Basic Athletic Training
Course Pack D

CHAPTER

25

Neurological Conditions

STUDENT OUTCOMES

1. Describe the pathophysiology of migraine headaches.
2. List the signs and symptoms of various types of migraine headaches.
3. Describe the prevention and management of migraine headaches.
4. Differentiate between a seizure disorder and epilepsy.
5. Identify the causes of epilepsy.
6. List the types of generalized and partial seizures.
7. Describe the characteristics and management of common seizures.
8. Describe the seizure situations that constitute a medical

emergency.

9. Explain the exercise guidelines for individuals with controlled seizures.

INTRODUCTION

The body's nervous system includes the brain, spinal cord, and nerves. It regulates and coordinates body activities, and it brings about responses by which the body adjusts to changes in its internal and external environment. Initially, this chapter explores migraine headaches—namely, their types, signs, symptoms, and management. Next, the various types of seizure disorders are presented followed by signs, symptoms, management, and physical activity guidelines for those who suffer from a seizure disorder. Finally, information is presented regarding infections of the central nervous system and reflex sympathetic dystrophy.

HEADACHES

? A female collegiate basketball player complains of a pounding headache with nausea. Two weeks earlier, she reported a similar headache that was accompanied by light sensitivity. Should this individual be referred to a physician for further assessment and care?

It is estimated that a majority of men and women have experienced one or more severe headaches. Migraine headaches in particular afflict women more than men.[1] In addition, headaches are the most common pain reported in adolescent children.[2] Headaches may be chronic or acute, and they often signal nothing more than fatigue, stress, or tension. In some cases, however, headaches can indicate a serious disease (Box 25.1).

BOX 25.1 Red Flags That Require Further Examination

- Serious headaches after 50 years of age
- Headache associated with focal neurological deficits
- Sudden onset of a headache
- Papilledema (i.e., edema of the optic disc)
- Change in pattern in a headache (e.g., increased severity and frequency)
- Headache associated with trauma
- Headache associated with antalgic gait, amnesia, or altered consciousness
- New-onset headache in immunocompromised patients
- Headache associated with systemic illness, fever, or neck stiffness
- Early morning nausea and vomiting without headache

Headaches are caused by irritation of one or more of the pain-sensitive structures or tissues in the head and neck including the cranial arteries and veins, the cranial and spinal nerves, the cranial and cervical muscles, and the meninges. The condition may stem from organic disorders (e.g., toxins, systemic diseases, or diseases in specific systems of the body), psychoneurological problems (e.g., nervous tension, fatigue, worry, excitement, or psychoneuroses), or environmental insults (e.g., head trauma, bright lights, noise, rapid altitude change, sunstroke, motion sickness, or irritants such as smoke, dust, or pollen).[3] According to the International Headache Society, there are four main classifications of headaches: migraine headache, tension-type headache (TTH), cluster headache and other trigeminal autonomic cephalalgias (TACs), and other primary headaches.[4]

Migraine Headache

Etiology

A migraine headache is defined by the International Headache Society as an idiopathic, episodic headache disorder with attacks lasting from 4 to 72 hours and is classified into two major subtypes, migraine without aura and migraine

with aura with four additional subgroups that include symptoms from one of the two major subtypes (Box 25.2).[4] Women with a history of migraines show a relationship between their headaches and menstrual cycle. Menstrual migraines are thought to be triggered by a change in estrogen levels that accompanies the menstrual cycle.[5] This fluctuation in hormone level is considered one of many **triggers** or conditions that hasten, worsen, or lengthen the duration of a migraine. Other common triggers include aspartame, caffeine (i.e., use or withdrawal), monosodium glutamate, nicotine, nitrates, alcohol, cheese, chocolate, missed meals, perfume, red grapes, too much or too little sleep, stress, bright lights, strong odors, or a change in altitude.[4,6]

BOX 25.2 Classifications of Migraine Headaches

- **Migraine without aura.** Recurrent headache disorder manifesting in attacks lasting 4–72 hours. Typical characteristics of the headache are unilateral location, pulsating quality, moderate or severe intensity, aggravation by routine physical activity, and association with nausea and/or photophobia and phonophobia.
- **Migraine with aura.** Recurrent disorder manifesting in attacks of reversible focal neurological symptoms that usually develop gradually more than 5 minutes and last 60 minutes. Attacks include unilateral visual, sensory, or other central nervous system symptoms such as reversible changes in speech, motor, or visual changes. Headache with the features of migraine without aura usually follows the aura symptoms. Less commonly, headache lacks migrainous features or is completely absent.
- **Chronic migraine.** Headache occurring on 15 or more days per month for more than 3 months with symptoms occurring at least 8 days per month. This migraine is classified because of the inability to differentiate individual headache episodes and difficulty in keeping individuals medication-free in order to assess the headache history.
- **Complications with migraine.** A debilitating migraine lasting more than

72 hours that may include migrainous aura and/or non–aura-debilitating symptoms. Such migraines include persistent aura without infarction, migrainous infarction, and migraine aura-triggered seizures.

