Transverse Myelitis

U.S. DEPARTMENT OF HEALTH
AND HUMAN SERVICES
National Institutes of Health

Transverse Myelitis

What is transverse myelitis?

Transverse myelitis is an inflammation of the spinal cord, the part of the central nervous system that sends impulses from the brain to nerves in the body. The spinal cord also carries sensory information back to the brain. The term *myelitis* refers to inflammation of the spinal cord; *transverse* refers to the pattern of changes in sensation—there is often a band-like sensation across the trunk of the body, with sensory changes below. Symptoms may develop suddenly (over a period of hours) or over days or weeks and include:

- pain
- sensory problems
- weakness in the legs and possibly arms, and
- bladder and bowel problems.

Transverse myelitis can affect people of any age, gender, or race. It does not appear to be genetic or run in families. The disorder typically occurs between ages 10 and 19 years and 30 and 39 years.

Although some people recover from transverse myelitis with minor or no residual problems, the healing process may take months to years. Most people with transverse myelitis have at least partial recovery, with most recovery taking place within the first 3 months after the attack. Others may suffer permanent impairments that affect their ability to perform ordinary tasks of daily living. Some individuals will have only one episode of transverse myelitis; other individuals may have a recurrence, especially if an underlying illness caused the disorder. There is no cure for transverse myelitis, but there are treatments to prevent or minimize permanent neurological deficits.

What causes transverse myelitis?

The exact cause of transverse myelitis and extensive damage to the bundles of nerve fibers of the spinal cord is unknown in many cases. Cases in which a cause cannot be identified are called idiopathic. Viral, bacterial, and fungal infections affecting the spinal cord may cause the disorder.

A number of conditions appear to cause transverse myelitis, including:

- **Immune system disorders** appear to play an important role in causing damage to the spinal cord. Such disorders are:
  - aquaporin-4 autoantibody associated neuromyelitis optica. Neuromyelitis optica is a disorder that affects the eye nerves and spinal cord. Aquaporin-4 is a channel on

the cell membrane that lets water enter the cell and helps maintain the chemical balance for processes to take place within the central nervous system. An antibody is a protein that binds to foreign substances that can attack the host organism.

- multiple sclerosis, a disorder in which immune system cells that normally protect us from viruses, bacteria, and unhealthy cells mistakenly attack the protective coating of myelin in the brain, optic nerves, and spinal cord
- post-infectious or post-vaccine autoimmune phenomenon, in which the body's immune system mistakenly attacks the body's own tissue while responding to the infection or, less commonly, a vaccine
- an abnormal immune response to an underlying cancer that damages the nervous system; or
- other antibody-mediated conditions that are still being discovered.

- **Viral infections** including herpes viruses such as varicella zoster (the virus that causes chickenpox and shingles), herpes simplex, cytomegalovirus, and Epstein-Barr; flaviviruses such as West Nile and Zika; influenza, echovirus, hepatitis B, mumps, measles, and rubella. It is often difficult to know whether direct viral infection or a post-infectious response causes the transverse myelitis.

- **Bacterial infections** such as syphilis, tuberculosis, actinomyces, pertussis, tetanus, diphtheria, and Lyme disease. Bacterial skin infections, middle-ear infections, campylobacter jejuni gastroenteritis, and mycoplasma bacterial pneumonia have also been associated with the condition.
- **Fungal infections** in the spinal cord, including aspergillus, blastomyces, coccidioides, and cryptococcus.
- **Parasites**, including toxoplasmosis, cysticercosis, shistosomiasis, and angtiostrongyloides.
- **Other inflammatory disorders** that can affect the spinal cord, such as sarcoidosis, systemic lupus erythematosus, Sjogren's syndrome, mixed connective tissue disease, scleroderma, and Bechet's syndrome.
- **Vascular disorders** such as arteriovenous malformation, dural arterial-venous fistula, intra-spinal cavernous malformations, or disk embolism.

