MULTIPLE SCLEROSIS

INTRODUCTION

Multiple sclerosis (MS) is a chronic disease of the nervous system. Multiple sclerosis causes inflammation and damage to the myelin sheaths, the protective coatings that cover tissues in the nervous system, in particular the nerve fibers. The brain and the nerves. Multiple sclerosis is considered to be an autoimmune disease, but despite extensive research, the exact causes or causes of MS are not known. There are approximately 400,000 Americans who have MS.

Although most patients with MS have similar signs and symptoms, the progress and pattern of these differs from patient to patient. The signs and symptoms and the progress of MS can also vary in each individual. There are also four distinct categories of MS that describe the clinical presentation and progression of the disease.

Supportive care and medications can make MS easier to tolerate. However, because there is no cure for MS and the signs and symptoms are very debilitating, MS is a very hard to disease to live with and many patients suffer significant disabilities and disruptions in their activities off daily living and their personal and social life.

OBJECTIVES

After completing this module the learner will be able to:

1. Identify the basic cause of MS.
2. Identify the pathologic process that causes MS.
3. Identify common signs and symptoms of MS.
4. Identify the most common presentation pattern of MS.

5. Identify medications that are used to treat MS.

MULTIPLE SCLEROSIS AND THE NERVOUS SYSTEM

The nervous system is comprised of the brain, the spinal cord, the nerve fibers, and the nerve endings, and the nervous system controls everything we do. It controls the involuntary actions of our bodies, the ones like breathing, circulation, and digestion that happen without conscious control. The nervous system also controls the things that we can do consciously, such as walk, talk, and think, activities that are considered to be the higher functions.

The nervous system functions and it exerts its control, by sending signals from the brain to the organs and tissues and receiving signals back from the body through the nerve fibers. These signals are actually electrical impulses, and the nerve fibers could be considered to be the “wiring” of the nervous system. In order for these signals to be transmitted effectively and quickly, the brain, spinal cord, and nerve fibers are covered with a protective sheath called myelin. Using the analogy of the nerve fibers as electrical wires, myelin is the insulation that surrounds the nerve fibers and other parts of the nervous system that are involved in sending and receiving signals. By doing so, the myelin makes sure these electrical signals traveling to and from brain are transmitted rapidly and effectively, but this process is irreversibly damaged by MS.

WHAT CAUSES MULTIPLE SCLEROSIS?

The basic cause of MS is damage to the myelin sheaths that cover the nerve fibers, and the term MS is an accurate description of this pathologic process and
damage. Multiple sclerosis causes *multiple* areas of *sclerosis* to the myelin sheaths, sclerosis being a medical term that means scarring. Because the myelin sheaths are damaged, the nerve signals moving out from, and back to the brain cannot be effectively transmitted, and this disruption in nerve signal transmission results in the typical signs and symptoms of MS.

This damage and scarring that is characteristic of MS are the result of *inflammation*. Inflammation is one of the ways the body’s immune system responds to trauma, injury, or infection. Inflammation increases blood flow to the damaged/infected area and also brings antibodies and other healing blood components to where they are needed, and the classic signs and symptoms of inflammation are pain, swelling, and heat and redness in the affected area. Inflammation is uncomfortable and painful but it is essentially a healing process and it is self-limiting; once the damage has been repaired, inflammation is stopped.

However, the inflammation that is caused by MS is chronic. The myelin sheaths are damaged (the initial cause of this is discussed below) and the normal healing process of inflammation is initiated in response to this damage, but in MS the inflammation does *not* stop; it is not self-limiting and it becomes chronic. Inflammation when it is mild and controlled is beneficial. But when it is chronic, intense, and widespread, as it is in MS, it can actually be a source of damage and this “collateral damage” of the inflammation in MS greatly contributes to the signs and symptoms and progression of the disease. Because of the damage to the myelin, the impulses and information that travel to and from
our brains are not transmitted normally. The nerve transmission is slow, spasmodic, and erratic and this is the basis for the signs and symptoms of MS.