- **Probable migraine.** Previously termed migrainous disorder, probable migraines are classified as migraine-like headaches that are secondary to another disorder. This attack is usually missing one of the features required for the two major subgroups of migraine.
- **Episodic syndromes that may be associated with migraine.** Episodes can occur from excessive, frequent crying in a baby from birth to 4 months who shows signs of colic, or childhood period syndromes such as motion sickness and periodic sleep disorders (sleep walking, sleep talking, night terrors, bruxism), recurrent gastrointestinal disturbance, cyclic vomiting syndrome, abdominal migraine, benign paroxysmal vertigo, and benign paroxysmal torticollis.

Headache Classification Committee of the International Headache Society. The international classification of headache disorders, 3rd edition (beta version). *Cephalalgia*. 2013;33(9):629–808. http://www.ihs-classification.org/_downloads/mixed/International-Headache-Classification-III-ICHD-III-2013-Beta.pdf.

Signs and Symptoms

Migraine with aura, commonly referred to as a classic migraine, is characterized by a forewarning, also known as an aura that usually precedes the onset of a migraine roughly 5 to 60 minutes before the headache. Some of the most common auras include seeing flashes, losing part of the visual field, smelling a specific odor, tasting a specific taste, or feeling dizzy. Migraine headaches typically are unilateral (but also can be bilateral), pulsating, of moderate to severe intensity, exacerbated by activity, and associated with nausea, vomiting, photophobia, phonophobia, and the desire to lie down in a dark, quiet room. Migraine headaches can last from 4 hours to 3 days.[4]

Tension-Type Headache

Etiology

This is the most common type of primary headache; its lifetime prevalence in the general population ranges in different studies from 30% to 78%. Previously, little was known about this type of headache, however, several studies have recently been completed strongly suggesting a neurobiological cause.[4]

Signs and Symptoms

This type of headache is characterized by bilateral, mild to moderate pain that is of a "pressing" or "tightening" quality in the bitemporal or occipital region. Pain lasts from 30 minutes to 7 days and may be associated with mild nausea, phonophobia, and photophobia. Chronic TTHs are present at least 15 days per month for at least 6 months.[4]

Cluster Headache

Etiology

Cluster headaches present as severe unilateral pain, either orbitally, supraorbitally, or temporally, that lasts from 15 to 180 minutes. They occur from every other day to eight times per day and often wake the patient from sleep.[4] Although less common than migraines, cluster headaches onset is between 20 and 40 years of age and tend to occur more often in males.

Signs and Symptoms

The pain is often described as unilateral "stabbing," "boring," or "burning." Pain is clustered, or grouped, and can last from 2 weeks to 3 months, followed by headache-free periods that last from months to years.[4] The episodes are associated with at least two of the following, all of which are ipsilateral: conjunctival injection, lacrimation, nasal congestion, rhinorrhea, forehead and facial sweating, pupillary contraction (miosis), lid drooping (ptosis), and eyelid edema. Most patients are restless or agitated during an attack. Alcohol may trigger the headache.

Other Primary Headaches

Etiology

This category of headaches is used when a new headache occurs for the first time in close temporal relation to another disorder that is a known cause of headache, and this new headache is coded according to the causative disorder as a secondary headache. This group can include the following[4]:

- Headaches precipitated by coughing or straining in the absence of any intracranial disorder (coughing headache)
- Headache precipitated by any form of exercise. Subforms such as "weight lifters' headache" are recognized (exertional headache).
- Headache precipitated by sexual activity, usually starting as a dull bilateral ache as sexual excitement increases and suddenly becoming intense at orgasm, in the absence of any intracranial disorder
- Attacks of dull headache that always awaken the patient from sleep
- High-intensity headache of abrupt onset mimicking that of ruptured cerebral aneurysm
- Persistent strictly unilateral headache responsive to indomethacin
- Headache that is daily and unremitting from very soon after onset (within 3 days at most). The pain is typically bilateral, pressing or tightening in quality, and of mild to moderate intensity. There may be photophobia, phonophobia, or mild nausea.

Signs and Symptoms

Because of the very nature of the diverse causes of headaches in this category, signs and symptoms are also varied.

Management of Headaches

Treatment begins with a history and description of the headache while ruling out metabolic and structural etiologies. Most headaches are treated with drug therapy; however, the longer the symptoms go untreated, the less likely that medication will relieve the pain. Over-the-counter pain relievers, such as

ibuprofen, naproxen, and caffeine, or nonsteroidal anti-inflammatory drugs (NSAIDs) may be sufficient. Prescription medications used for intense headaches include drugs intended to prevent the migraine from occurring and abortive drugs to stop the headache after it begins.

Preventive treatment may be warranted if headaches interfere with daily activities or occur more than four times per month. A number of drugs and alternative therapeutic techniques can be used, including β-blockers, calcium channel blockers, antidepressants, selective serotonin-reuptake inhibitors, monoamine oxidase inhibitors, NSAIDs, and corticosteroids.[1,4] Stress reduction and biofeedback techniques also have been successful for some patients.[4] If medications and stress reduction techniques are not helpful, a computed tomographic scan or magnetic resonance imaging may be necessary to determine if a structural disorder of the central nervous system is causing the pain.

The female basketball player most likely has a migraine headache. Her history is consistent with a migraine headache, including throbbing or pounding headache pain associated with light sensitivity, loss of appetite, and/or nausea four or more times per month. If the headache does not respond to an over-the-counter anti-inflammatory or analgesic medication, referral to a physician is warranted.

