Mitochondrial Disorders
For Healthcare Providers

This is a customized health care provider version of our website. Please visit the main website to find more comprehensive information for families and schools (www.gemssforschools.org).

Mitochondrial diseases are a clinically diverse group of disorders that arise as a result of dysfunction of the mitochondria, the energy producers of the cell. The inheritance of mitochondrial disorders is also diverse because they can be caused by mutations in either the nuclear DNA OR the specific DNA found only in mitochondria known as mtDNA. Some mitochondrial disorders only affect a single organ, while others may involve multiple organ systems. Neurologic features are often the presenting features, but features can involve any of the body systems. Mitochondrial disorders may present at any age and often show progression of symptoms with age. The clinical features described in Mitochondrial Disorders are often non-specific and may make it more difficult to diagnose.

Physical characteristics and/or symptoms

Note: not all people with Mitochondrial Disorders will have all of these features.

Common clinical features of mitochondrial disorders

- Neuromuscular
  - Proximal myopathy
  - Exercise intolerance
- Neurologic
  - Seizures
  - Fluctuating encephalopathy
  - Dementia
  - Migraines
  - Stroke-like episodes
  - Ataxia
  - Spasticity
- Sensorineural hearing loss
- Ophthalmologic

    - Ptosis
    - Paralysis or weakness of the eye muscles
    - Optic atrophy
    - Pigmentary retinopathy
- Cardiomyopathy
- Diabetes
- Autonomic dysfunction, such as the inability to regulate body temperature
- Cardiomyopathy
- Multiple mid- and late pregnancy losses

Specific Mitochondrial Syndromes

- Leber hereditary optic neuropathy is a disorder that affects the eye.
- Mitochondrial hearing loss and deafness
- Kearns-Sayre syndrome (KSS) is a condition that affects many parts of the body, especially the eyes.
- Chronic progressive external ophthalmoplegia (CPEO) is a disorder characterized by slowly progressive paralysis of the muscles around the eyes.
- MELAS (Mitochondrial encephalopathy with lactic acidosis and stroke like episodes) primarily affects the brain, nervous system and muscles.
- MERRF (Myolonic epilepsy with ragged red fibers) affects the nervous system and skeletal muscle as well as other body systems.
- NARP: Neurogenic weakness with ataxia
- Leigh syndrome is characterized by progressive loss of mental and movement abilities (psychomotor regression) and typically results in death within a couple of years.

Non-Specific Mitochondrial Disorders

- Overlapping features of the above conditions can occur.
- Individuals with multiple medical symptoms have been found to have deficiencies in the function of their mitochondria due to genetic changes.

Genetics of mitochondrial disorders

- There are approximately 1,200 people in the United States who have a mitochondrial disorder.
- If the Mitochondrial Disorder is caused by changes in nuclear genes, the inheritance can be autosomal dominant, autosomal recessive or X-linked.

- If the Mitochondrial Disorder is caused by changes in the mitochondrial DNA (myDNA), the condition is only passed on through the mother.
    - https://ghr.nlm.nih.gov/mitochondrial-dna

Other possible findings

Many Mitochondrial Disorders involve multiple organ systems. Often the most prominent features are neurologic and myopathic, but another common feature is progression of symptoms over time. Many of the other reported findings are listed in the main website section, under the Learn More section: https://www.gemssforschools.org/conditions/mito/learn-more

Recommended Routine Surveillance

Surveillance will vary based on the type of mitochondrial disease present, but in general individuals should be monitored for progression of any of their symptoms or presentation of new symptoms.

- MRI as needed
- EKG if seizures present
- Echocardiogram if cardiac findings
- Hearing and ophthalmological evaluation

Emergency Protocols

There are no specific emergency protocols for this particular condition as it is not typically associated with episodes of sudden and serious medical decompensation.

- Emergencies should be handled as with any child.
- If seizures are present, the following seizure action plan may be useful: https://www.aap.org/en-us/Documents/Seizure_Action_Plan_for%20School.pdf

Specialists Who May Be Involved

Follow up is need on a case-by-case basis. A multidisciplinary team approach to best meet the child's individual needs is recommended.

- Cardiologist
    - Cardiomyopathy
- Cardiac conduction defects Developmental evaluation:
    - Speech therapy
    - Physical therapy
    - Occupational therapy

    - Autism spectrum disorder
- Dietician
- Endocrinologist:
    - Diabetes
    - Pancreatic failure
    - Parathyroid failure
- ENT
    - Hearing loss
    - Deafness
- Gastroenterologist
    - GI issues
    - IBS
    - Diarrhea and constipation
    - GERD
    - Liver failure
- Geneticist / Genetic Counselor:
    - Diagnosis
    - Coordination of care
    - Genetic risk for family
    - Clinical trials
- Nephrologist
    - Renal tubular acidosis or wasting
- Neurologist
    - Seizures
    - Encephalopathy
    - Dementia
    - Migraine
    - Stroke-like episodes
    - Ataxia
    - Spasticity
    - Neuropathic pain
- Neuromuscular specialist
    - Myopathy
    - Exercise intolerance
    - Muscle cramps
- Ophthalmology surveillance:
    - Ptosis
    - External opthalmoplegia
    - Optic atrophy
    - Pigmentary retinopathy
    - Retinitis pigmentosa

    - Visual loss and blindness
    - Strabismus
- Pulmonologist
    - Respiratory problems

Sample Forms

- Sample paragraph to be used for Letters of Medical Necessity or Letters to the school:

My patient_____ has been diagnosed with a mitochondrial disorder. Mitochondrial disorders are characterized by abnormalities of the eyes, brain, kidneys, muscles, heart and developmental delays. Medical complications with mitochondrial disorder include management of seizures, cardiac and eye findings, hearing loss, and diabetes mellitus. Because of these, _____ needs the following accommodations.

Sample forms and sample letters specifically for Mitochondrial Disorders
http://www.mitoaction.org/tools-for-special-education

Seven Important Aspects of School Life

"Mitochondrial Disorders at a Glance" will help you talk with parents and schools about:

- Medical / Dietary Needs
- Education Supports
- Behavior & Sensory Supports
- Physical Activity, Trips, Events
- School Absences & Fatigue
- Emergency Planning
- Transitions

Resources

GeneReviews: Mitochondrial Disorders Overview
https://www.ncbi.nlm.nih.gov/books/NBK1224/

National Organization for Rare Disorders (NORD) Physician Guide to Mitochondrial Myopathies
http://www.nordphysicianguides.org/mitochondrial-myopathies-mm/

Information for teens/transition: Moving on With Mito
http://newenglandconsortium.org/files/moving-on-with-mito.pdf