Electromyogram (EMG) and Nerve Conduction Studies

An electromyogram (EMG) measures the electrical activity of muscles at rest and during contraction. Nerve conduction studies measure how well and how fast the nerves can send electrical signals. Nerves control the muscles in the body by electrical signals (impulses), and these impulses make the muscles react in specific ways. Nerve and muscle disorders cause the muscles to react in abnormal ways.

Measuring the electrical activity in muscles and nerves can help find diseases that damage muscle tissue (such as muscular dystrophy) or nerves (such as amyotrophic lateral sclerosis or peripheral neuropathies). EMG and nerve conduction studies are often done together to give more complete information.

Why It Is Done

An electromyogram (EMG) is done to:

- Find diseases that damage muscle tissue, nerves, or the junctions between nerve and muscle (neuromuscular junctions). These disorders may include a herniated disc, amyotrophic lateral sclerosis (ALS), or myasthenia gravis (MG).
- Find the cause of weakness, paralysis, or muscle twitching. Problems in a muscle, the nerves supplying a muscle, the spinal cord, or the area of the brain that controls a muscle can cause these symptoms. The EMG does not show brain or spinal cord diseases.

Nerve conduction studies are done to:

- Find damage to the peripheral nervous system, which includes all the nerves that lead away from the brain and spinal cord and the smaller nerves that branch out from those nerves. Nerve conduction studies are often used to help find nerve disorders, such as carpal tunnel syndrome or Guillain-Barré syndrome.

Both EMG and nerve conduction studies can help diagnose a condition called post-polio syndrome that may develop months to years after a person has had polio.

How To Prepare

Tell your doctor if you:

- Are taking any medicines. Certain medicines that act on the nervous system (such as muscle relaxants and anticholinergics) can change electromyogram (EMG) results. You may need to stop taking these medicines 3 to 6 days before the test.
- Have had bleeding problems or take blood thinners, such as warfarin (Coumadin) or heparin. If you take blood thinners, your doctor will tell you when to stop taking them before the test.
- Have a pacemaker.

Do not smoke for 3 hours before the test.
Do not eat or drink foods that contain caffeine (such as coffee, tea, cola, and chocolate) for 2 to 3 hours before the test.
Wear loose-fitting clothing so your muscles and nerves can be tested. You may be given a hospital gown to wear.
For an EMG, you may be asked to sign a consent form. Talk to your doctor about any concerns you have regarding the need for the test, its risks, how it will be done, or what the results will mean.

How It Is Done

An electromyogram (EMG) is done in a hospital, clinic, or doctor's office. A special room that stops any outside electrical interference may be used. The test may be done by an EMG technologist or a doctor specializing in diseases of the nervous system (neurologist) or in physical rehabilitation (physiatrist).
You will be asked to lie on a table or bed or sit in a reclining chair so your muscles are relaxed.

**Electromyogram**

The skin over the areas to be tested is cleaned with a special soap. A needle electrode that is attached by wires to a recording machine is inserted into a specific muscle.

Once the electrodes are in place, the electrical activity in that muscle is recorded while the muscle is at rest. Then the technologist or doctor asks you to tighten (contract) the muscle slowly and steadily. This electrical activity is recorded.

The electrode may be moved a number of times to record the activity in different areas of the muscle or in different muscles.

The electrical activity in the muscle is shown as wavy and spiky lines on a special video monitor (oscilloscope) and may also be heard on a loudspeaker as machine gun-like popping sounds when you contract the muscle. The activity may also be recorded on video.

An EMG may take 30 to 60 minutes. When the testing is done, the electrodes are removed and those areas of the skin where a needle was inserted are cleaned. You may be given pain medicine if any of the test areas are sore.

**Nerve conduction studies**

In this test, several flat metal disc electrodes are attached to your skin with tape or a special paste. A shock-emitting electrode is placed directly over the nerve and a recording electrode is placed over the muscles under control of that nerve. Several quick electrical pulses are given to the nerve, and the time it takes for the muscle to contract in response to the electrical pulse is recorded. The speed of the response is called the conduction velocity.

The same nerves on the other side of the body may be studied for comparison. When the test is completed, the electrodes are removed.

Nerve conduction studies are done before an EMG if both tests are being done. Nerve conduction tests may take from 15 minutes to 1 hour or more, depending on how many nerves and muscles are studied.

**How It Feels**

With an electromyogram (EMG) test, you may feel a quick, sharp pain when the needle electrode is put into a muscle. After an EMG test, you may be sore and have a tingling feeling in your muscles for 1 to 2 hours. If your pain gets worse or you have swelling, tenderness, or pus at any of the needle sites, call your doctor.

With the nerve conduction studies, you may feel a quick, burning pain, a tingling feeling, and a twitching of the muscle each time the electrical pulse is given. It feels like the kind of tingling you feel when you rub your feet on the carpet and then touch a metal object. The tests make some people anxious. Keep in mind that only a very low-voltage electrical current is used, and each electrical pulse is very quick (less than a split-second).

**Risks**

An electromyogram (EMG) is very safe. You may get some small bruises or swelling at some of the needle sites. The needles are sterile, so there is very little chance of developing an infection.

There is no chance of problems with nerve conduction studies. Nothing is put into your skin, so there is no chance of infection. The voltage of electrical pulses is not high enough to cause an injury.

**Results**

An electromyogram (EMG) measures the electrical activity of muscles at rest and during contraction. Nerve conduction studies measure how well and how fast the nerves can send electrical signals. Your doctor may be able to tell you about some of the results right after the tests. A full report may take 2 to 3 days.
**Electromyogram (EMG) and nerve conduction studies**

<table>
<thead>
<tr>
<th>Normal:</th>
<th>The EMG recording shows no electrical activity when the muscle is at rest. There is a smooth, wavy line on the recording with each muscle contraction.</th>
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<td>The nerve conduction studies show that the nerves transmit electrical impulses to the muscles or along the sensory nerves at normal speeds (conduction velocities). Sensory nerves allow the brain to feel pain, touch, temperature, and vibration. Different nerves have different normal conduction velocities. Nerve conduction velocities generally get slower as a person gets older.</td>
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<tr>
<td>Abnormal:</td>
<td>Electrical activity in a muscle at rest shows that there may be a problem with the nerve supply to the muscle. Abnormal wave lines when a muscle contracts may mean a muscle or nerve disorder, such as amyotrophic lateral sclerosis (ALS), post-polio syndrome, inflammation, or other muscle problems.</td>
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<td>In nerve conduction studies, the speed of nerve impulses (conduction velocity) may be slower than what is normal for that nerve. Slower conduction velocities may be caused by injury to a nerve (such as carpal tunnel syndrome) or group of nerves (such as Guillain-Barré syndrome or post-polio syndrome). Nerve conduction velocities generally get slower as a person gets older.</td>
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The results from EMG and nerve conduction studies are used along with your history, symptoms, physical and neurological examinations, and the results of other tests to help your doctor find out what the problem is or to see how a disease is changing.

**What Affects the Test**

Reasons you may not be able to have the test or why the results may not be helpful include:

- Taking medicines, such as muscle relaxants and anticholinergics.
- Having bleeding, swelling, or too much fat under the skin at the site of the nerves or muscles being tested.
- Not being able to do what is asked during the test.