SEIZURE DISORDERS AND EPILEPSY

What issues should be addressed in determining the sport participation level of an individual with a seizure disorder?

A seizure is an abnormal electrical discharge in the brain. A **seizure disorder** entails recurrent episodes of sudden, excessive charges of electrical activity in the brain, whether from known or idiopathic causes. **Epilepsy** is a general term used to describe only recurrent (at least two) idiopathic episodes of sudden, excessive discharges of electrical activity in the brain. The discharge may

trigger altered sensation, perception, behavior, mood, level of consciousness, or convulsive movements. Seizures and epilepsy often are used interchangeably; however, it is important to understand their definitions.

Causes of Epilepsy

Epilepsy appears to be directly related to age of onset and generally is categorized as provoked or unprovoked (Box 25.3). Seizures that begin before 5 years of age usually are associated with mental or neurological impairment. Seizures that begin between 5 and 15 years of age are not usually associated with a known metabolic or structural cause and are called idiopathic or unprovoked seizures. These seizures respond very well to treatment, and individuals usually can participate in physical activity with little to no restrictions. Trauma and tumors are responsible for most seizures in young adults; strokes are the most frequent cause in those 40 years and older.[7]

BOX 25.3 Causes of Epilepsy

1. Unprovoked or idiopathic (no cause of the seizure is identified)
2. Provoked
   - Posttraumatic (e.g., skull fracture, intracranial hematoma)
   - Metabolic (e.g., hyponatremia, hypocalcemia, hypoglycemia, hypomagnesemia, dehydration)
   - Drug and drug withdrawal (e.g., alcohol, cocaine)
   - Infections (e.g., meningitis, encephalitis, brain abscess)
   - Anoxia and hypoxia
   - Cerebrovascular (e.g., stroke, intracerebral or subarachnoid hemorrhage, sinus thrombosis)
   - Hyperthermia
   - Sleep deprivation
   - Febrile seizures
   - Neoplasms (e.g., primary intracranial, carcinomatous meningitis,

metastatic, lymphoma, leukemia)

- Perinatal or hereditary (e.g., congenital anomalies, genetic and hereditary disorders, perinatal trauma)

Types of Seizures

Seizures can be divided into three basic types:

1. Partial or focal
2. Generalized
3. Special epileptic syndromes

Box 25.4 summarizes the classifications of seizures.

BOX 25.4 Classifications of Seizures

1. **Partial or focal seizures**
   - Simple (i.e., consciousness not impaired)
   - Complex (i.e., impairment of consciousness)
   - Partial with secondary generalization
2. **Generalized seizures**
   - Tonic–clonic (i.e., grand mal)
   - Intermittent seizure
   - Continuous seizure (i.e., status epilepticus)
   - Absence (i.e., petit mal)
   - Myoclonic epilepsy
   - Posttraumatic
3. **Special epileptic syndromes**
   - Febrile seizures
   - Hysterical seizures

- Reflex epilepsy

Partial or Focal Seizures

Etiology

Partial or focal seizures have a localized onset, are focused in one particular area of the brain, and are restricted to specific areas of the body. Partial seizures may be subdivided into simple, in which consciousness is retained, and complex, in which consciousness is impaired.

Signs and Symptoms

A simple partial seizure is relatively common. It is classified according to the main clinical manifestations. The sensory manifestation includes bodily sensations and discomforts, such as tingling, numbness, "pins and needles," or loss of feeling. A motor manifestation is characterized by involuntary movements of the face, limbs, or head and may involve an inability to speak. The seizures, which can last for minutes or hours, may be followed by localized weakness or paralysis of the body part in which the seizure occurs; this condition is termed **Todd paralysis**. The patient may experience powerful emotions, such as fear, anxiety, depression, or embarrassment, for no apparent reason. In some cases, a feeling of the mind and body separating may be reported. The person also may experience visual, olfactory, and auditory hallucinations. Psychic symptoms may include disturbing memory flashbacks or frequent, disconcerting feelings of déjà vu, in which something or someone unfamiliar seems to be familiar, or jamais vu, in which something or someone familiar seems to be unfamiliar. Time distortions, out-of-body experiences, sudden nausea, or stomach pain may occur. Consciousness is not impaired; however, a partial or focal seizure may precede a generalized seizure and serve as an aura that consciousness is about to be altered.[8]

Complex partial seizures affect a larger area of the brain and, therefore, impair consciousness. They also are referred to as temporal lobe epilepsy or psychomotor seizures and are characterized by attacks of purposeful

movements or experiences followed by impairment of consciousness. In other words, although appearing to be conscious, the patient is in an altered state of consciousness, an almost trancelike state. These purposeful activities and experiences may include the following[7]:

- Emotions (e.g., depression, fear, paranoia, or crying out)
- Simple automatism (e.g., chewing, swallowing, lip smacking, or saying the same words over and over)
- Complex automatism (e.g., walking into a room, undressing, or arranging objects)
- Hallucinations (e.g., auditory, visual, gustatory, or olfactory)

If engaged in activity, an individual's movements usually are disorganized, confused, and unfocused, but observers may find it hard to believe that the individual does not know of his or her actions. The average seizure lasts from 1 to 5 minutes. The individual is unresponsive to verbal stimuli and may exhibit disorientation or confusion. Afterward, the individual is unable to recall the actions that took place. These types of seizures usually start between 10 and 30 years of age.

