

DIAGNOSIS

MS is a disease of the central nervous system. The central nervous system consists of the brain, spinal cord, and the optic nerves. Surrounding and protecting the nerve fibers (or axons) of the central nervous system is a fatty tissue called myelin, which helps nerve fibers conduct electrical impulses.

In MS, myelin is lost in multiple areas, leaving scar tissue called sclerosis. These damaged areas are also known as plaques or lesions. Sometimes the underlying nerve fiber (or axon) is also damaged or broken.

When myelin or the nerve fiber is destroyed or damaged, the ability of the nerves to conduct electrical impulses to and from the brain is disrupted, and this produces the various symptoms of MS.

MS is not contagious. No one can catch MS from another person.

What causes MS?

While the exact cause of MS is unknown, most researchers believe that the damage to myelin results from an abnormal response by the body's immune system. Normally, the

immune system defends the body against foreign invaders such as viruses or bacteria. In autoimmune diseases, the body attacks its own tissue. MS is probably an autoimmune disease in which myelin is the major target of an immune attack.

Scientists do not yet know what might cause the immune system to do this. Most agree that several factors are involved, including something in the person's genetic make-up coupled with exposure to something in the outside world, possibly exposure to a common virus or bacterium.

How is MS detected?

The diagnosis of MS can be very difficult. Because there is no single test that can be used to confirm MS, the process of diagnosis typically involves:



- evidence from the person's history (see **Symptoms**)
- a clinical examination (see **Signs**)
- and one or more laboratory tests (see **Tests**).

A physician often requires all three in order to rule out other possible causes for symptoms and to gather facts consistent with a diagnosis of MS.

Symptoms

The range of **symptoms** experienced by people with MS varies dramatically from person to person. Symptoms are problems that are reported by the person him- or herself.

MS symptoms can include reduced or abnormal sensations, weakness, vision changes, clumsiness, sudden loss of bladder control, and so on. Symptoms might appear in any combination and be mild or severe. They are usually experienced for unpredictable periods of time.

But symptoms alone don't indicate MS. Any one or combination of these symptoms might have causes unrelated to MS.

Signs

After taking a careful medical history, including all of a person's symptoms, past and present, the physician will do a series of tests to check for **signs** that can explain the symptoms or point to disease activity of which a person may not be aware.

Signs are indications of the disease that are objectively determined by a physician. Some signs might even explain a person's symptoms, but others have no corresponding symptom.

Common signs that can be detected by the doctor during a physical examination include:

- altered eye movements and abnormal responses of the pupils
- subtle changes in speech patterns
- altered reflex responses
- impaired coordination
- sensory disturbances
- evidence of spasticity and/or weakness in the arms or legs.



The physical examination may consist of the following:



- an eye examination, which may reveal the presence of damage to the optic nerve
- a check of muscle strength, by gently but firmly pulling and pushing a person's arms and legs
- measuring coordination, usually with a finger-to-nose test, in which a person is asked to bring the tip of an index finger to the nose rapidly, with eyes open and then closed
- an examination of body surface sensation, tested with a safety pin, and by a feather or a light touch
- a test of vibratory sense, with a vibrating tuning fork placed against a joint or bone so the person experiences a buzz-like sensation
- a test of reflexes, using fingers or a small rubber mallet.

Tests

Magnetic Resonance Imaging

Laboratory **tests** may be the crucial element of the diagnosis process. The preferred test, which detects plaques or scarring possibly caused by MS, is **magnetic resonance imaging (MRI)**.

The MRI scan is a diagnostic tool that currently offers the most sensitive non-invasive way of imaging the brain.

Unlike Computerized Tomography (CT) or conventional X-ray, the MRI scan does not use radiation. Instead, it uses magnetism and radio waves. Powerful magnetic fields interact with the hydrogen atoms found in the water contained in all body tissues and fluids. Radio frequency signals cause these hydrogen atoms to release energy, and computers translate the changes into cross-sectional images.

The scanning procedure is very sensitive and can often create pictures of lesions or areas of damage that would be missed by a CT scan.



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Although the absence of radiation is an asset, the powerful magnetic field of MRI means that it can't be used by people who have cardiac pacemakers or metal implants, such as aneurysm clips,

in their bodies. Dental fillings cause no problem.

An abnormal MRI does not necessarily mean MS. There are other diseases that cause lesions in the brain that look like those caused by MS. There are also spots found in healthy individuals, particularly in older persons, which are not related to any ongoing disease process. These are often called UBOs, for unidentified bright objects.

On the other hand, a normal MRI does not absolutely rule out MS. About 5% of people, who are confirmed to have MS on the basis of other criteria, do not show any lesions in the brain on MRI. These people may have lesions in the spinal cord or may have lesions that cannot be detected by MRI.

A clear-cut diagnosis might be made based on an evaluation of **symptoms, signs**, and the results of an **MRI**, but

additional tests may be ordered as well. These include tests of **evoked potential, cerebrospinal fluid**, and **blood**.

Evoked Potential

Evoked potential (EP) tests are electrical diagnostic studies that can show if there is a slowing of messages in various parts of the brain. They often provide evidence of scarring along nerve pathways not apparent any other way.

The EP test most widely accepted as an aid to an MS diagnosis is the Visual Evoked Potential (VEP). The person sits before a screen on which an alternating checkerboard pattern is displayed.

The results are interpreted by a neurologist or neurophysiologist who has special training in this test.

Cerebrospinal Fluid

Cerebrospinal fluid, sampled by a lumbar puncture (also called a spinal tap), is tested for levels of certain immune system proteins and for the presence of a staining pattern of antibodies called oligoclonal



bands. These bands indicate an immune response within the central nervous system.