Multiple sclerosis is a disease that has been exhaustively studied in the search for a cause. There are strong suspicions that MS is a disease that is caused by several factors working together and like many diseases, MS probably begins when someone who is genetically susceptible to MS encounters a "trigger" that sets the disease in motion. The most recent research suggests that MS is caused by a combination of:

- Environmental and life style factors: Cigarette smoking, the use of alcohol, and diet are considered to be possible causes, or contributing causes of MS. Lack of exposure is also correlated with the MS, and the highest incidence of the disease is found in areas of the world that receive little sunlight for parts of the year. Vitamin D deficiency is also a possible cause of MS, and vitamin D deficiency may also worsen the disease process of MS once it has begun.

- Genetic factors: Genes have been identified that may make someone more likely to develop MS. But it is also very likely that there are multiple genetic variations that would need to be combined to cause MS, and genetic transmission of MS is not considered to be a significant cause of the disease.

- Infection: There has long been a strong suspicion that chronic infections may be the cause, or a contributing cause of MS. For example, the Epstein-Barr virus is a common virus, and it can cause diseases such as
mononucleosis and rheumatoid arthritis. There is some evidence that the Epstein-Barr virus may be a cause of MS, perhaps acting as a trigger that initiates inflammation. However, there is no conclusive proof that viruses are a direct cause of MS, and infection with and Epstein-Barr and other viruses probably contributes to a susceptibility to MS but is not a primary cause of the disease. Multiple sclerosis is not contagious.

The environmental/life style issues, the genetic susceptibility, and viral infections are thought to be important risk factors in the development of MS. However, none of them is considered to be, either alone or in combination, a primary cause of MS. Instead these risk factors are considered to be triggers, triggers that initiate a process called the autoimmune response that is considered to be the primary cause of MS.

Most sources consider MS to be an autoimmune disease. Autoimmune diseases happen when the body’s immune system misidentifies normal body tissues and organs as foreign and organizes an immune response. Many common diseases such as type I diabetes mellitus, rheumatoid arthritis, and MS are considered to be autoimmune diseases, and the immune response that is triggered by MS risk factors is strong and enduring enough to permanently damage the myelin sheaths. As mentioned earlier, the inflammatory response is usually: 1) a normal defense mechanism against harmful microorganisms; 2) a normal healing mechanism when there is injury or trauma, and; 3) it is self-limiting. But in MS as with other autoimmune diseases, the inflammatory
response attacks healthy tissues and organs and it is chronic: in MS, as with other autoimmune diseases, the inflammatory response continues for years.

**WHO IS AFFECTED BY MULTIPLE SCLEROSIS**

Multiple sclerosis is much more common in women than in men. The risk of developing MS is approximately three times greater for women, and women typically develop MS at an earlier age than do men. However, the progression of the disease is much faster for men, they suffer more from cognitive impairment, and the prognosis for men is worse. It is not clear why women are more likely than men to develop MS, but differences in sex hormones are the most likely explanation. During puberty, for example, the risk for developing MS increases sharply, it decreases during the third trimester of pregnancy, but the risk then increases in the first trimester post-partum.

**WHAT ARE THE SIGNS AND SYMPTOMS OF MULTIPLE SCLEROSIS?**

Most cases of MS develop in people between the ages of 20 to 40, but the onset can be earlier or later. In some patients the signs and symptoms are minor and very subtle and the onset of the disease is quite slow and because of that the patient may not seek medical attention. For other patients, MS begins very suddenly and the signs and symptoms are dramatic. It is interesting to note that post-mortem examinations have found that there can be damage to the brain that indicates the patient had MS but he/she had no clinical evidence of the disease.

The clinical presentation of MS is quite variable but there are signs and symptoms that are common to almost everyone who has MS. Some of the typical signs and symptoms of the disease include:
This list emphasizes that the clinical presentation of MS can be very complex and that the disease affects both physical and emotional well-being. Some people who have MS will have predominantly sensory signs and symptoms such as heat intolerance and numbness in the extremities and others will have emotional disturbances and cognitive dysfunction. The presentation of MS can vary significantly from person to person, and it can also change for the individual, as well. Some people who have MS may experience signs and symptoms that are constant in nature while for others the clinical picture can change from time to time.