Generalized Seizures

Generalized seizures can affect the entire brain. These seizures may be further subdivided into convulsive and nonconvulsive types.

The tonic–clonic, or grand mal, seizure is the most common and severe seizure of the convulsive type. It may occur in an intermittent or a continuous form. Tonic refers to prolonged contractions of skeletal muscles, whereas clonic refers to rhythmic contractions and relaxation of muscles in rapid succession.

An intermittent seizure may be tonic, clonic, or both, and it often is associated with loss of consciousness. Many individuals experience a sensory phenomenon (aura), such as a particular taste or smell, before the seizure. The average seizure lasts from 50 to 90 seconds but may extend up to 5 minutes. Because the unconscious, seizing individual is overtaken by the excessive

electrical discharge during the seizure, control of bladder and bowel functions may be lost, resulting in urination or defecation. This action typically is embarrassing and unpleasant but not unexpected. When the seizure ends, the brain may shift into a sleep pattern. As such, the individual may be unarousable for a brief period of time (i.e., seconds to a few minutes). The muscles relax during this period, and the person awakens. Following the seizure, the person often is disoriented, confused, and lethargic and may not remember what happened.

A continuous tonic–clonic seizure (status epilepticus) is a medical emergency. Continuous convulsions can last 30 minutes or longer, or recurrent generalized convulsions can occur without the person regaining full consciousness between attacks. If the convulsions exceed 60 minutes, irreversible neuronal damage may occur. Any seizure that lasts longer than 5 minutes should be seen as indicating a serious problem. Accordingly, the emergency action plan, including summoning of emergency medical services (EMS), should be activated.

Myoclonic seizures are characterized by sporadic or continuous clonus of muscle groups. They are associated with progressive mental deterioration. These types of seizures are seldom seen in the physically active population.

Posttraumatic seizures are provoked by head trauma and are classified as impact, immediate, early, and late. Impact seizures occur at the time of trauma and are considered to result from electrochemical changes induced by the trauma. Immediate seizures occur within the first 24 hours of trauma. Early seizures occur within the first week after head trauma and often are associated with prolonged posttraumatic amnesia lasting more than 24 hours. A late seizure occurs after the first week of head trauma but primarily within 1 year, and it may be associated with a history of childhood epilepsy.

The typical absence, or petit mal, attack is characterized by a slight loss of consciousness, or blank staring into space, for 3 to 15 seconds without loss of body tone or falling. Slight twitching of the facial muscles, lip smacking, or fluttering of the eyelids may occur. Onset of the condition usually is between 4 and 8 years of age; it tends to resolve by age 30 years.

Special Epileptic Syndromes

A third category of seizures includes febrile seizures during infancy and

childhood. Febrile seizures have their onset during the course of a fever usually greater than 38.9°C (102°F) and are most likely to happen while the temperature is rising rapidly. Other seizures in this category include hysterical seizures and reflex epilepsy. These conditions represent a small subgroup of seizures that occur only in response to specific stimuli, such as flickering lights, specific sounds, sudden movements, eating, or reading of words or numbers.

Immediate Management of Seizures

It is important that the clinician note the time at the onset and the end of a seizure. Seconds may seem like minutes; unless accurately timed, the actual length of the seizure may be exaggerated. Management of any seizure is directed toward protecting the individual from injury. Nearby objects should be removed or padded so that the individual does not strike them during uncontrollable muscle contractions. The individual should not be restrained, but the head should be protected at all times. Although the individual may bite the tongue during the seizure, nothing (e.g., fingers or any object) should be placed into the mouth. In an effort to avoid embarrassment to the individual, any observers or spectators should be removed from the area, if possible, to allow privacy. When the seizure ends, it is not unusual for the individual to fall into a sleep pattern. The clinician should ensure an adequate airway and wait until the individual awakens.

Medications and Epilepsy

Antiepileptic and anticonvulsive medications are the agents of choice for those with seizure disorders and epilepsy. These medications should be taken at least 1 to 2 hours before physical activity. The long-term goal is to control or eliminate seizure activity with the lowest doses of the fewest medications. Because anticonvulsive agents have long half-lives, they clear the body slowly and take time to build up to the therapeutic range. As such, regular, long-term administration (i.e., months to years to a lifetime) of medication is needed to keep the body level of the medication in the therapeutic range. Failure to take

medication over several days can result in falling out of the effective therapeutic range. Serum levels should be checked frequently for two reasons:

1. To ensure that the medication is within the therapeutic range
2. If the patient is physically active, to ensure that increased fitness levels have not altered the drug metabolism

It is essential to document the length of time of the seizure and the amount of time the patient sleeps. If a single, continuous seizure or a series of intermittent seizures exceeds 5 minutes, the emergency action plan, including summoning EMS, should be activated. If the patient has a known seizure disorder, the athletic trainer should attempt to discern the reason for the seizure. If possible, the patient should be questioned about the use of prescribed medication; this information should be provided to EMS on their arrival. Application Strategy 25.1 summarizes the management of a seizure.

APPLICATION STRATEGY 25.1

Management of Seizures

During the Seizure

1. Note the time that the seizure began.
2. Help the patient to a supine position; protect the head and remove glasses and loosen clothing.
3. Do not stop or restrain the person or place your fingers or any object in the mouth.

