



Nemaline (rod) myopathies

Nemaline, or rod, myopathies are a group of conditions which fall under the umbrella of congenital myopathies. They are characterised by rod-like structures in the muscle cells, and clinical features such as muscle weakness, breathing problems, and feeding problems. There are 6 sub-groups which are defined according to age of onset and severity.

Around 1 in 50,000 individuals are estimated to be affected, and these include both males and females. There is currently no effective treatment or cure to halt the progression, but management of the condition is very important and includes physiotherapy, and where necessary the use of ventilation and/or a feeding tube.

What is nemaline myopathy?

Nemaline myopathies, or rod body myopathies, are a group of conditions which fall under the category of congenital myopathies. There are a number of different types of rod myopathies and they affect both males and females. In the majority of cases (90%) the condition becomes apparent at birth or early childhood, although in very rare cases, it does not become apparent until adulthood. Rod myopathies are estimated to affect 1 in 50,000 individuals.

What causes it?

In the majority of cases, a rod myopathy is inherited, although there are sometimes sporadic cases where there are no other family members affected. There have been mutations identified in 5 different genes, which cause a rod myopathies. The protein products of all of these genes are involved in muscle tone and contraction.

ACTA1 - This gene produces a protein called α -actin. Mutations in this gene account for around 15-25% of cases. Errors in this gene are inherited in an autosomal dominant or autosomal recessive pattern.

NEM2 - The product of this gene is a protein called nebulin. It is thought that mutations in this gene are a common cause of nemaline myopathy but definite statistics are unavailable. Mutations in this gene are inherited in an autosomal recessive pattern.

TPM3 - The product of this gene is a protein called α -Tropomyosin 3. Mutations in this gene account for only 2-3% of affected individuals, and are inherited in an autosomal dominant or autosomal recessive pattern.

TPM2 - This gene encodes a protein called β -Tropomyosin. Only very few individuals have been identified with errors in this gene. Inheritance is in an autosomal dominant pattern.

TNNT1 - This gene produces a protein called Troponin 1. Errors in this gene have only been identified in a population of Old Order Amish individuals. Inheritance is in an autosomal recessive pattern.

What are the common features?

There are six sub-groups of nemaline myopathy which are defined based on age of onset and severity of condition, although there is a high degree of overlap between the conditions. There does not seem to be a correlation between severity of the condition and the gene which has the mutation.

Although heart problems are not common in people with a rod myopathy, it is important that cardiac function is regularly monitored.

The six sub-groups are described in the table below.

Sub-group	Onset	Clinical signs
Severe congenital form	Birth	Severe floppiness and muscle weakness Little spontaneous movement Difficulties with sucking and swallowing Severe breathing problems Death usually occurs early
Amish nemaline myopathy	Birth	Floppiness/hypotonia Contractures/ tightening of joints Breathing problems Death usually within 2 years of life
Intermediate congenital form	Birth	Severity in-between severe and mild forms Early development of contractures/ tightening of joints Delayed motor milestones Independent breathing at birth Use of ventilatory support and/or wheelchair by 11 years
Typical (mild) congenital form	Birth → 1 year	Floppiness/ hypotonia Weakness in muscles closest to trunk, and sometimes spreading to more distal muscles. Feeding difficulties Some respiratory weakness, but less severe than other forms

Childhood-onset	8 → 15 years	<p>Early motor development normal</p> <p>Symmetrical weakness of ankle including foot drop</p> <p>Slowly progressive weakness with eventual involvement of all ankle movement.</p> <p>Motor development normal</p>
Adult-onset	20 → 50 years	<p>Generalised weakness with rapid progression</p> <p>Muscle pain</p> <p>Sometimes severe neck weakness</p> <p>Usually no previous family history</p>

How is it diagnosed?

- Muscle biopsy** - Generally, diagnosis is made through a muscle biopsy. A sample of muscle is taken, and examined under a microscope. This is done in one of two ways: either a small piece of muscle is taken under general anaesthetic or a needle biopsy is performed to remove a small sample. Muscle from people affected by nemaline myopathy has a distinctive pattern with thin thread- or rod-like structures in the muscle cells. It is important to note that these structures are also seen in other, unrelated conditions. For this reason, the muscle sample must be considered along with the physical signs and/or molecular tests, in order for a diagnosis of nemaline myopathy to be made. A factsheet on *Muscle biopsies* is available from the Information and Support Line, or from the website at www.muscular-dystrophy.org
- Molecular testing** - In families where the mutation is known to occur in the gene for α - actin, molecular testing is available. This involves taking a blood sample and analysing the DNA for the presence of a mutation. The gene is “read” from end to end, and this sequence is compared to a normal α - actin sequence. This process can take up to several weeks to complete. Once this error has been identified in one family member, it is possible to use this sequence to diagnose other family members.

What other tests are available?

Prenatal diagnosis - Prenatal diagnosis is available for families where the mutation has been identified as being in the gene for α - actin, and the precise nature of the mutation established. The technique is described in the section Molecular testing, but there are two ways to obtain samples for testing:

- Amniocentesis is traditionally performed at 15 to 17 weeks into the pregnancy. Using ultrasound to visualise, a needle is inserted through the abdominal wall, and a sample of the fluid surrounding the baby (amniotic fluid) is taken.
- Chorionic villus sampling (CVS) is carried out at 10 to 11 weeks. This involves taking a sample of tissue from the placenta. Results are available earlier using this technique than amniocentesis, but the rate of spontaneous abortion is slightly higher.

Carrier testing - As with prenatal diagnosis, carrier testing is currently only available for families where a mutation in the α - actin has been identified and characterised.

How will it progress?

