



Myoclonus

U.S. DEPARTMENT OF HEALTH
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National Institutes of Health

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What is myoclonus?

Myoclonus refers to sudden, brief involuntary twitching or jerking of a muscle or group of muscles. It describes a clinical sign and is not itself a disease. The twitching cannot be stopped or controlled by the person experiencing it.

Myoclonic twitches or jerks usually are caused by sudden muscle contractions (tightening), called positive myoclonus, or by muscle relaxation, called negative myoclonus.

Myoclonic jerks may occur alone or in sequence, in a pattern of movement or without pattern. They may occur infrequently or many times per minute. Myoclonus sometimes happens in response to an external event or when a person attempts to make a movement.

In its simplest form, myoclonus consists of a quick muscle twitch followed by relaxation. Examples of this type of myoclonus are hiccups and the jerks or “sleep starts” that some people experience while drifting off to sleep. These forms of myoclonus occur in healthy people and are called *physiologic* myoclonus. They cause no difficulties and do not require medical treatment.

When myoclonus is more widespread, it may involve persistent, shock-like contractions in a group of muscles. In some cases, myoclonus begins in one region of the body and spreads

to muscles in other areas. More severe cases of myoclonus can affect movement and severely limit a person's ability to eat, talk, or walk. These types of myoclonus are called *pathologic* myoclonus and can be one of many signs indicating a wide variety of underlying disorders in the brain or nerves, secondary to certain medical conditions, or can be a reaction to certain types of medication.

The severity of myoclonus may range from mild to severe. It may begin in childhood or adulthood.

What causes myoclonus?

Most myoclonus is caused by a disturbance of the brain or spinal cord (the central nervous system, or CNS). Although rare, myoclonus may be caused by an injury to the peripheral nerves (the nerves outside the central nervous system that connect to sensory organs and muscles, and relay information from/to the CNS).

Myoclonus can occur by itself or as one of several symptoms associated with a wide variety of nervous system disorders. For example, myoclonic jerks may develop in individuals with multiple sclerosis or epilepsy, and with neurodegenerative diseases such as Parkinson's disease, Alzheimer's disease, or Creutzfeldt-Jakob disease.

Myoclonus may also be seen in conjunction with infection, head or spinal cord injury, stroke, brain tumors, kidney or liver failure, chemical or drug intoxication, or metabolic disorders. Prolonged oxygen deprivation to the brain, called hypoxia, may lead to post-hypoxic myoclonus.

What are the types of myoclonus?

Classifying the many different forms of myoclonus is difficult because the causes and responses to therapy vary widely. Some of the commonly described types are:

- **Sleep myoclonus** (also called hypnic myoclonus) occurs during sleep and sleep transitions, often as one is dropping off to sleep. Some forms appear to be stimulus-sensitive. Some people with sleep myoclonus are rarely troubled by, or need treatment for, the condition. However, myoclonus may be a symptom in more complex and disturbing sleep disorders, and may require treatment by a doctor.
- **Stimulus-sensitive myoclonus** is triggered by a variety of external events, including noise, movement, and light. Being surprised may increase the sensitivity of the individual.
- **Essential myoclonus** occurs on its own, without being influenced by abnormalities in the brain or nerves. Involuntary twitches or spasms can occur in people with no family history of the condition, and the cause may be unexplained (idiopathic), but it also can appear among members of the same family—indicating that it may be an inherited disorder. Essential myoclonus tends to be stable without increasing in severity over time. In some families there is an association of essential myoclonus with essential tremor or a form of dystonia (myoclonus-dystonia). Dystonia is a movement disorder in which sustained muscle contractions cause twisting and repetitive movements or abnormal postures.

- **Action myoclonus** is triggered or made stronger by voluntary movement or even the intention to move. It may become worse during attempts at precise, coordinated movements. Action myoclonus can be the most disabling form of myoclonus and may affect the arms, legs, and face. One of the causes may be brain damage that results from a lack of oxygen and blood flow to the brain, or it can be secondary to other medical or neurological conditions.
- **Cortical reflex myoclonus** originates in the cerebral cortex—the outer layer of the brain that is largely responsible for information processing. In this type of myoclonus, jerks usually involve only a few muscles in one part of the body, but jerks involving many muscles also may occur. Cortical reflex myoclonus can become more intensive when a person attempts to move in a certain way (action myoclonus) or perceives a particular sensation.
- **Epileptic myoclonus** is the presence of myoclonus in people living with epilepsy. Myoclonus can occur as the only seizure manifestation, as one component of a seizure, or one of multiple types of seizures within an epilepsy syndrome. Some examples of syndromes with myoclonic seizures include juvenile myoclonic epilepsy, myoclonic-astatic epilepsy, Lennox-Gastaut Syndrome, or progressive myoclonic epilepsy. Juvenile myoclonic epilepsy is seen starting around puberty and involves myoclonic seizures usually of the neck, shoulders, or upper arms, as well as generalized tonic-clonic seizures (affecting the whole body). Myoclonic-astatic seizures manifest as generalized

