Cardiac Considerations and Care in Children with Neuromuscular Disorders

- importance of early and ongoing treatment, management and available medications.

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Primary Myopathies with Cardiac involvement

- Duchenne Muscular Dystrophy
- Becker Muscular Dystrophy
- Emery-Dreifuss Muscular Dystrophy
- Facioscapulohumeral Dystrophy
- Limb-Girdle Muscular Dystrophy 2C, 2D, 2E and 2F
- Myotonic Muscular Dystrophy
- Metabolic Myopathies
  - Glycogenosis II, III, IV, VII and IX
  - Mitochondrial Myopathies
  - Carnitine Deficiency
  - Lysosomal Glycogen Storage Disorders
- Congenital Myopathies
  - Desmine Myopathy
  - Nemaline Myopathy
  - Central core Disease
- Others
  - Barth Disease, Bethlem Myopathy
Management of Children with Neuromuscular Disorders

- Physiotherapy
- Occupational Therapy
- Speech Therapy
- Orthotics and Orthopaedic Surgery
- Respiratory Medicine
- Genetics
- Cardiology
Normal Cardiac Anatomy
Normal Cardiac Anatomy
Normal Conduction Pathway

- SA node
- AV node
- His bundle
- Purkinje fibers
Cardiac Complication of Childhood Myopathies

- Disease of the myocardium
  - Leading to pump failure
  - Cardiomyopathy

- Valvar disease
  - Leading to stenosis or regurgitation

- Disorder of electrical conduction
  - Slow or fast heart rhythms
  - Arrhythmias
Cardiomyopathy

- Dilated cardiomyopathy
  - Decreased contractile function
  - Dilatation of all four chambers
  - Walls are not thickened

- Hypertrophic cardiomyopathy
  - Gross thickening of the ventricle
  - Small ventricular cavity
  - Preserved contractility

- Restrictive cardiomyopathy
  - Impaired relaxation / diastolic function
  - Dilated atria
Cardiac Arrhythmias / Conduction Disorders

- Long QT Syndrome
- Limb-Girdle Muscle Dystrophy
- Duchenne Muscular Dystrophy
- Becker Muscular Dystrophy
- Emery-Dreifuss Muscular Dystrophy
**Slow Heart Rates**

- Sinus Bradycardia

- First Degree Heart Block

- Second Degree Heart Block

- Third Degree Heart Block

**Escape Rhythm**

- Junctional Escape
- Ventricular Escape
Fast Heart Rates

- Atrial Fibrillation / Atrial Flutter
- Supra-Ventricular Tachycardias
- Ventricular Tachycardias

Typical sequence of electrical events:

Sinus rhythm  Ventricular tachycardia  Ventricular fibrillation  Asystole
Duchenne Muscular Dystrophy

- Most common and severe form of childhood muscular dystrophy
- Inherited X-linked disease
- Typically diagnosed between 3 and 7 years of age
- Characterised by progressive muscle weakness and loss of ambulation by 12 years of age
- Death occurs in early adulthood secondary to respiratory and cardiac failure
- Incidence of Dilated Cardiomyopathy
  - 30% of patients by age 14
  - 50% of patients by age 18
- Cardiac conduction problems
  - Less common
Becker Muscular Dystrophy

- A milder form of Duchenne Muscular Dystrophy
- Dystrophin protein is reduced in quantity or abnormal in size
- Onset of muscle weakness
  - Adolescence / Early adulthood
- Cardiomyopathy
  - Common
  - Out of proportion with skeletal involvement
  - Onset of cardiomyopathy can precede the onset of muscle weakness
  - 70% of patients by age 40
Emery-Dreifuss Muscular Dystrophy
Slow progressive muscle wasting with humero-peroneal distribution

X-linked form
- Long term prognosis is entirely dependent on cardiac status
- Cardiac Conduction defects
  - Slow heart rate
  - Heart block
  - Atrial flutter
  - Complete atrial paralysis
- Conduction defects
  - Rare in first decade of life
  - Almost invariable by age 30
- Pacemaker insertion is justified even in asymptomatic patients

Autosomal dominant
- Progression of muscle weakness more rapid
- Cardiac conduction defects
- Life threatening ventricular dysrhythmias
- Sudden cardiac death
- Cardiomyopathy
Myotonic Muscular Dystrophy

Autosomal dominant multi-system disorder
- Cardiac involvement - Common
- Cardiac conduction problems
- Ventricular arrhythmias leading to sudden death / Long QT
- Coronary artery dysfunction
- Cardiomyopathy - hypertrophic

Typical sequence of electrical events:
- Sinus rhythm
- Ventricular tachycardia
- Ventricular fibrillation
- Asystole
Limb-Girdle Muscular Dystrophy

- AD / AR forms
- Caused by a deficiency of a dystrophin related protein
  SARCOGLYCANS
- Clinical progression is similar to Duchenne Muscular Dystrophy
- Cardiac involvement is present in some forms but not others
- Overall incidence of cardiomyopathy 30-40%
Referral to Cardiologist

- **Who can refer?**
  - Any medical practitioner.