The progression of these conditions is variable, and some may progress more quickly than others. Generally it is accepted that the earlier the onset, the more severe the condition. For children who live

beyond the early years, only some will lose the ability to walk. Respiratory function is thought to improve over time, with the most severe problems occurring earlier in life.

Is there a treatment?

There is currently no effective treatment to halt the progression of the nemaline myopathies, but management of the condition is very important for prolonging life.

- **Night time ventilation** - Breathing problems are common with the nemaline myopathies, and thus respiratory function should be regularly monitored. A decrease in oxygen intake can lead to, among other things, headaches, breathlessness, poor appetite and disturbed sleep. Night time ventilation involves the use of a face mask attached to a small machine, which assists in breathing. This aids the muscles which control breathing, and allows a greater intake of oxygen. Night time ventilation may be beneficial to people with a rod body myopathy, but this should be discussed fully with a consultant to determine whether it is appropriate.
- **Feeding tube (or gastrostomy)** - This is a tube that goes into the stomach through the stomach wall and enables a person to be given food and fluids by passing them directly into the stomach via the tube. People with a myopathy may have problems with swallowing which can lead to choking and inhalation of food. This can result in chest infections. A feeding tube prevents this from happening. There are a number of different types of feeding tube which are available, and these are fitted by a short surgical procedure. A factsheet on *Gastrostomy* is available from the Information and Support Line, or from the website at www.muscular-dystrophy.org
- **Physiotherapy** - The primary aim of an individual with a neuromuscular disorder is to increase or at least maintain function and mobility. Physiotherapy can assist in doing this, and it can also maintain breathing capacity, delay the onset of curvature of the spine (scoliosis), and help prevent the development of contractures. It is important that the physiotherapist involved is familiar with the treatment of people with neuromuscular disorders.
- **Exercise** - There is debate over whether people with neuromuscular disorders should undertake strenuous physical exercise. Some say that putting additional strain on already weakened muscles will cause additional harm, whilst others believe that the exercise may increase muscle strength. Insufficient evidence exists to support either, but it is believed that moderate non-weight bearing exercise such as swimming, walking or peddling may be the best solution. This sort of aerobic exercise helps to maintain a healthy cardiovascular system and a steady weight. It is however, important that this is discussed fully with a clinician.
- **Antibiotics** - Chest infections are common with the nemaline myopathies and complications with breathing can lead to a variety of other problems, including lethargy, headaches, and poor appetite. Antibiotics are used to treat chest infections. There are a variety of antibiotics available, and a GP will be able to advise on the most suitable. If there is a tendency to chest infections it is worth considering pneumovax (prevenar in children under two years) and the flu vaccine.

Is there a cure?

Currently there is no cure for the nemaline myopathies although much research is being currently being conducted into the myopathies, including the rod body myopathies. Although there is no effective treatment to halt the progression, there are a couple of different ways in which to manage the symptoms of the nemaline myopathies and these are outlined above.

What research is currently being done?

Researchers world-wide are exploring many avenues in an attempt to develop more effective treatments and hopefully a cure. The research department at the Muscular Dystrophy Campaign, regularly monitors research advances in the congenital myopathies, and produces releases which are sent to members when significant scientific advances occur.

Email: research@muscular-dystrophy.org

Planning for the future?

Nemaline myopathies are progressive conditions which means that the needs of individuals with the condition will change with time.

There are a number of things which should be considered:

- Education
- Holidays
- Home adaptations
- Ventilation
- Wheelchairs

More information on any of these topics can be obtained by contacting the Information and Support Line.

Other things to consider

- **Anaesthetics** - It has now been recognised that the use of both local and general anaesthetics in people with neuromuscular disorders, can cause a variety of different problems. Although anaesthetics are generally well tolerated by people with a nemaline myopathy, due to the nature of the anaesthetic drugs used, problems can include dysfunction of the heart, and relaxation of the muscles round the lungs causing problems with breathing. Generally if a patient is properly assessed and monitored, the risks associated with anaesthetic use are low, but it is very important that the medical professionals involved are fully aware of the muscle condition.
- **Medical alert card** - It is very important that health professionals are aware of your condition should you require treatment. There are often issues they will have to consider. Many companies are able to provide a Medic Alert Card, which can be carried to advise of any medical condition. These come in the form of bracelets, pendants etc and carry essential information. Please contact the Information and Support Line for details of companies that produce alert cards.
- **Pregnancy** - Pregnancy and delivery are generally well tolerated in mothers with nemaline myopathy. It is however, important to monitor breathing and heart function, and consideration should be given to any muscle weakness or contractures which may complicate the delivery.

Where can I get help?

Muscular Dystrophy Campaign

61 Southwark Street

London SE1 0HL

Tel: **020 7803 4800**

Freephone: **0800 652 6352**

Information and Support Line: info@muscular-dystrophy.org

Research: research@muscular-dystrophy.org

Contact a Family

209-211 City Road,

London EC1V 1JN

Tel: **020 7608 8700**

Helpline: **0808 808 3555** or

Textphone: **0808 808 3556**

Email: info@cafamilly.org.uk

Web: www.cafamilly.org.uk

Nemaline Myopathy Foundation (USA)

P.O. Box 5937
Round Rock, Tx 78683-5937
Tel: **00 1 (512) 388-7985**

Other MDC factsheets that may be useful

- Anaesthetics
- Carrier detection tests and prenatal diagnosis of inherited neuromuscular conditions
- Gastrostomy
- Inheritance and the muscular dystrophies
- Muscle biopsies
- Surgical correction of spinal deformity in muscular dystrophy and other neuromuscular disorders

Please contact the Information and Support Line for copies, or visit **www.muscular-dystrophy.org**

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