The Heart Is A Muscle, Too!
The Cardiomyopathy of Duchenne and Becker Muscular Dystrophy

Linda Cripe MD
Professor of Pediatrics
Vice Chair of Faculty Affairs
Nationwide Children’s Hospital/The Ohio State University
Why should we all be interested in the heart?
The heart is a muscle, TOO!!!(and a very very very important muscle...)
Important heart vocabulary

- **Cardiologist**- a heart doctor
- **Atria**- the chambers that receive blood in the heart
  - There are two atria (left and the right)
- **Ventricles**- are pumping chambers of the heart
  - There are two ventricles (left and right)
- **Cardiomyopathy**- disease of the heart muscle
- **Heart Failure**- when the heart is no longer able to meet the body’s demands
- **Ejection fraction (EF)**- is a measurement of the percentage of blood leaving the heart each time it contracts.
- **Fibrosis**- scar tissue
Blood returns from upper half of body

Blood returns from lower half of body

Blood returns from the lungs where it received oxygen

Blood gets pumped to the body

right atria

Left ventricle

Blood returns from lower half of the body
A key concept in understanding DMD cardiomyopathy

Cardiomyopathy in Duchenne muscular dystrophy is characterized by extensive sub-epicardial fibrosis
How should we care for the DMD/BMD heart?
Diagnosis and management of Duchenne muscular dystrophy, part 2: respiratory, cardiac, bone health, and orthopaedic management

David J Birnkrant, Katharine Bushby, Carla M Bann, Benjamin A Alman, Susan D Apkon, Angela Blackwell, Laura E Case, Linda Cripe, Stasia Hadjiyannakis, Aaron K Olson, Daniel W Sheehan, Julie Bolen, David R Weber, Leanne M Ward, for the DMD Care Considerations Working Group*

**Diagnosis**
Baseline evaluation at diagnosis
- Consultation with cardiologist
- Cardiac medical history
- Family history
- Physical examination
- Electrocardiogram
- Non-invasive imaging:
  - Echocardiogram
    - (<6–7 years old)
  - Cardiovascular MRI
    - (≥6–7 years old)

**Annual assessment**
Annual cardiovascular assessment
- Cardiac medical history
- Physical examination
- Electrocardiogram
- Non-invasive imaging

**Assessment of female carriers**
Cardiac assessment in early adulthood
- Cardiovascular MRI
- If symptomatic or imaging positive, increase assessment frequency on the basis of cardiologist recommendation
- If negative, repeat evaluation every 3–5 years

**Symptomatic**
- Increase assessment frequency on the basis of cardiologist recommendation
- Initiate pharmacological treatment

**Ambulatory and early non-ambulatory stage**
- Conduct cardiac assessment at least annually
- Initiate angiotensin-converting enzyme inhibitors or angiotensin receptor blockers by age 10

**Late non-ambulatory stage**
- Monitor closely for signs and symptoms of cardiac dysfunction; symptomatic heart failure can be difficult to diagnose in this stage
- Monitor for rhythm abnormalities
- Treat with known heart failure therapies

**Surgery**
- Assess with electrocardiogram and non-invasive imaging before major surgery
- Make anaesthetist aware of Duchenne muscular dystrophy diagnosis; patients have increased anaesthesia risks
Cardiac care-summary

- Should begin at diagnosis
- Establish relationship with family
- Family history is important
  - Maternal carriers are at risk
- Evaluation should include
  - Physical examination
  - Cardiac testing
    - ECG and non-invasive imaging (echo or CMR)
- Early years patient should be seen yearly
- Frequency increased based on clinical needs
- Cardiac evaluation before major surgeries
- ACE inhibitors started prior to the age of 10 years
No, those chest pains don't mean you're having a heart attack! You're just thumping your chest too hard!
Chest pain in the DMD patient

- FREQUENT
- Must be musculoskeletal?
- Often dismissed in a peds ER
- Cardiac evaluation rarely undertaken
  - ECG “maybe”
  - Troponin I (cTnI) “rarely”
    - cTnI sensitive and reliable marker of cardiac tissue injury
    - cTnI is normal or minimally elevated at baseline in DMD
Chest pain in DMD patient

• Hypothesize progression of DMD cardiomyopathy results from episodic myocardial injury rather than from continuous ongoing injury
  • Series of silent recurrent events leading to cumulative injury
  • Process similar to that in skeletal muscle??
  • Suggests a step wise model of disease progression as opposed to a linear one
• Unknown if there could there be external triggers
  • Viral infection
  • Physiological stress
  • Other illnesses
Cardiac imaging

- Historically it was believed that
  - “Cardiomyopathy did not manifest until late teen early adult years”
  - Disease was characterized when imaging was “less sophisticated”
  - If you can’t see it must not be there
  - Better tools now allow us to see important new things
- Imaging allows us to redefine natural history of DMD cardiomyopathy
  - As imaging improves we see the disease with new eyes
  - Two imaging modalities are commonly employed
    - Echo
    - CMR
Echocardiography has limitations

- Image quality is poor in many DMD patients (especially in non-ambulatory patients)
- Sub-optimal images result in poor clinical decision making and poor clinical trial data
CMR offers imaging advantages

• **Advantages**
  • Lack of radiation exposure
  • Detailed information:
    • LV and RV function
    • Fibrosis quantification
    • Myocardial strain

• **Disadvantages**
  • IV placement required for fibrosis quantification
  • Longer scan times
  • Sedation may be needed
  • Lack of global availability
Summary

- The heart is an important muscle, too!
- DMD chest pain may signal acute cardiac injury
  - cTnI levels and ECG should be obtained
- CMR is a valuable tool to evaluate DMD cardiomyopathy
- CMR is a valuable tool to evaluate DMD cardiomyopathy
- In conclusion...
The Heart is a muscle too!