myoclonic jerks followed by a loss of muscle tone. Lennox-Gastaut Syndrome occurs in childhood and involves multiple seizure types which are usually difficult to control, as well as intellectual disability. Progressive myoclonus epilepsy (PME) is a group of disorders characterized by myoclonic seizures and other neurologic symptoms such as trouble walking or speaking. These rare disorders often get worse over time and sometimes are fatal. There are many forms of PME, one of which is Lafora body disease (also called Lafora progressive myoclonus epilepsy), which is characterized by myoclonic seizures, progressive loss of memory, and impaired intellectual functions.

- **Reticular reflex myoclonus** originates in the brain stem, the part of the brain that connects to the spinal cord and controls vital functions such as breathing and heartbeat. Myoclonic jerks usually affect the whole body, with muscles on both sides of the body affected simultaneously. In some people, myoclonic jerks occur in only a part of the body, such as the legs, with all the muscles in that part being involved in each jerk. Reticular reflex myoclonus can be triggered by either a voluntary movement or an external stimulus.
- **Palatal myoclonus**, also called palatal tremor, is a regular, rhythmic contraction of one or both sides of the rear of the roof of the mouth, called the soft palate. The contractions are very rapid and may continue during sleep. The condition usually appears in adults and can last indefinitely. People with palatal myoclonus may note a “clicking” sound in the ear when the muscles in the

soft palate contract. This can be idiopathic or secondary to injury in the brain stem or adjacent cerebellum.

- **Spinal myoclonus** originates in the spinal cord. In some instances, the myoclonic jerk involves the whole trunk, beginning in the thoracic (middle) spinal segments and spreading up and down, a phenomenon known as propriospinal myoclonus.
- **Peripheral myoclonus** refers to myoclonic jerks that originate from a peripheral nerve (outside of brain and spinal cord). An example of this is hemifacial spasm (frequent spasms of the muscles on one side of the face).

What do scientists know about myoclonus?

Studies suggest that several locations in the brain are involved in myoclonus. The cerebral cortex is the most common origin for myoclonus. Another location is in the brain stem close to structures that are responsible for the startle response—an automatic reaction to an unexpected stimulus involving rapid muscle contraction.

The specific mechanisms underlying myoclonus are not yet fully understood. Scientists believe that some types of stimulus-sensitive myoclonus may involve overexcitability of the parts of the brain that control movement. Laboratory studies suggest that an imbalance between chemicals called neurotransmitters may bring about myoclonus, with the end result being a lack of inhibition (a decrease in the rate of chemical reaction, or its prevention) at some level. Neurotransmitters carry messages between

nerve cells. They are released by one nerve cell and attach to a protein called a receptor on neighboring (receiving) cells. This attachment signals the receiving cell to act in a certain way.

Abnormalities or deficiencies in the receptors for certain neurotransmitters may contribute to some forms of myoclonus. Receptors that appear to be related to myoclonus include those for two important inhibitory neurotransmitters: serotonin and gamma-aminobutyric acid (GABA). Other receptors with links to myoclonus include those for glycine (an inhibitory neurotransmitter important for the control of motor and sensory functions in the spinal cord) and opiates. More research is needed to determine how these receptor abnormalities cause or contribute to myoclonus.

How is myoclonus diagnosed?

Following a review of the person's medical history and physical exam, a physician may order additional tests:

- electromyography (EMG), which measures electrical activity from muscle and is commonly used to diagnose myoclonus as well as nerve and muscle dysfunction;
- electroencephalography (EEG), which uses electrodes attached to the scalp to record the electrical activity of the brain that may trigger the myoclonic jerk;
- evoked potential studies, which capture electrical activity in the brain, brain stem and spinal cord evoked by specific stimuli (i.e., tactile, auditory, visual stimulation);

- laboratory tests of urine or blood, to check for possible causes and to rule out other conditions that may cause symptoms similar to myoclonus; and
- magnetic resonance imaging (MRI), which uses computer-generated radio waves and a magnetic field to produce three-dimensional images of the brain, spinal cord, nerve, and other tissue (including muscles).

How is myoclonus treated?

The first consideration is reversing or treating any underlying cause or origin of the myoclonus. However, in many cases, this may not be possible or effective, so symptomatic treatment is warranted if the myoclonus is disabling. Clonazepam is commonly used to treat some forms of myoclonus. Dosages of clonazepam usually are increased gradually until the individual improves or side effects become bothersome. Drowsiness and loss of coordination are common side effects. The beneficial effects of clonazepam may diminish over time if the individual develops a tolerance for the drug.