In some people, transverse myelitis represents the first symptom of an autoimmune or immune-mediated disease such as multiple sclerosis or neuromyelitis optica. "Partial" myelitis—affecting only a portion of the cord cross-section—is more characteristic of multiple sclerosis. Neuromyelitis optica is much more likely as an underlying condition when the myelitis is "complete" (causing severe paralysis and numbness on both sides of the spinal cord). Myelitis attacks with neuromyelitis optica spectrum disorder (NMOSD) tend to be more severe and are associated with less recovery than attacks with multiple sclerosis.

What are the symptoms of transverse myelitis?

Transverse myelitis may be either *acute* (developing over hours to several days) or *subacute* (usually developing over one to four weeks).

The segment of the spinal cord at which the damage occurs determines which parts of the body are affected. Damage at one segment will affect function at that level and below. In individuals with transverse myelitis, myelin damage most often occurs in nerves in the upper back.

Four classic features of transverse myelitis are:

- **Weakness of the legs and arms**. People with transverse myelitis may have weakness in the legs that progresses rapidly. If the myelitis affects the upper spinal cord it affects the arms as well. Individuals may develop *paraparesis* (partial paralysis of the legs) that may progress to *paraplegia* (complete paralysis of the legs), requiring the person to use a wheelchair.
- **Pain**. Initial symptoms usually include lower back pain or sharp, shooting sensations that radiate down the legs or arms or around the torso.
- **Sensory alterations**. Transverse myelitis can cause *paresthesias* (abnormal sensations such as burning, tickling, pricking, numbness, coldness, or tingling) in the legs, and sensory loss. Abnormal sensations in the torso and genital region are common.

- **Bowel and bladder dysfunction**. Common symptoms include an increased frequency or urge to use the toilet, incontinence, and constipation.

Many individuals also report experiencing muscle spasms, a general feeling of discomfort, headache, fever, and loss of appetite, while some people experience respiratory problems. Other symptoms may include sexual dysfunction and depression and anxiety caused by lifestyle changes, stress, and chronic pain.

How is transverse myelitis diagnosed?

Physicians diagnose transverse myelitis by taking a medical history and performing a thorough neurological examination. Tests that can indicate a diagnosis of transverse myelitis and rule out or evaluate underlying causes include:

- **Magnetic resonance imaging (MRI)** produces a cross-sectional view or three-dimensional image of tissues, including the brain and spinal cord. A spinal MRI will almost always confirm the presence of a lesion within the spinal cord, whereas a brain MRI may provide clues to other underlying causes, especially MS. In some instances, computed tomography (CT) may be used to detect inflammation.
- **Blood tests** may be performed to rule out various disorders, including HIV infection and vitamin B12 deficiency. Blood is tested for the presence of autoantibodies

(anti- aquaporin-4, anti-myelin oligodendrocyte) and antibodies associated with cancer (paraneoplastic antibodies). The presence of autoantibodies (proteins produced by cells of the immune system) is linked to autoimmune disorders and point to a definite cause of transverse myelitis.

- **Lumbar puncture and spinal fluid analysis** (also called spinal tap) can identify more protein than usual in some people with transverse myelitis and an increased number of white blood cells (leukocytes) that help the body fight infections.

If none of these tests suggests a specific cause, the person is presumed to have idiopathic transverse myelitis.

How is transverse myelitis treated?

Treatments are designed to address infections that may cause the disorder, reduce spinal cord inflammation, and manage and alleviate symptoms.

Initial treatments and management of the complications of transverse myelitis include:

- **Intravenous corticosteroid drugs** may decrease swelling and inflammation in the spine and reduce immune system activity. Such drugs may include methylprednisolone or dexamethasone. These medications may also be given to reduce subsequent attacks of transverse myelitis in individuals with underlying disorders.