Oligoclonal bands are found in the spinal fluid of 90-95% of people with MS. However, they are present in other diseases as well, so oligoclonal bands alone cannot be relied on as positive proof of MS.

Blood Tests

While there is no definitive **blood** test for MS, blood tests can positively rule out other causes for various neurologic symptoms such as Lyme disease, a group of diseases known as “collagen-vascular diseases,” certain rare hereditary disorders, and AIDS.

The diagnosis of MS

The basic “rule” for diagnosing MS requires both of the following:

1. Objective evidence of at least two areas of myelin loss, or demyelinating lesions, “separated in time and space.” This means lesions have occurred in different places within the brain, spinal cord, or optic nerve—at different points in time.

2. All other diseases that can cause similar neurologic symptoms have been objectively ruled out.

Until “1” and “2” have been satisfied, a physician will not be able to make a definite diagnosis of MS. Waiting in limbo is extremely trying. Receiving an incorrect diagnosis may be even worse. Depending on the clinical problems present when a person sees a physician, one or more of the tests described above might be done. Sometimes tests are done several times over a period of months to help gather needed information. A definite MS diagnosis satisfies the McDonald criteria, named for the distinguished neurologist W. Ian McDonald who sparked Society-supported efforts to make the diagnostic process for MS faster and more precise. The McDonald criteria were revised in 2005 to incorporate new data that should speed the diagnosis without compromising accuracy.

Before definite diagnosis

In some circumstances, treatment with a disease-modifying drug may be recommended before the individual receives a definite diagnosis. In January 2003,





the FDA approved the use of Avonex[®] for individuals who have had one major attack of MS symptoms and have evidence of MS lesions within the central nervous system, as seen by MRI scanning.

Studies of

Betaseron[®] and Rebif[®] have also demonstrated benefit in people with one major attack and supporting MRI data, although the manufacturers of these medications have not yet applied to the FDA for approval of this use of their medications.

The National MS Society does not require people to have a definite diagnosis before offering support and information.

A word on referral

There has been an enormous increase in knowledge about MS in the United States medical community, but MS remains a complicated and highly variable disease. It is also relatively uncommon. Many general practice physicians and even some neurologists will have little experience with it.

Your chapter of the National MS Society can refer you to physicians in your community who have the most experience with MS.

Additional Information

Call 1-800-FIGHT-MS (1-800-344-4867), or log on to **nationalmssociety.org** for information about chapter-affiliated MS clinical centers in your area or region.

Sources for this publication

1. Physician/patient photos: Dr. Aaron Miller, the Society's Chief Medical Officer, with three of his patients. Photographs by Bill Stanton.
2. MRI photos: "Siemens Press Picture".
3. "International Panel Revises Diagnostic Criteria for MS", Research/Clinical Update, Nov.10, 2005. © 2005 National MS Society.
4. The National Multiple Sclerosis Information Sourcebook. © 2006 National MS Society.
5. "Living with MS", by Debra Frankel, MS, OTR with Hettie Jones. © 2005 National MS Society.
6. "Multiple Sclerosis: The Questions You Have—The Answers You Need", by Rosalind C. Kalb, PhD, Third Edition. © 2004 Demos Medical Publishing.

The National Multiple Sclerosis Society is proud to be a source of information about multiple sclerosis. Our comments are based on professional advice, published experience and expert opinion, but do not represent individual therapeutic recommendation or prescription. For specific information and advice, consult your personal physician.

Preparing for an MRI

MRI is painless and requires no physical preparation (such as fasting), but it can be intimidating if you aren't prepared for it. It is reassuring to know what to expect.

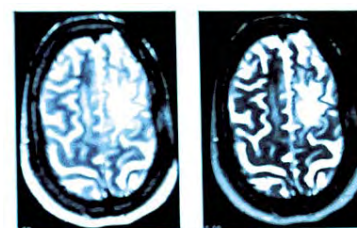


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When you arrive for the scan, metallic objects and credit cards are removed because of the magnetic field. You will also be asked if you have any metal implants in your body. You will be given a hospital gown and you may even be asked to pass through a metal detection device similar to those used at airport security checkpoints. Then you will be placed on the scanner bed, which is rolled into a short tunnel within the center of the scanner's magnet. It is possible you will receive an injection of a contrasting agent called gadolinium, if your doctor requests it, to help distinguish types of lesions. During the scan, you can breathe normally but you must lie perfectly still. You will be able to hear and talk with a technician during the entire procedure.

There are no physical side effects to be concerned about. Psychologically, however, it's worth being prepared for the following:

- You will have to hold still for a long period of time, often 30–60 minutes with brief breaks.
- You may experience some discomfort from lying on a hard surface for that length of time.
- You may experience some claustrophobia from lying inside the machine. While an “open” MRI does exist, it may not provide clear enough pictures of the brain to be useful as part of an MS diagnosis. If you're inclined to suffer from claustrophobia or from tremors you may want to ask your physician in advance for a tranquilizer or some other medication before the scan.
- Be prepared for a loud banging or clicking noise that goes on during the scan. It can throw you off at first.



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Efforts will be made to help you feel comfortable and relaxed—especially if you make your needs known ahead of time. Some people report that they asked for and received earphones to listen to music. A small pillow could be requested to reduce back discomfort. Very often a buzzer is provided to signal if you have to go to the bathroom. Most important, remember the technician is always there for you to talk to.

Most people report that MRI tests are no picnic, but they're really not uncomfortable. The scan will draw more on your patience quota than on your pain quota.