- **Who should be referred?**
  - Any one with proven or suspected neuromuscular disease.

- **When should patients be referred?**
  - At time of diagnosis

- **Waiting list for outpatient clinics.**
Signs and Symptoms

- Cardiomyopathy
  - Shortness of breath
  - Decreased exercise tolerance
  - Fatigue
  - Weight loss
  - Loss of appetite
  - Difficulty in keeping up with peers
  - Fast resting heart rate
  - SUDDEN DEATH

- Conduction problems
  - Slow heart rate
  - Fast heart rate
  - Palpitations
  - Chest pain
  - Decreased exercise tolerance
  - Collapse
  - SUDDEN DEATH
Investigations

- ECG
- ECHO
- 24 hour Holter Monitor Recording
- Distant Heart Monitoring / Loop Recording
- Exercise Stress Test
- Others:
  - Electrophysiological Studies
  - Cardiac MRI
ECHO – Cardiac Ultrasound Scan

- Exclude congenital heart disease
- Assess valvar function
- Assess cardiac chamber size and wall thickness
- Assess cardiac function
- Assess ventricular synchrony
Cardiac Synchrony Assessment
ECG

- Recording over 10 seconds
- Confirms patient’s rhythm
- Does not exclude arrhythmias
Holter / Distant Cardiac Monitoring
Aim of Management

1. Slow progression of cardiomyopathy
2. Symptomatic relief
3. To prevent sudden or premature death
Medical management of cardiomyopathy / heart failure

- Ace Inhibitors
- Beta-blockers
- Diuretics
Genetic Predictors and Remodeling of Dilated Cardiomyopathy in Muscular Dystrophy

John L. Jefferies, MD, MPH; (Circulation. 2005;112:2799-2804.)

- 69 patients with DMD and BMD were flowed
- 31 of the patients developed cardiomyopathy at the mean age of 15
- After the first abnormal ECHO ACE inhibitors +/- b-blockers were commenced
  - 2 patients showed stable function, 8 improved function and 19 normalised function
  - Therefore 93% of patients had improved function
- Genetics
  - Some mutations protective others strongly linked to cardiomyopathy
Perindopril preventive treatment on mortality in Duchenne muscular dystrophy: 10 years’ follow-up

Denis Duboc, MD, PhD, (Am Heart J 2007;154:5962602.)

- French study
- The effect of treatment on survival seems to have begun at 7 years
- At 10 years
  - 93% of the patients were alive in group 1 – early treatment group
  - 65.5% of patients alive in group 2 – late treatment group
Side effect of medications

- Hypotension
- Electrolyte disturbance
- Excessive slowing of heart rate
Non-Pharmacological Treatment of Heart Failure

- Pacemaker therapy – cardiac resynchronization
- Bridging to transplantation
- Cardiac transplantation
Treatment of rhythm problems

Slow
- Conservative
- Pacemaker Insertion

Fast
- Medications
  - Amiodarone
  - Digoxin
  - Sotalol
  - Fleccanide
- Defibrillation
  - Portable
  - Implantable
- Ablation

Typical sequence of electrical events:
- Sinus rhythm
- Ventricular tachycardia
- Ventricular fibrillation
- Asystole
Pacemakers and Implantable Defibrillators
Pacemakers and Implantable Defibrillators
Follow up

- Annual Cardiology visits

- More frequent if problems identified

- This stage we do not have the ability to predict who is going to develop cardiac complications
Cardiac Care in Carriers of
Duchenne and Becker Muscular Dystrophy

- Do not develop skeletal muscle weakness
- Can develop cardiomyopathy
- Should be referred to a cardiologist
- Require complete cardiac evaluation every 5 years
Summary

1. Cardiac involvement is common
2. We are still unable to predict who will develop cardiac problems
3. Signs and symptoms of heart failure can be difficult to recognise
4. Early diagnosis and treatment can
   - Improve heart function
   - Improve quality of life
   - Prevent unexpected sudden death