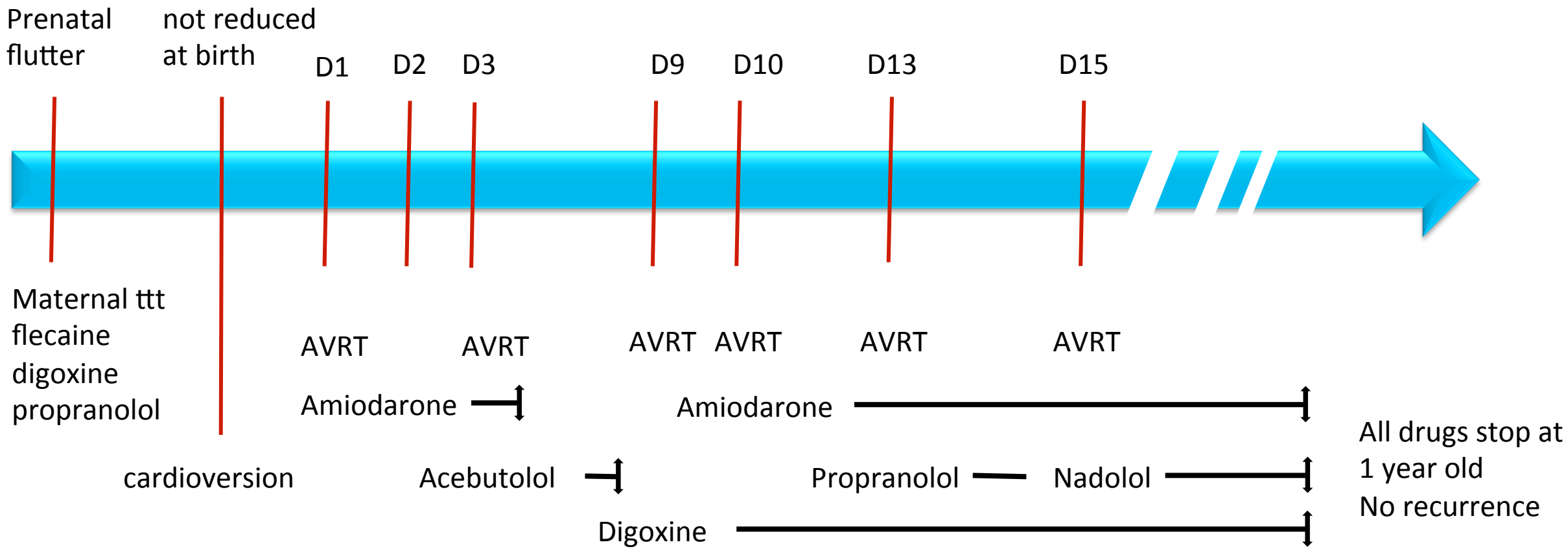
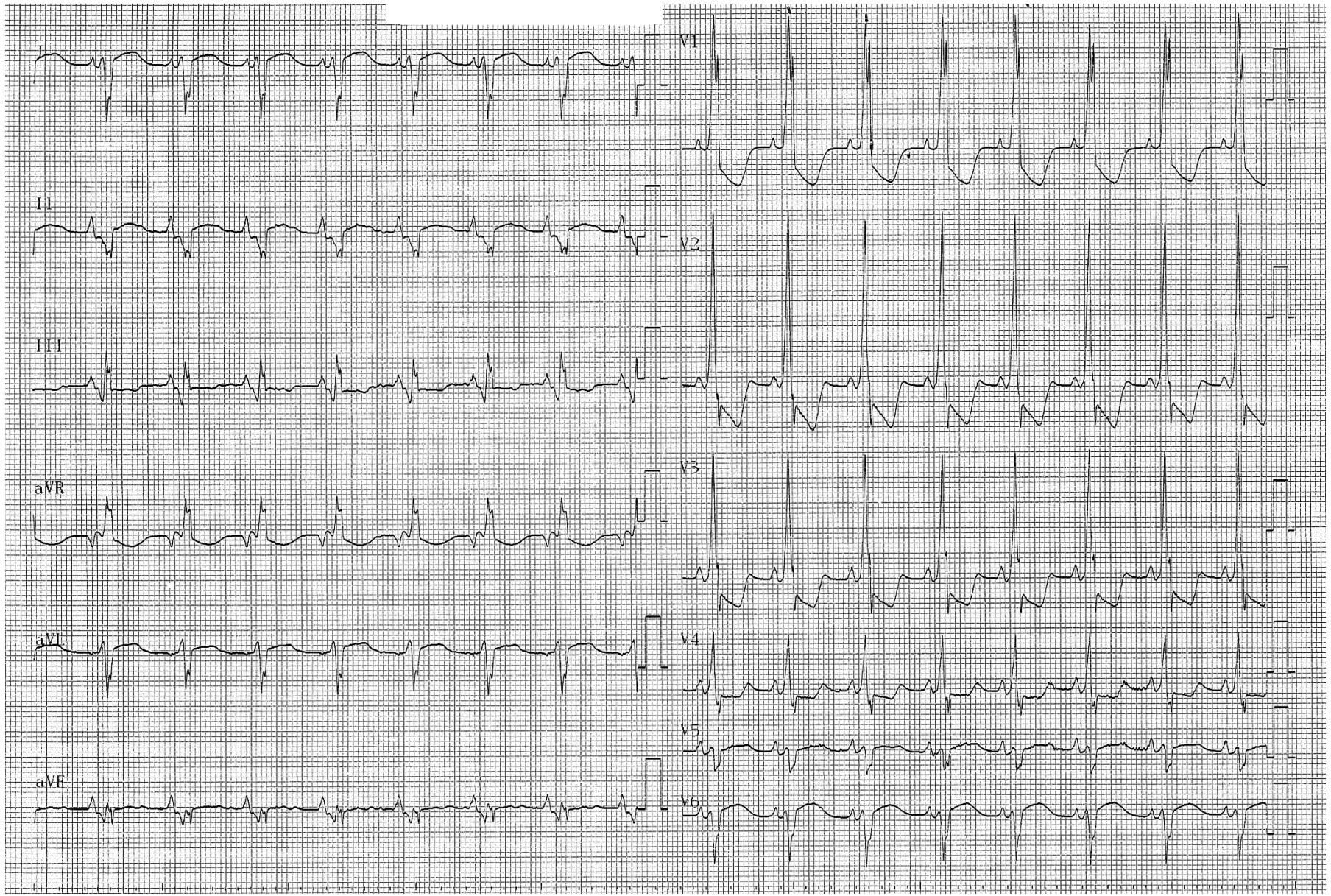