There are many signs and symptoms associated with MS, but the following ones are relatively common, very distressing to the patient, and can be particularly disruptive in terms of the activities of daily living: Cognitive

- Ataxia
- Cognitive dysfunction
- Constipation
- Depression
- Dizziness
- Fatigue
- Fecal incontinence
- Heat intolerance
- Mobility and balance impairment
- Mood swings
- Muscle weakness
- Numbness in the extremities
- Optic neuritis
- Pain
- Sexual dysfunction
- Spasticity
- Tremors
- Urinary incontinence
- Weakness
dysfunction, depression, fatigue, heat intolerance, incontinence, mobility and balance impairment, optic neuritis, pain, sexual dysfunction, and spasticity.

**Cognitive dysfunction** refers to abnormalities or changes in intellectual functioning. People who have MS may, at times, have difficulty with abstract thinking and problem solving. Their attention span may be unusually short and they cannot focus on an issue or an idea. The ability to understand and/or use speech can be affected. Cognitive dysfunction is a very common complication of MS. It is typically not serious enough to interfere with day-to-day functioning, but the loss of intellectual ability can be very upsetting for the patient.

**Depression** affects approximately 50% of everyone who has MS and it is much more common in MS patients than in the general population. Depression in patients who have MS has been associated with increased levels of cognitive dysfunction, increased levels of fatigue, poor compliance with medication regimens, sexual dysfunction, and an increased risk of suicide. The physical signs and symptoms of MS are obvious to focus on as they are easily seen. But many patients with MS are troubled by depression, and the suicide rate for people with MS is almost 8 times higher than that of the population without MS.

**Fatigue** is an almost universal complaint of people who have MS. Fatigue in MS is different in several important ways than merely being tired from lack of sleep or from over-exertion. The fatigue of MS is far more debilitating. Patients who have MS describe their fatigue as an overwhelming lack of energy, and fatigue is a significant reason why people who have MS cannot work. Fatigue for the MS patient is also a regular occurrence, and it often begins in the morning,
even after a full night’s sleep, and it gets worse as the day progresses. Patients who have MS often report that their fatigue is aggravated by heat and humidity, and the depression and sleep disturbances that often accompany MS certainly worsen the intensity of fatigue.

Heat intolerance is very common in people who have MS. Exposure to hot, humid conditions, overheating while exercising, or simply lying in the sun will tend to worsen the signs and symptoms of MS. Fortunately this effect is temporary and does not affect the progression of MS.

Incontinence, both fecal and urinary, is obviously very distressing and unfortunately incontinence is very common in people who have MS. People who have MS can also have urinary frequency, urgency, and sleep disruptions caused by the need to urinate, and these urinary tract dysfunctions occur in more than 90% of all people who have MS. Fecal incontinence is less common but no less disturbing.

Within 10-15 years of the diagnosis of MS, approximately 80% of all patients who have the disease will have some form of mobility and/or balance impairment. As the disease progresses these problems become worse, walking becomes difficult or impossible, and falls are common. Ataxia, defined as an inability to coordinate movement, is also very common in people who have MS and contributes to mobility problems.

Optic neuritis is defined as inflammation of the nerves supplying the eyes. Optic neuritis in someone who has MS is characterized by blurred vision; double vision; decreased ability to distinguish colors; pain that is aggravated by moving
the eyes, and; decreased clarity of vision. The heat intolerance that is common in MS patients may worsen some of these vision problems.

**Pain** affects approximately two-thirds of people who have MS. Many people who have MS feel that aside from fatigue, pain is the most distressing and challenging symptom they must cope with and it is associated with increased levels of anxiety, depression, disability, and interference with activities of daily living. Pain associated with MS can occur almost anywhere, but headache, extremity pain, and back pain are the most common. Pain can be a direct result of MS or it can be secondary and caused by spasticity.

**Sexual dysfunction** in people who have MS can be a direct result of nerve damage caused by MS. It can be psychological in nature, or it can be due to physical impairments of MS such as bowel and bladder dysfunction, pain, spasticity, or fatigue that affect sexual response and intimacy. Up to 80% of people who have MS experience some form of sexual dysfunction, and it is one of the more psychologically traumatic aspects of the disease.

**Spasticity** affects up to 90% of people who have MS and many people who have MS have spasticity that is classified as moderate to severe. Spasticity is in people who have MS is characterized by sudden and involuntary muscle movements and/or muscle movements that are stiff, awkward, and uncoordinated. Spasticity in this patient population can affect a single body part, a specific area of the body, or it can be generalized. Spasticity in MS is unpredictable, it causes pain, it increases the level of fatigue and this part of the disease, along with fatigue and mobility and balance impairment, significantly
reduces the patient’s ability to ambulate, work, and participate in other activities of daily living.