- **Plasma exchange therapy** (plasmapheresis) may be used for people who don't respond well to intravenous steroids. Plasmapheresis is a procedure that reduces immune system activity by removing plasma (the fluid in which blood cells and antibodies are suspended) and replacing it with special fluids, thus removing the antibodies and other proteins thought to be causing the inflammatory reaction.
- **Intravenous immunoglobulin (IVIG)** is a treatment thought to reset the immune system. IVIG is a highly concentrated injection of antibodies pooled from many healthy donors that bind to the antibodies that may cause the disorder and remove them from circulation.
- **Pain medicines** that can lessen muscle pain include acetaminophen, ibuprofen, and naproxen. Nerve pain may be treated with certain antidepressant drugs (such as duloxetine), muscle relaxants (such as baclofen, tizanidine, or cyclobenzaprine), and anticonvulsant drugs (such as gabapentin or pregabalin).
- **Antiviral medications** may help individuals who have a viral infection of the spinal cord.
- **Medications can treat other symptoms and complications**, including incontinence, painful muscle contractions called tonic spasms, stiffness, sexual dysfunction, and depression.

Following initial therapy, it is critical part to keep the person's body functioning during the recovery period. This may require placing the person on a respirator in the uncommon scenario where breathing is significantly affected.

Prevention of future transverse myelitis episodes

Multiple sclerosis and neuromyelitis optica typically require long-term treatment to modify the immune system response. Treatment of MS with immumodulatory or immunosuppressant medications such as alemtuzumab, dimethyl fumarate, fingolimod, glatiramer acetate, interferon-beta, natalizumab, or teriflunomide may be needed.

Immunosuppressant treatments are used for neuromyelitis optica spectrum disorder and recurrent episodes of transverse myelitis that are not caused by multiple sclerosis. They are aimed at preventing future myelitis attacks (or attacks at other sites) and include steroid-sparing drugs such as mycophenolate mofetil, azathioprine, and rituximab.

Rehabilitative and long-term therapy

Many forms of long-term rehabilitative therapy are available for people who have disabilities resulting from transverse myelitis. Strength and functioning may improve with rehabilitative services, even years after the initial episode. Although rehabilitation

cannot reverse the physical damage resulting from transverse myelitis, it can help people, even those with severe paralysis, become as functionally independent as possible and attain the best possible quality of life.

Common neurological deficits resulting from transverse myelitis include incontinence, chronic pain, and severe weakness, spasticity, or paralysis. In some cases, these may be permanent. Individuals with lasting or permanent neurological defects from transverse myelitis typically consult with a range of rehabilitation specialists, which may include physiatrists, physical therapists, occupational therapists, vocational therapists, and mental health care professionals.

- **Physical therapy** can help retain muscle strength and flexibility, improve coordination, reduce spasticity, regain greater control over bladder and bowel function, and increase joint movement. Individuals are also taught to use assistive devices such as wheelchairs, canes, or braces.
- **Occupational therapy** teaches people new ways to maintain or rebuild their independence by participating in meaningful, self-directed, everyday tasks such as bathing, dressing, preparing meals, and house cleaning.
- **Vocational therapy** involves offering instructions to help people develop and promote work skills, identify potential employers, and assist in job searches. Vocational therapists act as mediators

between employees and employers to secure reasonable workplace accommodations.

- **Psychotherapy** for people living with permanent includes strategies and tools to deal with stress and a wide range of emotions and behaviors.

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. NINDS is a component of the National Institutes of Health, the leading supporter of biomedical research in the world.

NINDS researchers are working to better understand how the immune system destroys or attacks the nerve-insulating substance called myelin in autoimmune diseases or disorders. Other work focuses on strategies to repair demyelinated spinal cords, including approaches using cell transplantation. This research may lead to a greater understanding of the mechanisms responsible for damaging myelin and may ultimately provide a means to prevent and treat transverse myelitis.

Glial cell studies. Glia, or neuroglia, are non-neuronal cells (they do not provide electrical impulses) in the nervous system that form myelin and provide support and protection for neurons. Oligodendrocyte progenitor cells (OPCs) are stem cells that generate myelin-producing oligodendrocytes, a type of glial cell.