After the Seizure

1. Ensure an adequate airway.
2. Turn the patient to one side to allow saliva to drain from mouth.
3. Protect the person from curious bystanders.
4. Do not leave until the patient is fully awake.
5. If this is

A first-time seizure

The patient should be seen by a physician.

A continuous seizure or if another seizure occurs in rapid succession

Activate the emergency action plan, including summoning EMS.

6. Send documentation, including a written description of the following:
   - Type of seizure; localized or generalized
   - How it started
   - Length of time from onset until return of consciousness
   - Number of seizures

If serum levels are too low, the risk of seizures is increased. If levels are too high, the toxic effects of the medication may depress brain activity, and as such, vital functions may not be supported. Side effects of some of the medications may cause sedation, dizziness, nausea, vision changes, concentration difficulties, and fatigue.[8] These agents should be avoided in competitive athletes, although many anticonvulsive agents are approved by the National Collegiate Athletic Association (NCAA) and the United States Olympic Committee (USOC).

Physical Activity Guidelines

In nearly all instances, seizure disorders can be controlled with proper medication. Traditionally, good seizure control has been identified as being seizure-free for 6 months or a year. Patients should be carefully evaluated by a neurologist before participation in physical activity and sports, particularly those sports with a danger of falling, contact sports, and water sports, is allowed. Several issues must be addressed in determining participation levels:

- What type of physical or sport activity is being performed?
- Is there a risk of death or severe injury if the patient has a seizure during activity?
- Is there a preexisting brain injury or any neurological dysfunction?
- Is there a risk of potential brain injury from participation in the activity (e.g., concussion or intracranial hematoma)?
- Will exercise adversely affect seizure control?

- What are the potential effects of anticonvulsive medications on performance (e.g., impaired judgment or delayed reaction time)?

Head injury during activity participation can certainly precipitate seizures. Individuals with epilepsy, however, are no more prone to seizures after a head injury than are individuals without epilepsy. In addition, epilepsy does not increase the risk of injury while participating in sports, although certain activities (e.g., football, scuba diving, mountain climbing, and automobile racing) should be discouraged if they put the individual or others at risk should a seizure occur. Any individual with a history of seizures should be prohibited from boxing, regardless of seizure control. Individuals who experience frequent seizures should choose physical activities accordingly. It is highly recommended that children with seizure disorders be allowed to participate in physical activity and sports provided that good seizure control and proper supervision are available at all times.

In determining the sport participation level of an individual with a seizure disorder, the following areas should be addressed: the type of sport being played (i.e., contact or collision versus noncontact), the risk of death or severe injury if the individual has a seizure during activity, the presence of a preexisting brain injury or any neurological dysfunction, the risk of potential brain injury from participation in the sport (e.g., concussion, intracranial hematoma), any adverse effect of exercise on seizure control, and the potential effects of anticonvulsive medications on sport performance (e.g., impaired judgment or delayed reaction time).

OTHER CENTRAL NERVOUS SYSTEM DISORDERS

A 35-year-old male recreational soccer player sustained an ankle injury. He reported to a sports medicine clinic for evaluation and

treatment. Assessment indicated a mild inversion ankle sprain, and standard acute management was initiated. During the 2 weeks postinjury, the pain intensified (related as a 10+ on a scale of 1 to 10); he was unable to walk, to put any pressure on the left leg, to ascend or descend stairs, or to put any type of material (e.g., sheets, blankets, or clothes) on the ankle. He reports getting only 2 to 4 hours of sleep each night. He has been taking naproxen for the pain, but the naproxen appears to be causing nausea, vomiting, and dizziness. After completing a thorough reassessment of the ankle, the presence of an injury that supports the level of pain and dysfunction cannot be confirmed. How should this condition be managed?

Three rare but serious central nervous system disorders can impact the physically active participant. Meningitis, an infection and inflammation of the membranes (i.e., meninges) and fluid (i.e., cerebrospinal fluid) surrounding the brain and spinal cord, most often is caused by bacteria or viruses. Encephalitis is an inflammation of the brain caused by a viral infection; the disease often is spread by insects, particularly mosquitoes that feed on infected birds and animals. Complex regional pain syndrome (CRPS), sometimes referred to as reflex sympathetic dystrophy, is an uncommon disturbance of the sympathetic nervous system (i.e., the part of the nervous system that controls blood flow and sweat glands). If not recognized early and treated immediately, each condition can have devastating effects on an individual.

Meningitis

Etiology

Most cases of meningitis are caused by bacteria or a virus, but meningitis also can result from a fungal infection; parasites; a blow to the head; some types of cancer; inflammatory diseases, such as lupus; a sensitivity reaction to certain medications, especially ibuprofen (e.g., Advil or Motrin); and an infusion of gamma globulins used to treat other conditions.

Viral meningitis, also called aseptic meningitis, usually is mild and often

clears on its own in 1 to 2 weeks. Common intestinal viruses cause approximately half the cases in the United States. Viruses associated with mumps, herpes infection, or other diseases as well as polluted water also can cause viral meningitis.

