Chapter 25

Neurology

Lesson 25.1

Anatomy, Physiology, Pathophysiology, and Assessment
Learning Objectives

• Describe anatomy and physiology of nervous system.
• Outline pathophysiological changes in nervous system that may alter the cerebral perfusion pressure.
• Describe assessment of patient with nervous system disorder.

Nervous System Anatomy and Physiology

• Divided into two parts
  – Central nervous system (CNS)
  – Peripheral nervous system (PNS)
• Ability of human body to maintain state of balance (homeostasis) is chiefly result of nervous system’s ability to coordinate and regulate body’s activities
Nervous System Anatomy and Physiology

- CNS consists of brain and spinal cord
  - Both are encased in and protected by bone
  - Total of 43 pairs of nerves originate from CNS to form PNS
  - 12 pairs of cranial nerves originate from brain
  - 31 pairs of spinal nerves originate from spinal cord

Nervous System Cells

- Cells of nervous system
  - Neurons
    - Basic units of nervous system
    - Connective tissue cells
  - Neuroglia
    - Specialized cells that protect and hold functioning neurons together
  - Each neuron has three main parts
    - Cell body, which has a single, relatively large nucleus with prominent nucleolus
    - One or more branching projections, called dendrites
    - Single, elongated projection, known as axon
Nervous System Cells

• Dendrites transmit impulses to cell bodies
• Axons
  – Transmit impulses away from cell bodies
  – Surrounded by supportive and protective sheaths formed by cytoplasmic extensions of neuroglial cells in CNS (unmyelinated axons)
  – Surrounded by Schwann cells in PNS (myelinated axons)

Nervous System Cells

• White matter
  – Bundles of parallel axons with their associated sheaths are white
• Action potential
  – Initiated in neuron body
  – Propagated through axons via conduction pathways or nerve tracts from one area of CNS to another
• In PNS, bundles of axons and their sheaths are called nerves

Nervous System Cells

• Gray matter
  – Collections of nerve cells
  – Grayer in color
  – Site of integration in nervous system
  – Outer surface of cerebrum and cerebellum consists of gray matter
    • Forms cerebral cortex and cerebellar cortex
Neuron Types

• Neurons are classified as
  – Sensory neurons
  – Motor neurons
  – Interneurons
• Based on direction in which they transmit impulses

Neuron Types

• Sensory neurons
  – Transmit impulses to spinal cord and brain from all parts of body
  – Also called afferent neurons
• Motor neurons
  – Transmit impulses in opposite direction, away from brain and spinal cord
  – Transmit impulses only to muscle and glandular epithelial tissue
  – Also called efferent neurons

Neuron Types

• Interneurons
  – Conduct impulses from sensory neurons to motor neurons
  – Also called central or connecting neurons
Impulse Transmission

- Transmission of nerve impulses in nervous system is similar to conduction of electrical impulses through heart
  - In its resting state, neuron is positively charged on outside and negatively charged on inside
  - When stimulated by pressure, temperature, or chemical changes, permeability of neuron's membrane to sodium ions increases
    - As a result, positively charged sodium ions rush into interior of neuron
    - This inward movement begins wave of depolarization
    - Wave travels down axon, resulting in propagation of action potential

In unmyelinated axons, action potentials are spread along entire axon membrane

- Nodes of Ranvier
  - Myelinated axons have interruptions in myelin sheaths
  - Allow nerve impulses to “jump” from one node to next without spreading along entire length of cell (saltatory conduction)
  - Myelinated axons conduct action potentials faster than unmyelinated axons
Synapse

- Membrane-to-membrane contact that separates axon endings of one neuron (presynaptic neuron) from dendrites of another neuron (postsynaptic neuron)
- Structures that compose synapse
  - Presynaptic terminal
  - Synaptic cleft
  - Plasma membrane of postsynaptic neuron
- Within each presynaptic terminal are synaptic vesicles that contain neurotransmitter chemicals

Synapse

- Each action potential arriving at presynaptic terminal initiates series of specific events
  - Result in release of neurotransmitter substance
  - Neurotransmitter chemical rapidly diffuses short distance across the synaptic cleft
  - Then binds to specific receptor molecules on postsynaptic membrane
Synapse

• After impulse is generated and conducted by postsynaptic neurons, neurotransmitter activity ends rapidly
• Several substances have been identified as neurotransmitters, others are thought to be neurotransmitters

Synapse

• Well-known neurotransmitters include
  – Acetylcholine
  – Norepinephrine
  – Epinephrine
  – Dopamine

Reflexes

• One type of route traveled by nerve impulses is reflex or reflex arc
  – Basic unit of nervous system capable of receiving stimulus and generating response
  – Allow conduction of impulses in one direction
  – Have several basic components
    • Sensory receptor
    • Sensory neuron
    • Interneurons
    • Motor neuron
    • Effector organ
What is an example of a pressure, temperature, and chemical stimulus of a nerve?