NINDS-funded scientists are studying cellular mechanisms that control the generation and maturation of OPCs to allow remyelination, which could be an effective therapy for transverse myelitis and spinal cord injury. Other NINDS-funded investigators are focusing on mechanisms and interventions designed to increase oligodendrocyte proliferation and remyelination after spinal cord injury.

Astrocytes are another type of glial cell. The aquaporin-4 IgG antibody binds to astrocytes, which has led to an increased interest in its role in transverse myelitis of neuromyelitis optica spectrum disorder (NMOSD). The antibody appears to cause myelitis in NMOSD by activating other components of the immune system, resulting in injury to the spinal cord. Many studies are trying to better understand the role of astrocytes in autoimmune diseases.

Genetic studies. NINDS-funded scientists hope to develop a better understanding of the molecular control of central nervous system myelination and remyelination by studying the *Brg1* (Brahma-related) gene that appears to be involved in oligodendrocyte myelination. The long-term objective of this research is to develop drugs that modulate the activity of *Brg1* and other genes to promote myelination and remyelination.

Animal models. NINDS funds research using animal models of spinal cord injury aimed at replacing or regenerating spinal cord nerve cells. The ultimate goals of these studies are to develop interventions for regeneration or remyelination of spared nerve fibers in humans and to restore function to paralyzed individuals.

Neuroimaging with MRI. Research funded by NINDS aims to develop and implement new MRI techniques to quantitatively assess the relationship between spinal cord pathology and neurological dysfunction in MS. This new approach may assess changes in lesions and myelin in MS and possibly transverse myelitis. Other NIH-funded researchers plan to develop MRI methodologies to non-invasively detect and characterize networks to identify the extent of injury to the spinal cord and to monitor the progression of recovery after injury. These techniques may aid in earlier detection of transverse myelitis and other neurological disorders such as MS.

Brain-machine interfaces and prosthetic devices. Scientists are developing brain-machine interfaces and neural prostheses to help people with spinal cord damage regain functions by bypassing the injury site. These sophisticated electrical and mechanical devices connect with the nervous system to supplement or replace lost motor and sensory function.

Where can I get more information?

For more information on neurological disorders or research programs funded by the National Institute of Neurological Disorders and Stroke, contact the Institute's **Brain Resources and Information Network (BRAIN)** at:

BRAIN
P.O. Box 5801
Bethesda, MD 20824
800-352-9424
https://www.ninds.nih.gov

More information on transverse myelitis and spinal cord injury research supported by the NINDS and other NIH components is available through the NIH RePORTER (http://projectreporter.nih.gov), a searchable database of current and previously funded research, as well as research results and publications.

Information also is available from the following organizations:

Siegel Rare Neuroimmune Association
1787 Sutter Parkway
Powell, OH 43605-4884
855-380-3330
https://wearesrna.org

Christopher and Dana Reeve Foundation
636 Morris Turnpike, Suite 3A
Short Hills, NJ 07078
800-225-0292
https://www.christopherreeve.org

The Guthy-Jackson Charitable Foundation
Post Office Box 15185
Beverly Hills, CA 90210
310- 620-3074
https://guthyjacksonfoundation.org

National Organization for Rare Disorders (NORD)
55 Kenosia Avenue
Danbury, CT 06810
203-744-0100
https://rarediseases.org

National Library of Medicine
8600 Rockville Pike
Bethesda, MD 20894
301-594-5983
888-346-3656
https://www.nlm.nih.gov

National Institute of
Neurological Disorders
and Stroke

NIH . . . Turning Discovery Into Health

Prepared by:
Office of Neuroscience Communications and Engagement
National Institute of Neurological Disorders and Stroke
National Institutes of Health
Department of Health and Human Services
Bethesda, Maryland 20892-2540

Like us on Facebook:

@NINDSBrainForLife
https://www.facebook.com/NINDSBrainForLife

Follow us on Twitter:

@NINDSnews
https://twitter.com/NINDSnews

NIH Publication No. 21-NS-4841 January 2021