These signs and symptoms are experienced by many people who have MS. It is also quite common for these signs and symptoms to wax and wane, and a pattern of having good days and bad days is one of the hallmarks of the disease. When someone who has MS is having an “attack” it is very difficult for that person to function normally. Moving and walking can be painful and unsafe, and they may have difficulty with their vision. The patient will feel tired and depressed, and their moods may be very variable.

THE DISEASE PATTERNS OF MULTIPLE SCLEROSIS

Multiple sclerosis is classified into four categories, each one describing a particular pattern of how the disease progresses, the prognosis for the patient, the frequency of the attacks, and the patient’s condition between attacks. These four categories are relapsing-remitting; primary-progressive; secondary-progressive, and; progressive-relapsing.

- Relapsing-remitting: The relapsing-remitting form of MS is the most common type of MS. In the relapsing-remitting form of the disease the patient will have symptomatic episodes of MS that evolve over weeks or months. These symptomatic episodes are followed by periods of relapse in which the signs and symptoms are absent - there is a full recovery - or there will be some mild functional deficits but the patient is essentially stable. The relapses, as with the symptomatic periods, take weeks and months to evolve. The symptomatic periods may be separated by months
or years: the average frequency of an MS attack in this form of the disease is once every two years. Most patients who have relapsing-remitting MS will eventually develop the secondary progressive type of MS.

- **Primary-progressive MS:** People who have primary-progressive MS do not return to their normal health status between attacks, but become progressively more and more disabled with each attack. They do not have relapses in which they return to their normal level of functioning. Approximately 10% of all people with MS have this form of the disease. Primary progressive MS is more common in older adults and in men.

- **Secondary-progressive:** The secondary-progressive form of MS is always preceded by the relapsing-remitting form. Secondary-progressive MS is characterized by a steady progression in the signs, symptoms, and disabilities. The symptomatic periods become more frequent and severe and the patient does not recover neurologic function during the relapses. Approximately 50% of people who have relapsing-remitting MS will develop secondary-progressive MS within 10 years, and 90% will develop secondary-progressive MS within 25 years.

- **Progressive-relapsing:** This form of MS is very uncommon. The patient has relapses, but the disabilities get worse over time. This is the rarest form of MS. Progressive-relapsing MS and secondary-progressive MS differ in that progressive-relapsing MS is not preceded by the relapsing-remitting form of the disease.
Most people with MS have a normal or close to normal life span. If people with MS die as a result of the disease, it is usually because they are immobile and develop an overwhelming pneumonia or other infection but MS is typically not the direct cause of death for these patients. Most people who have MS die of common diseases such as heart disease, stroke, and cancer, not from MS. However, patients with MS do often have a lot of fatigue and a lot of pain and weakness in their arms or legs. Eventually, some patients with MS are not able to walk without a lot of assistance. They will need a cane, a walker, or a motorized scooter to get around. Multiple sclerosis may not be a fatal disease, but it is a crippling one.

**HOW IS MULTIPLE SCLEROSIS DIAGNOSED?**

The signs and symptoms that are typical of MS are non-specific; they are very common complaints that can be caused by many different medical problems. However, if someone has fatigue, heat intolerance, and numbness in the extremities and other typical signs and symptoms of MS and these signs and symptoms present in a pattern of waxing and waning, there should be a strong suspicion that the patient has MS.

There are no blood tests that can detect MS. The physician will perform a physical exam, interview the patient, and then to confirm the diagnosis will order several types of tests. A magnetic resonance imaging (MRI) test can be useful, but some people with MS will have a normal MRI. A lumbar puncture is another diagnostic test that can be used to confirm the presence of MS. A lumbar puncture is performed by inserting a needle into through the skin of the back and
into the space adjacent to the spinal cord. Spinal fluid is removed and analyzed and in some patients with MS there will be characteristic abnormalities. However, like the MRI, there are a percentage of people who have MS and will have normal spinal fluid. Finally, there is a test called a visual evoked potential test. In this exam the response of the patient's nervous system is examined while he/she is undergoing various types of stimulation such as visual or auditory. The response will be abnormal or slow in a patient with MS.