Acute bacterial meningitis, caused primarily by the bacterium *Streptococcus pneumoniae* (pneumococcus), is considered to be a medical emergency. Most cases occur when bacteria from an infection in another part of the body (e.g., osteomyelitis, pneumonia, or endocarditis) travels through the bloodstream to the brain and spinal cord. Bacteria also can spread directly to the brain or spine from a severe head injury (e.g., skull fracture); from an infection in the paranasal sinus, middle ear, nose, or teeth; neurosurgical procedures (e.g., cerebrospinal fluid diversion shunts); or penetrating wounds.[9] The condition is contagious through exposure to the bacteria when someone with meningitis coughs or sneezes. The bacteria also can be spread through kissing or sharing eating utensils, a toothbrush, or a cigarette.

Cryptococcal meningitis is a fungal form of the disease that affects approximately 10% of people with AIDS. Although cryptococcal meningitis can be treated effectively with antifungal medications, it tends to recur in nearly half of those affected. In these cases, a physician may recommend long-term antifungal therapy with drugs such as fluconazole (e.g., Diflucan).

See **Causes of Acute Bacterial Meningitis**, available on the companion Web site at thePoint.

Signs and Symptoms

Early symptoms of bacterial and viral meningitis are similar to those of the flu but tend to have a sudden onset (**Box 25.5**). Symptoms may include a sudden high fever, severe headache, cervical rigidity, vomiting, sensory disturbances, and mental confusion.[10] During assessment, a positive Kernig or Brudzinski sign may be present (see Chapter 21). In older patients, nuchal rigidity is a classic sign.

BOX 25.5 Signs and Symptoms of Acute Bacterial

Meningitis

- High fever that prevents one from eating or drinking
- Irritability
- Delirium
- Severe headache
- Progressive lethargy
- Chills
- Drowsiness
- Photophobia
- Nuchal rigidity associated with positive Kernig and Brudzinski signs
- Nausea and vomiting
- An accompanying skin rash, especially near the axilla or on the hands or feet
- Confusion
- Convulsion or seizure
- Rapid progression of small hemorrhages under the skin

As the disease progresses, the brain swells and may begin to bleed. Initial drowsiness may progress to stupor or coma. Meningitis is fatal in approximately 10% of cases. Unfortunately, those who survive may have serious long-term neurological complications (e.g., deafness, blindness, loss of speech, learning disabilities, and behavior problems) or nonneurological complications (e.g., kidney and adrenal gland failure).[9]

Chronic (ongoing) forms of meningitis occur when slow-growing organisms, such as the microorganisms that cause tuberculosis, invade the membranes and fluid surrounding the brain. Although acute meningitis strikes suddenly, chronic meningitis develops over weeks or months. Nevertheless, the symptoms of chronic meningitis (i.e., headaches, fever, vomiting, and mental cloudiness) are similar to those of acute meningitis.

Management

Acute bacterial meningitis requires prompt treatment with intravenous antibiotics to ensure recovery and reduce the risk of complications. The choice of antibiotics depends on the degree of penetration of the agent through the blood–brain barrier and the bactericidal effect of the agent. Often, analyzing a sample of cerebrospinal fluid can help to identify the causative agent. In general, antibiotic treatment should be administered as soon as possible following the cerebrospinal fluid collection and treatment against *S. pneumoniae* should extend for 10 to 14 days, followed by a course of oral antibiotics.[10,11] Also, corticosteroids can be administered to help prevent hearing loss, which is the most common complication of the disease.

Meningitis is a medical emergency. The recovery rate depends on the length of time that elapses before the patient receives treatment. If meningitis is suspected, the emergency action plan should be activated.

Mild cases of viral meningitis usually are treated with bed rest, plenty of fluids, and analgesics to reduce fever and relieve body aches. If meningitis is caused by the herpes virus, treatment may include a herpes group antiviral medication. Not all viruses that cause meningitis, however, have antiviral agents available for use.

Encephalitis

Etiology

Encephalitis is an inflammation of the brain, especially the cerebral hemisphere, cerebellum, or brainstem, caused by a viral infection. It may occur in epidemic outbreaks. The disease often is spread by insects, particularly mosquitoes that feed on infected birds and animals. Encephalitis takes two forms:

- **Primary.** Caused by a direct viral invasion of the brain and spinal cord, the condition can be sporadic or epidemic. The most common sporadic form, herpes simplex encephalitis, may start as a minor illness with headache and fever, followed by more serious symptoms. Epidemic varieties commonly

are caused by mosquito-borne viruses. The major types of mosquito-borne encephalitis that infect people in the United States are Eastern equine encephalitis, Western equine encephalitis, St. Louis encephalitis, La Crosse encephalitis, and more recently, West Nile encephalitis.

- **Secondary (postinfectious).** This form follows or occurs with a viral infection in another part of the body, such as chickenpox, measles (rubeola), mumps, rubella, or polio. The cause of encephalitis in some secondary cases may be a hypersensitivity reaction manifested as an overreaction of the immune system to a foreign substance.

Primary encephalitis is the most serious kind of encephalitis, but the secondary form is more common. A few thousand cases of encephalitis are reported annually in the United States. In addition, many cases likely go unreported, because people experience only mild or nonspecific symptoms. Even though mosquito-borne encephalitis is rare, encephalitis is the most common mosquito-borne disease in the United States.