Figure 1 Selection of treatment with catheter ablation or antiarrhythmic drugs for the management of supraventricular tachycardia in children under 5 years.

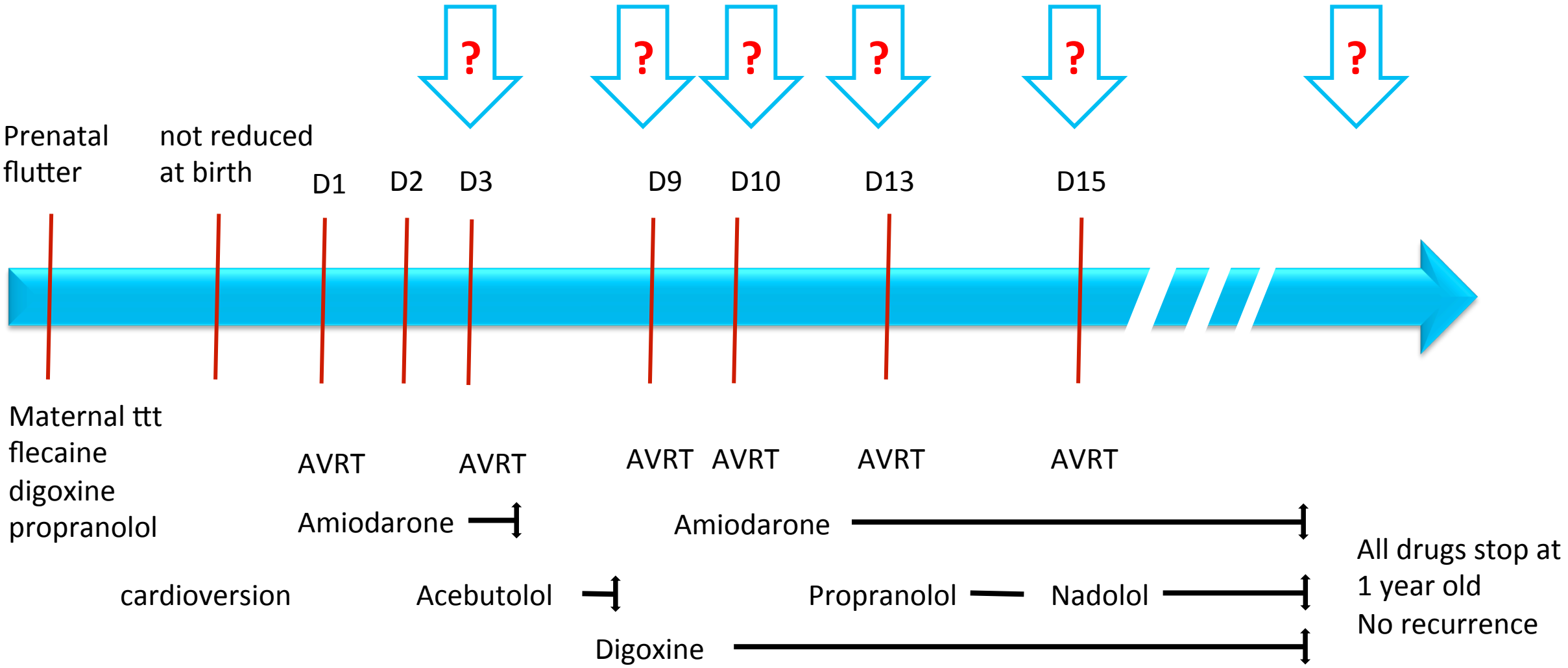
Hernandez-Madrid et al, EUROPACE 2014

Baby boy born 38 WG, 3140 g, no LV dysfunction, PFO

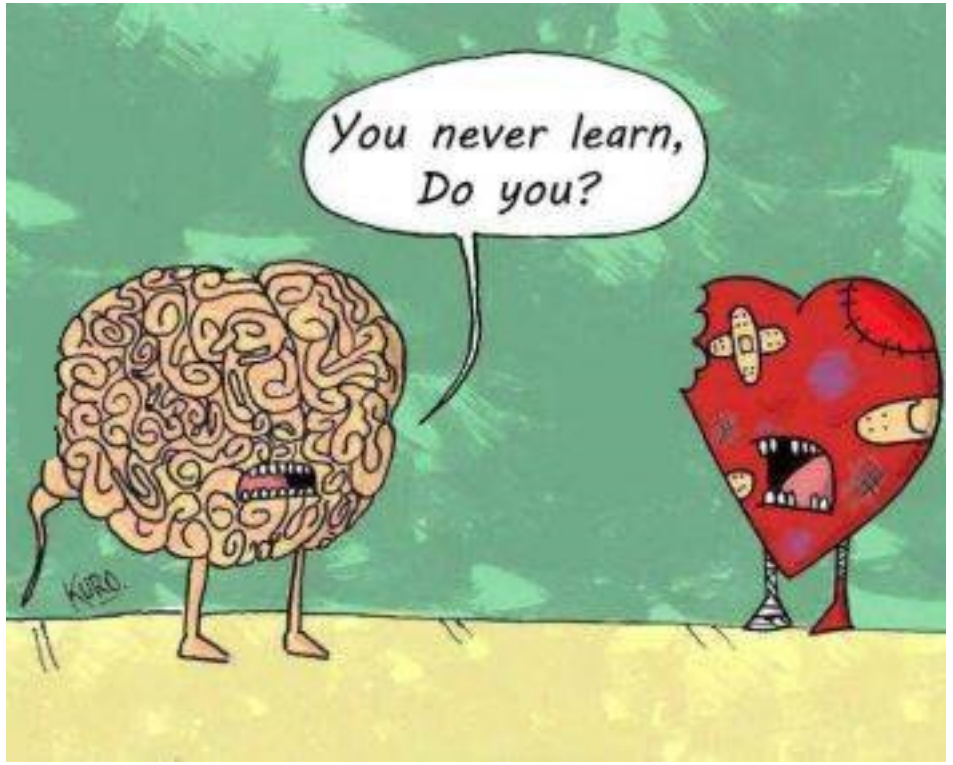



I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

When would you do the ablation ?



Conclusion



Standardized management is impossible

Age

Weight

Substrat