**TREATMENT FOR THE PATIENT WITH MULTIPLE SCLEROSIS**

There is no cure for MS. Most people have a normal life expectancy, but the disease can result in a lot of pain and fatigue and severely limit what someone can and can't do, especially in terms of mobility. In addition, many people who have MS will eventually develop significant disabilities. However, the available treatments for MS can make a big difference in helping someone cope with the disease and these treatments can significantly improve quality of life. Treatment basically focuses on three goals: modifying the course of the disease; treat the patient during the symptomatic attacks, and improve the patient’s functional abilities.

Modifying the course of the disease is accomplished with drug therapy. There are medications that can modify the course of the disease by decreasing the frequency of the attacks and also by prolonging the asymptomatic periods between the attacks. These disease-modifying medications are not curative.

People who are having an exacerbation of their MS are often in a great deal of discomfort, and drug therapy can provide relief during these symptomatic
periods. These medications help by affecting the pathologic process of MS and by relieving the signs and symptoms caused by that process.; they are not curative.

Improving the functional abilities of someone who has MS typically involves a multi-faceted approach involving physical therapy, occupational therapy, speech therapy, exercise, and other types of physical and psychological intervention. There are also many practical ways that someone who has MS can improve his/her functional abilities and by doing so, the quality of life.

**Disease Modification Therapy**

Disease modifying therapy is designed to decrease inflammation, to shorten the duration of relapses, to help stabilize the clinical course, and to decrease the frequency of relapses. There is a variety of medications that are used as disease modifying agents for MS, but all of them work by their action on the immune system. The disease-modifying medications can be very helpful, but as with any medical intervention, there are risks and benefits. These drugs must be used on a long-term basis, many patients will not respond to them, they are expensive, and they have side effects that make it difficult to adhere to the therapy regimen.

The **corticosteroids** are drugs that are used to suppress the inflammation that is associated with MS. Two commonly prescribed corticosteroids are prednisone and methylprednisolone. These drugs are often used to treat acute and particularly severe MS relapses.

**Immunomodulators** are helpful in treating MS because they decrease the number and intensity of relapses. The mechanisms of action of many of the
immunomodulators are not completely understood but it is thought that they work by altering the abnormal immune response that is the basic cause of the inflammatory changes in MS. Immunomodulators that are commonly used to treat MS are interferon beta-1a (trade name Avonex®) and glatiramer (trade name Copaxone®)

The immunosuppressive drugs are prescribed for people who will be having, or have had an organ transplant or who have an autoimmune disease. The immunosuppressants are similar to the immunomodulators but the immunomodulators typically target a specific part of the abnormal immune system response of MS while the immunosuppressants act in a general way to decrease immune system activity. Azathioprine and methotrexate are immunosuppressive drugs that are used to treat MS.

Chemotherapeutic agents that are intended to be anti-cancer drugs have been used off-label to treat MS. Cyclophosphamide and mitoxantrone, both of which are typically used to treat various types of leukemia and other cancers, have immunosuppressive properties and can be used to treat progressive forms of MS and relapsing-remitting MS that is particularly severe.

Symptom Management

Many different classes of medications are used to provide the MS patient with symptomatic relief. These drugs are different than the disease-modifying agents because: 1) they do not act as anti-inflammatories or affect the immune system, and; 2) they do not change the number, frequency, or severity of relapses nor do they change the progress of MS. They are strictly intended to relieve symptoms.
There are too many medications used for this purpose to list and describe them all, so some of the more commonly used ones are discussed below, classified according to the symptom they are intended to alleviate.

Spasticity can be treated with skeletal muscle relaxers such as **baclofen**, **dantrolene**, and **tizanidine** (trade name **Zanaflex®**), the neuromuscular blocker **botulinum toxin**, the anti-epileptic drug **gabapentin** (trade name **Neurontin®**) and benzodiazepines such as **clonazepam** (trade name **Klonopin®**) and diazepam (trade name **Valium®**).

Bladder dysfunction and urinary incontinence is treated with **anti-spasmodic agents** such as **oxybutinin** (trade name **Ditropan®**) or **tolterodine** (trade name **Detrol®**).