Signs and Symptoms

Signs and symptoms vary with the age of the patient but, in most cases, generally appear within 5 to 15 days of being bitten by an infected mosquito. In infants, there may be a sudden onset of fever, convulsions, and bulging in the soft spots (i.e., fontanelles) of the skull. Children may experience headache, fever, and drowsiness, followed by nausea, vomiting, photophobia, muscular pain, and nuchal rigidity. Adults often experience a sudden onset of fever, nausea, and vomiting accompanied by severe headache, muscle aching that may progress to tremors, and photophobia. Mental confusion and disorientation are hallmark symptoms in adults.

Management

In treating herpes simplex encephalitis, an antiviral agent, such as acyclovir, may be prescribed initially. In some cases, an anticonvulsant medication is prescribed. Anti-inflammatory drugs or medications that reduce pressure within the skull may be used as well. Because viruses that cause encephalitis

do not respond to antibiotics, supportive treatment may consist of rest and a healthy diet, including plenty of liquids to help the immune system fight the virus. In some cases, physical and speech therapy may be a part of the treatment plan.

Complex Regional Pain Syndrome

Etiology

CRPS is the new term for pain disorders formerly called **reflex sympathetic dystrophy**. CRPS requires the presence of regional pain and sensory changes following a noxious event. The pain is associated with findings such as abnormal skin color, temperature changes, abnormal sweating, hypersensitivity in the affected area, abnormal edema, and significant impairment of motor function (e.g., muscle weakness in the affected limb). The combination of these findings exceeds their expected magnitude in response to known physical damage.[12] CRPS is more likely to affect women (~75%) than men, and although the condition can occur at any age, it is most common in people between 50 and 70 years of age.[13]

CRPS occurs in two types, with similar signs and symptoms but different causes. Type I, previously known as reflex sympathetic dystrophy, occurs following an illness or injury that has not directly damaged the nerves in the affected limb. This injury could be as simple as a splinter, ankle sprain, intravenous catheter insertion, or back strain or as complex as a myocardial infarction, surgery, or infection. Type II, once referred to as causalgia, follows a distinct nerve injury.[13] The diagnosis of CRPS is excluded by the existence of painful conditions with known pathology that could account for the degree of pain and dysfunction at the injured site.

The nature of CRPS is puzzling, and the cause is not clearly understood. It is thought that the initiating event, often minor trauma, sensitizes C-nociceptive fibers. These small-diameter axons with slow conduction velocities are polymodal, responding to mechanical, thermal, and chemical stimuli. The activation of the sympathetic nervous system permits the body to respond appropriately to injury by activating the inflammatory response. Normally, this

activity decreases within minutes to hours after the injury. In CRPS, however, the sympathetic impulses do not shut off. This triggers a constant inflammatory response, causing vessels to spasm and leading to continual release of neurotransmitters, increased pain, and tissue destruction.

Signs and Symptoms

Signs and symptoms of both types of CRPS develop in three stages (**Box 25.6**). Some people never progress past stage 1, and only a small percentage of those affected advance to stage 3. Signs and symptoms initially appear only near the site of the injury. Pain, usually located in the distal part of an extremity, is described as burning or aching and is aggravated by movement or lowering the affected limb. Tapping on the skin (i.e., Tinel sign) may increase pain, or sudden jolts of sharp pain may occur, especially at trigger points.[13]

BOX 25.6 Signs and Symptoms of Complex Regional Pain Syndrome

Stage 1: Generally lasts from 1 to 3 months and is characterized by the following:

- Severe burning or aching pain, tenderness, and swelling limited to the site of injury
- Changes in skin temperature, color, and texture. The skin may be sweaty or cold. Skin color can range from white and mottled to red or blue. The skin may become tender, thin, or shiny in the affected area.
- Increased hair and nail growth
- Muscle cramps or spasms
- Edema and joint stiffness restrict mobility.

Stage 2: Generally lasts from 3 to 6 months and is marked by the following:

- Pain intensifies and spreads; pain is disproportionate to the injury.
- Edema increases.
- More pronounced changes in skin color and texture
- Hair becomes coarse, then scant; nails become brittle, cracked, and grooved.
- Muscle and joint stiffness increases; atrophy occurs.

Stage 3: Permanent damage occurs. Signs and symptoms may include the following:

- Debilitating pain that may now affect an entire limb
- Muscle atrophy and advanced joint damage, causing reduced mobility in the affected body part
- Flexion tendon contractures
- Irreversible skin damage
- Osteoporosis

Initially, the affected limb usually is warmer, shows a red and sometimes mottled discoloration, and has pronounced distal edema. Skin temperature can shift from hyperthermic to hypothermic during the later course of the disease. Substantial muscle weakness in the affected limb that is disproportionate to the injury also can be reported. Nails become brittle and grooved, and regional hair growth increases. The skin appears to be thin and glossy; eventually, hyperkeratosis and palmar or plantar fibrosis may be present.[13]

The illness can spread from its source to elsewhere in the body in the following patterns:

- **Continuity type.** Symptoms may migrate from the initial site of the pain, for example, from the hand to the shoulder, trunk, and face, affecting a quadrant

of the body.

- **Mirror-image type.** Symptoms may spread from one limb to the opposite limb.
- **Independent type.** Symptoms may leap to a distant part of the body.