Many of the other drugs used for myoclonus, such as certain barbiturates, phenytoin, levetiracetam, valproate, and primidone, also are used to treat epilepsy. Each has side effects and drug interactions; however, a doctor will select the most appropriate treatment for individual patients.

Some studies have shown that doses of 5-hydroxytryptophan (5-HTP), a building block of serotonin (a chemical made in the body that transmits nerve impulses), leads to improvement

in individuals with some types of action myoclonus and progressive myoclonus epilepsy. However, other studies indicate that 5-HTP therapy is not effective in all people with myoclonus, and may even worsen the condition in some individuals. These differences in the effect of 5-HTP on people with myoclonus have not yet been explained, but they may offer important clues to underlying abnormalities in serotonin receptors.

The complex origins of myoclonus may require the use of multiple medications for effective treatment. Although some medications have a limited effect when used individually, they may have a greater effect when used with others that act on different pathways or mechanisms in the brain. By combining several drugs, physicians often can achieve greater control of myoclonic symptoms. Hormonal therapy also may improve responses to antimyoclonic drugs in some people.

Botulinum toxin injections can reduce excess muscle activity by blocking the activity of a chemical that makes muscles contract at the cellular level. Botulinum toxin injection is the first line therapy for hemifacial spasm, and has also shown to effectively treat some individuals with palatal myoclonus.

What research is being done?

The mission of the National Institute of Neurological Disorders and Stroke (NINDS) is to seek fundamental knowledge about the brain and nervous system and to use that knowledge to reduce the burden of neurological disease. The NINDS is a component of the National Institutes of Health, the leading federal supporter of biomedical research in the world.

As part of its mission, the NINDS supports research on myoclonus at its laboratories in Bethesda, Maryland and through grants to major research institutions across the country.

Botulinum toxin is a treatment for a variety of movement disorders. A current NINDS study is comparing the use of ultrasound (using sound waves) and electrophysiologic guidance (using electrical stimulation and a needle) to precisely target muscles for botulinum toxin injection to treat upper limb spasticity and focal hand dystonia. Results may lead to improved treatment for movement disorders such as myoclonus.

Animal models are being used to study the mechanisms involving myoclonus. For example, NINDS-funded scientists have developed a mouse model of myoclonus-dystonia (an inherited movement disorder characterized predominantly by myoclonus of the upper body and dystonia). A striking characteristic of this disorder is that motor symptoms improve with alcohol consumption. Researchers will test the hypothesis that abnormal activity of the cerebellum (the part of the brain responsible for coordination and regulation of voluntary movement) causes myoclonus and dystonia in myoclonus-dystonia, and that by acting on targets in the cerebellum, alcohol injections will normalize cerebellar activity to relieve motor symptoms. Results may provide a better understanding of the underlying neurological cause of myoclonus and dystonia in myoclonus-dystonia, and provide targets for treatment options.

Complex movement disorders (CMDs), defined as disorders in which individuals are affected by more than one movement disorder (such as parkinsonism and dystonia, or **myoclonus** and tremor), are a continuing challenge for diagnosis and treatment. NINDS-funded researchers are recruiting individuals with familial and sporadic CMDs to identify genetic mutations that may cause these disorders. Findings may lead to improvements in disease diagnosis and treatment.

Glycogen is a form of sugar that is used as an energy reserve in many cells. Abnormal glycogen metabolism in nerve cells causes several illnesses, including Lafora disease. NINDS-funded scientists hope to understand what goes wrong with glycogen storage in Lafora disease, which could help provide clues to new treatments.

In addition to NINDS, other NIH institutes and centers support research on movement disorders that include myoclonus. More information is available through the NIH RePORTER (<https://projectreporter.nih.gov>), a searchable database of current and previously funded research, as well as research results and publications.

Many neurological disorders do not have effective treatment options. Clinical trials offer hope for many people and an opportunity to help researchers find better ways to safely detect, treat, or prevent disease. For more information about finding and participating in a clinical trial, visit [Clinicaltrials.gov](https://clinicaltrials.gov) at <https://clinicaltrials.gov>. Use the search term “myoclonus” to find trials on this disorder.

Where can I get more information?

The National Institute of Neurological Disorders and Stroke conducts and supports a wide range of research on neurological disorders, including myoclonus. For information on other neurological disorders or research programs funded by the NINDS, contact in the Institute's Brain Resources and Information Network (BRAIN) at:

BRAIN

P.O. Box 5801
Bethesda, MD 20824
301-496-5751
800-352-9424
www.ninds.nih.gov

Interested individuals may wish to contact the following organization for additional information:

Opsoclonus-Myoclonus Support Network, Inc.

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National Organization for Rare Disorders (NORD)

55 Kenosia Avenue
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