Cognitive dysfunction and fatigue can be treated with **stimulants** such as methylphenidate (trade name **Ritalin®**) modafinal (trade name **Provigil®**), and dextroamphetamine (trade name **Dexedrine®**). The anti-influenza drug **amantadine** (trade name **Symmetrel®**) is also used for this purpose. The stimulants, along with **anti-depressants**, can also be used to treat the depression that is so common in patients who have MS.

Pain in MS can either be primary and related to inflammation or it can be secondary and related to poor posture and abnormal muscle movements caused by spasticity. The **tricyclic antidepressants** such as amitriptyline are the first-choice drug for primary pain of MS; anti-epileptic drugs such as carbamazepine or gabapentin would be second-line choices. Treatment of secondary pain
caused by MS can be treated with non-steroidal anti-inflammatory drugs such as ibuprofen.

**Improving Functional Ability: Non-Pharmacologic Methods**

Disease-modifying drug therapy and symptomatic drug therapy can both contribute significantly to improving a patient’s functional ability. But medications, of course, have side effects and cost considerations. In addition, not all drugs are effective for all patients, and a patient may have to tolerate a trial and error period during which the appropriate drug and dose is discovered.

Because of those concerns, and because they can be effective, non-pharmacological therapies are often used for symptomatic relief for patients with MS. These can include, but are not limited to, exercise, occupational therapy, psychotherapy, and physical therapy. Physical therapy and exercise can help the patient with MS stay strong and flexible. It can also help improve coordination. The physical therapist or an exercise specialist can instruct the patient on ways to reduce energy expenditure and schedule activity. Occupational therapy can help the patient find strategies for managing aspects of day to day life such as dressing, transportation, etc. Patients can also benefit from speech therapy.

There are also many patient support groups and professional organizations that can provide practical tips for handling the challenges of MS. Several examples of this type of advice are:

- **Heat intolerance:** Schedule outside activities for times of the day when the temperature is lowest and sun exposure would be minimal, e.g., early
morning or late evening. If you must do outside activities, plan on taking extra time to accomplish them if the ambient temperature is hot. Use air conditioning as much as is possible and practical and avoid exposure to hot tubs, saunas, an excessively hot baths or showers.

- **Fatigue:** The person who has MS should know that the fatigue associated with the disease has a physical basis: it is caused by the neurological damage that is part of MS and it is not psychological. Do not reprimand yourself if you do not have the energy to complete an activity or accomplish something immediately. It should also be remembered that fatigue is a very common symptom of MS, experienced by essentially everyone who has the disease. However, depression and pain can contribute to fatigue so addressing these problems can help alleviate fatigue. Exercise can help to increase strength and endurance, and planning activities - and planning rest periods - to allow for the limiting effects of fatigue can be useful. Patients can also try and discern their particular pattern of fatigue and if fatigue occurs at a certain time of day, adjustments can be made.

- **Bladder dysfunction/incontinence:** Try and schedule times to void, even if the sensation to urinate is not there or particularly urgent. Avoid natural diuretics such as coffee, and limit fluid intake for several hours prior to going to bed. The latter will help prevent the need to wake up at night to urinate, maintaining a good sleep pattern.

**WORKING WITH A PATIENT WHO HAS MULTIPLE SCLEROSIS**
When you are working with a patient who has MS, there are four areas of care you will need to focus on. These are obviously not the only concerns for someone who has MS but the patient’s activity status, safety concerns, skin care, and elimination patterns are often of primary importance.

- **Activity:** The patient with MS can be very limited in what he/she can do. This can be because of fatigue. It can also be caused by, pain, numbness, and spasticity. You will need to work closely with the patient to determine an appropriate level of activity and how much assistance you will need to provide. Remember: Patients with MS very often cannot tolerate hot temperatures.

- **Safety:** Because of the activity limitations, the patient must be protected against falls. Make sure you avoid hot showers or baths, s heat intolerance can often be manifested with mobility impairment.

- **Skin care:** Incontinence of stool or urine can cause skin breakdown. If the patient has limited mobility, the skin irritation and the inability to move normally can lead to pressure sores.

- **Elimination:** Constipation can also be a problem for the patient with MS. Encourage the patient to stay hydrated, and make sure you document the patient’s pattern of elimination. Notify your supervisor if you suspect the patient is constipated. The patient should also be monitored for bladder dysfunction and urinary incontinence.