Associated CHD

Natural history

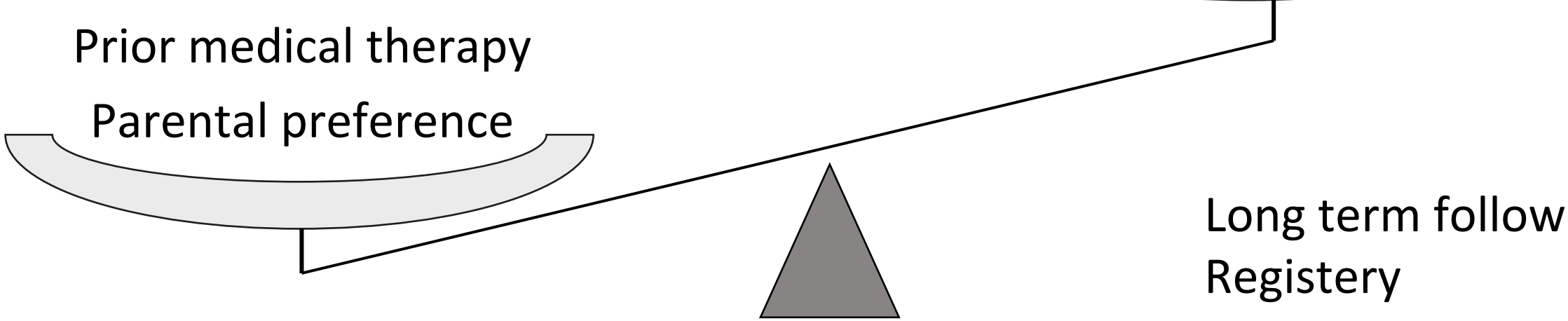
Prior medical therapy

Parental preference

Local experience

Caregivers preference

Persnnal definition of a smaller children



Long term follow up

Registery

PEDIRHYTHM VII

Pediatric and Congenital Rhythm Congress VII

4 - 7 February 2017 / Grand Hotel Palace - Thessaloniki, GREECE

Beyond those indications for infants and smaller children, should catheter ablation be routinely performe for the so called larger kids ?