Childhood cardiomyopathies

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Malformations Cardiaques Congénitales Complexes-M3C
Centre de Référence Maladies Rares
Maladies Cardiaques Héréditaires- CARDIOGEN
Epidemiology

- Annual incidence of childhood cardiomyopathies: 1.13 per 100,000
- Incidence higher among children <1 year: 8.34 vs. 0.70 per 100,000
- Categorized according to type:
  - Hypertrophic 42%
  - Dilated 51%
  - Restrictive 2.5%
  - Non compaction 9.2%
- Sudden death as presenting symptom 3.5%
Cumulative frequency distribution of age at presentation

Nugent AW et al. NEJM 2003;348:1703-5
Survival to death or transplantation from time to presentation in pediatric cardiomyopathies

Daubeney PEF et al. Circulation 2006
Alexander PMA et al. Circulation 2013
Evidence-based data for the treatment of chronic heart failure in children is scarce

Informations from registries
1-Chronic heart failure due to cardiomyopathies has a high mortality
2-Survival depends on age at presentation
3-Cause is a major predictor of outcome
4-Recovery of left ventricular function is possible
5-A child with HF admitted to the hospital has an over 20-fold increase in the risk of death compared to a child without HF
6-Children with cardiomyopathy hospitalized with HF have significantly increased morbidity, mortality, and resource utilization compared to adults.

Informations from clinical trials and guidelines
1-No RCT has ever proven efficacy of any drug on mortality in pediatric heart failure
2-Guidelines level of evidence are Level C

Daubney PEF et al. Circulation 2006
Alexander PMA et al. Circulation 2013
Pressure volume curve

- LVEDP
- LVESV
- LVEDV
Systolic dysfunction
Low contractility

EDP
EDP
EDV
EDV
Preserved EF heart failure
Low compliance

Diagram showing the relationship between EDP and EDV with low compliance in preserved EF heart failure.
Schéma hémodynamique du Cœur en Série
Insuffisance ventriculaire gauche
Post charge VD

Insuffisance ventriculaire droite
Pré charge VG
Systolic dysfunction

Low contractility/treatment

Inotropes

Vasodilators

Béta-blockers

EDP

EDV

Diuretics
Cardiac phenotypes
Dilated cardiomyopathy
Hypertrophic cardiomyopathy
Restrictive cardiomyopathy
Non compaction
Ischemic
Aneurysm and diverticulum
Heart failure without myocardial disease
Chronic constrictive pericarditis
Right ventricular cardiomyopathies
A.R.V.D
A.R.V.D
Booby-traps

*Adult congenital heart disease*
Booby-traps
Adult congenital heart disease
Right ventricular dysfunction in PAH
Difficulties in phenotyping

- Unusual phenotypes
  - Dilated with hypertrophic walls and restrictive physiology

- Changing phenotype
  - From hypertrophic to dilated

- Uncertain phenotype
  - Penetrance increasing with age
Cardiomyopathies are rarely familial and a known cause of ventricular dilatation and/or hypertrophy should be extensively searched

- Volume and pressure overload
- Myocardial ischemia
- Sustained arrhythmias
- Infective myocarditis
- Toxic
- Neuromuscular disorders
- Syndromic cardiomyopathies
- Metabolic diseases
- Inherited cardiomyopathies
Heart failure due to increased afterload
Normal contractility and compliance
Critical aortic valve stenosis
Heart failure due to increased preload
Normal contractility and compliance
Severe mitral valve regurgitation
Ischemic cardiomyopathies

ALCAPA-Main stem atresia
Post-operative
TGA
Kawasaki disease
Hypercholesterolemia
GACI
Arrhythmic cardiomyopathy

- Supraventricular tachycardia of the newborn
- Booby-traps
  - Atrial arrhythmias after atrial correction of TGA
  - Arrhythmias after TCPC
Arrhythmic cardiomyopathy fetal

JT/AVB
Infectious cardiomyopathies

Viral myocarditis
Lyme disease
Chagas disease
HIV
Toxoplasmosis
Rheumatic
Myocarditis
Toxic

• Anthracyclines

• Radiations
Neuromuscular disorders

• Dystrophinopathies
  – Duchenne de Boulogne
  – Becker
• Emery-Dreyfus: laminopathies
• Steinert
• Friedreich
First stop !
What have you done?

- Clinical examination
- Medical history
- ECG
- Echocardiography
- Troponine
- MRI
Primary causes of CMP in children

Lipshultz SE et al. NEJM 2003;348:1647-55
Primary causes of CMP in children

Lipshultz SE et al. NEJM 2003;348:1647-55
When should you think of metabolic cardiomyopathy?

- Family history of sudden death or unexplained death in infancy
- Multisystemic disease
- Changing phenotype
- Severe hemodynamic compromise with mild alteration of LV function
- Atypical anomalies of ECG: left bundle branch block, AVB, ventricular tachycardia
Cardiac metabolism for pediatric cardiologists

Substrate accumulation (non toxic): storage diseases

Substrate accumulation (toxic): intoxication diseases

Product decrease or absent: energetic defects

Lysosomal: HCM, valves
Peroxisomal
Reticulum: glycosylation

Organic aciduria

Fatty-acid oxidation
Respiratory chain
Krebs cycle
Glycogenoses
Mitochondrial disease
Primary causes of CMP in children

Lipshultz SE et al. NEJM 2003;348:1647-55
Cardiomyopathy genes in pediatric inflammatory cardiomyopathy

Costamere

Sarcomere

Desmosome

Ion channels
Formes familiales dominantes de cardiomyopathies hypertrophiques

• 20% de formes familiales
• Objectifs de la prise en charge
  – Dépistage des facteurs de risque de MS
    • Antécédents familiaux
    • Adaptation tensionnelle à l’effort
    • TVNS
    • Epaisseur septale
    • Obstruction gauche
Formes familiales dominantes de cardiomyopathies dilatées

• <20% de formes familiales
• Insuffisance cardiaque progressive
• Pronostic très difficile à évaluer
  – Risque rythmique
  – Anémie
  – Nutrition
  – Réponse au traitement médical
Dysplasie arythmogène du ventricule droit
Enquête familiale

• Apparentés au 1er degré
• ECG
• Echocardiographie
• Enquête génétique
Résumé de la démarche diagnostique

• Cardio standard + anamnèse
• ECG + Echocardiographie
• IRM + troponine pour myocardite
• Dysmorphologistes pour les formes syndromiques
• Métabolisme simple
  – Glycémie, corps cétoniques, lactates,
  – Chromato AO, profil acylcarnitines, carnitine T+L

  – Et c’est tout!