**SUMMARY**
Multiple sclerosis is a chronic disease that affects the nervous system. Multiple sclerosis is an autoimmune disease, and it is thought to be caused by an abnormal inflammatory process that is triggered in susceptible individuals by a combination of environmental, life style, infectious, and genetic influences. The chronic inflammation of MS causes permanent damage to the myelin sheaths that surround nerve fibers. Because of this damage to the myelin sheaths the transmission of nerve signals to and from the brain is disrupted, becoming slow, spasmodic, and erratic, and this is the basis for the signs and symptoms of MS.

Multiple sclerosis usually begins between the ages of 20 and 40, although earlier and later onsets are possible. The disease affects women far more than it does men, but the disease is typically more serious in men; the prognosis is worse and the level of disabilities is higher. It is a progressive disease and many people who develop MS will eventually have significant disabilities.

There are four categories of MS, each category describing a characteristic pattern of signs and symptoms: relapsing-remitting; primary-progressive; secondary-progressive, and; progressive-relapsing. The clinical presentation of MS is quite variable, but cognitive dysfunction, depression, fatigue, heat intolerance, incontinence, mobility and balance impairment, optic neuritis, pain, sexual dysfunction and spasticity are especially common. The disease is characterized by a waxing and waning of the signs and symptoms; there are periods of time in which the patient will be relatively symptom free alternating with periods during which she/he is impaired. In the most common form of MS, relapsing-remitting, the patient will have periods of impairment (the relapses)
separated by long periods during which she/he is symptom free or relatively free of symptoms (remission). Most people who have the relapsing-remitting form of MS will eventually develop a more serious form of the disease.

There is no cure for MS. Most people who have MS do not succumb to the disease, but MS typically causes increasing levels of physical and psychological disabilities that profoundly affect normal activities of daily living. Treatment for MS is focused on increasing and maintaining the patient’s functional abilities and maintaining a good quality of life. Drug therapy with anti-inflammatories, immunomodulators and immunosuppressives are used to modify the course of the disease, and a wide variety of medications are used to provide symptomatic relief. Non-pharmacological treatments can include exercise, occupational therapy, physical therapy, and psychotherapy.

POST-TEST

1. Multiple sclerosis is a disease that affects the:
   a. liver.
   *b. nervous system.
   c. heart.
   d. lungs.

2. Multiple sclerosis causes:
   *a. damage to the myelin sheaths of the nerve fibers.
   b. damage to bronchial passage of the lungs.
   c. damage to arteries and capillaries.
   d. damage to blood vessels in the brain.

3. The primary pathologic process of multiple sclerosis is:
   a. vasoconstriction.
   b. infection.
   c. thrombosis.
   *d. inflammation.

4. Multiple sclerosis is considered to be:
   a. an infectious disease.
b. the result of trauma.
c. an autoimmune disease.
d. a genetic disease.

5. Risk factors for multiple sclerosis include:
a. lifestyle issues, genetic susceptibility, and infections.
b. hypertension, elevated cholesterol, and infections.
c. abstinence from alcohol, sedentary lifestyle, and male gender.
d. age < 20 years, male gender, over-exposure to sunlight.

6. Common signs and symptoms of multiple sclerosis include:
a. chest pain, shortness of breath, and nausea.
b. fatigue, heat intolerance, and pain.
c. hypotension, fever, and diarrhea.
d. anorexia, hypertension, and memory loss.

7. Common signs and symptoms of multiple sclerosis include:
a. anemia and postural hypotension.
b. diaphoresis and persistent cough.
c. dry/irritated skin and peripheral edema.
d. mobility/balance impairment and spasticity.

8. Multiple sclerosis is characterized by signs and symptoms:
a. that are constant in nature.
b. that slowly increase in severity.
c. that slowly decrease in severity.
d. that wax and wane.

9. True or false: Multiple sclerosis can be cured.
a. True.
b. False.

10. Many people who have multiple sclerosis will
a. develop significant disabilities.
b. have only minor signs and symptoms.
c. suffer an early death directly related to MS.
d. be at risk for infections and stroke.

**Answers**

1. B
2. A
3. D.
4. C
5. A
6. B
7. D
8. D
9. B
10. A