Management

Dramatic improvement and even remission of CRPS are possible if treatment begins within a few months of the initial symptoms. The main goal of the treatment plan is pain relief, functional recovery, and psychological improvement. Over-the-counter NSAIDs, such as aspirin, ibuprofen (e.g., Advil or Motrin), and naproxen sodium (e.g., Aleve), may ease pain and inflammation. Prescription pain relievers may be recommended in some cases. Because hypersensitivity to heat is one of the most consistent symptoms in patients with acute CRPS, cryotherapy may provide substantial relief of pain, swelling, and sweating. If the affected area is cool, applying heat may offer relief. Gentle, guided exercising of the affected limbs may improve range of motion and strength.

If the preceding treatments are not effective, the supervising physician may recommend use of the corticosteroid prednisone to reduce inflammation or may inject an anesthetic to block pain fibers in the affected nerves. Vasodilators, which traditionally are used to treat high blood pressure, may help to relieve pain in affected areas by easing blood vessel constriction. Transcutaneous electrical nerve stimulation (TENS) may be used to ease chronic pain, or biofeedback techniques may help the patient to relax the body and relieve pain symptoms. In rare cases, surgically cutting the nerves in the affected area may be recommended. This procedure is controversial, however, because it also may destroy other sensations.[13]

The 35-year-old male recreational soccer player sustained an ankle inversion sprain that did not correspond to the level of the reported symptoms. The individual may be experiencing CRPS. As such, the individual should be referred to a physician for further evaluation.

SUMMARY

1. Migraine headaches are characterized by moderate to severe throbbing or pounding pain often accompanied by light sensitivity, nausea or vomiting, loss of appetite, and abdominal pain.
2. Treatment for migraine headaches is based on the type, frequency, and cause of the migraine. Most often, migraines are treated with various drug therapies.
3. A seizure disorder entails recurrent episodes of sudden, excessive charges of electrical activity in the brain, whether from known or unknown (idiopathic) causes. Epilepsy is a general term used to describe only recurrent idiopathic episodes (at least two) of sudden, excessive discharges of electrical activity in the brain. The discharge may trigger altered sensation, perception, behavior, mood, or level of consciousness or may lead to convulsive movements.
4. Seizures are classified as partial, generalized, or special epileptic syndromes.
5. The most serious seizure is the tonic–clonic seizure, which may occur in an intermittent or a continuous form. An intermittent seizure, which usually lasts only from 50 to 90 seconds but may extend to 5 minutes, often is preceded by a particular taste or smell (aura).
6. The typical absence (petit mal) attack is characterized by a slight loss of consciousness or blank staring into space for 3 to 15 seconds without loss of body tone or falling.
7. The simple partial seizure is characterized by involuntary movements of the face, limbs, or head, and the individual may experience tingling or numbness. The localized motor seizures may be followed by localized weakness or paralysis of the body part in which the seizure occurs.
8. Complex partial (psychomotor) seizures are characterized by purposeful movements or experiences followed by impairment in consciousness.

9. Management of any seizure is directed toward protecting the individual from injury. The area surrounding the individual should be clear of objects; immovable objects should be padded. The individual should not be restrained, but the head should be protected at all times. Nothing should be placed in the mouth of an individual having a seizure. When the seizure ends, an adequate airway should be ensured. If the time of the seizure exceeds 5 minutes, activation of the emergency action plan is warranted.
10. In the majority of cases, individuals with a seizure disorder can be allowed to participate in certain physical activities and sports provided that good seizure control and proper supervision are available at all times.
11. Certain activities (e.g., football, scuba diving, mountain climbing, and automobile racing) may put the individual or others at risk if a seizure occurs. Participation in these activities should be discouraged.
12. Meningitis, an infection and inflammation of the membranes (meninges) and fluid (cerebrospinal fluid) surrounding the brain and spinal cord, most often is caused by bacteria or viruses.
13. Encephalitis is an inflammation of the brain caused by a viral infection. The disease often is spread by insects, particularly mosquitoes that feed on infected birds and animals.
14. CRPS, sometimes referred to as reflex sympathetic dystrophy, is an uncommon disturbance of the sympathetic nervous system. The condition often is associated with intense pain, abnormal skin color, temperature changes, hypersensitivity to touch, edema, and motor dysfunction not proportionate to the injury.

APPLICATION QUESTIONS

1. A high school baseball player reports to the preseason physical examination with a history of partial seizures. Should this individual be

permitted to participate in baseball? Explain your response. If the individual wanted to play on the school ice hockey team, would your response be the same or different? Why?

2. Your high school soccer team participated in a weekend tournament sponsored by a school district in a neighboring state. The Tuesday following the tournament, the parent of a member of your soccer team calls to report that her daughter will not be in school today, having just been seen by a doctor who diagnosed the young girl with meningitis. How would you respond to the parent about this news? What is your obligation, as an athletic trainer, to notify other individuals about this condition? Why? Will any follow-up management be required on your part?
3. You are an athletic trainer employed at a university. A member of the women's gymnastics team complains of a pounding headache with nausea. How would you immediately manage this condition? Should this individual be immediately referred to a physician for further assessment and care, or can she wait to be seen tomorrow? Explain your response.
4. During field hockey practice, one of the athletes has a partial seizure. The athlete has no previous history of seizures. How would you manage this condition to safeguard the athlete?

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