Reflexes

- Individual reflexes vary in complexity
  - Some function to remove body from painful stimuli
  - Some prevent body from suddenly falling or moving as result of external forces
  - Others are responsible for maintaining relatively constant blood pressure, body fluid pH, blood CO₂ level, and water intake
  - All reflexes are homeostatic
    • Function to maintain healthy survival

Reflexes

- Action potentials initiated in sensory receptors spread along sensory axons in PNS to CNS
  - There they synapse with interneurons
  - Interneurons synapse with motor neurons in spinal cord, which send their axons out of spinal cord and through PNS to muscles or glands
    • Causes effector organ to respond
Blood Supply

- Arterial blood supply to brain comes from vertebral arteries and internal carotid arteries
- Right and left vertebral arteries (supplying cerebellum) enter cranial vault through foramen magnum
  - Unite to form midline basilar artery
  - Artery branches to supply pons and cerebellum
  - Divides again to form posterior cerebral arteries
  - Supply posterior portion of cerebrum
Blood Supply

• Internal carotid arteries enter cranial vault through carotid canals
  – Vessels give rise to anterior cerebral arteries
    • Anterior cerebral arteries supply blood to frontal lobes of brain
    • End by forming middle cerebral arteries
    • These supply large portion of lateral cerebral cortex
  – Posterior communicating artery branches off each internal carotid artery and connects with ipsilateral posterior cerebral artery

Blood Supply

• Two posterior cerebral arteries are connected at their common origin from basilar artery
• Anterior cerebral arteries are connected by anterior communicating artery
  – Complete a circle around pituitary gland and brain
    • Circle of Willis
      – Provides important safeguard
      – Helps to ensure supply of blood to all parts of brain in event of blockage in one of vertebral or internal carotid arteries

Blood Supply

• Veins that drain blood from head form venous sinuses
  – Spaces in dura mater surrounding brain
  – Eventually drain into internal jugular veins
    • Veins exit cranial vault and join with several other veins that drain external head and face
    • Internal jugular veins join subclavian veins on each side of body
Ventricles

- Each cerebral hemisphere contains large space filled with cerebrospinal fluid (CSF)
  - Space known as lateral ventricle
    - Connected posteriorly

Ventricles

- Third ventricle is located in center of diencephalon between two halves of thalamus
  - Two lateral ventricles communicate with third ventricle through two interventricular foramina
  - Third ventricle communicates with fourth ventricle (located in superior region of medulla) by way of narrow canal
    - Known as cerebral aqueduct
  - Fourth ventricle is continuous with central canal of spinal cord
What happens if the flow in one of these canals becomes obstructed?

Brain Divisions

- Major divisions of adult brain
  - Brain stem
    - Medulla
    - Pons
    - Medulla
  - Site of reticular formation
  - Cerebellum
  - Diencephalon
    - Hypothalamus
    - Thalamus
  - Cerebrum
Neurological Pathophysiology

- Some neurological emergencies are consequence of
  - Structural changes or damage
  - Circulatory changes
  - Alterations in intracranial pressure (ICP) that affect cerebral blood flow (CBF)

Neurological Pathophysiology

- Three structures occupy intracranial space
  - Brain tissue
    - Contains mostly water, both intracellular and extracellular
  - Blood
    - Contained within major arteries in base of brain
    - In arterial branches, arterioles, capillaries, venules, and veins in substance of brain
    - In cortical veins and dural sinuses
  - Water
    - Located in ventricles of brain
    - In CSF
    - In extracellular and intracellular fluid

Cerebral Blood Flow

- Brain accounts for
  - 2 percent of adult weight
  - 20 percent of total body O2 use
- 25 percent of total body glucose use are devoted to brain metabolism
  - O2 and glucose delivery are controlled by cerebral blood flow
Cerebral Blood Flow

• Cerebral blood flow is function of cerebral perfusion pressure (CPP) and resistance of cerebral vascular bed
  – To measure CPP, intracranial pressure is subtracted from mean arterial pressure (MAP)
    • MAP is diastolic BP (DBP) + 1/3 pulse pressure (PP)
    • MAP = DBP + 1/3 PP
  – Cerebral blood flow is difference between MAP and ICP
    • (CPP = MAP – ICP)
    – Normal ICP is 10 to 15 mm Hg or less

• Normal mean arterial pressure ranges from 70 to 95 mm Hg
• Normal CPP is between 60 and 80 mm Hg
  – Cerebral perfusion pressure of 60 mm Hg is critical minimum threshold for organ blood flow
  – As ICP rises and approaches mean arterial pressure, gradient for flow decreases and cerebral blood flow decreases
    • When ICP increases, CPP decreases
  – As CPP decreases, vessels in brain dilate (cerebral vasodilation)
    • Results in increased cerebral blood volume (increasing ICP) and further cerebral vasodilation
Relate the difficulty in cerebral blood flow with increased intracranial pressure to having someone pushing on a door from the outside while you are trying to open it from the inside. How much harder is it for you to open the door?

Cerebral Perfusion Pressure

• Cerebral blood flow (CBF) depends on cerebral perfusion pressure (CPP), which is pressure gradient across brain
• CBF remains constant when CPP is 50 to 160 mm Hg
  – If CPP falls below 40 mm Hg, CBF declines
  – Critically affects cerebral metabolism
  – With mild to moderate elevation of ICP, MAP usually rises
    • Rise in MAP causes cerebral blood vessels to constrict and prevents increase in blood volume and CBF that normally would occur

Cerebral Perfusion Pressure

• If MAP falls, cerebral arteries dilate, increasing cerebral blood flow
  – With MAP of about 60 to 150 mm Hg, cerebral blood flow may be maintained in constant state
  – When ICP elevations are marked (greater than 22 mm Hg), perfusion of brain tissue often decreases despite rise in systemic arterial pressure
    • If mass or cerebral edema develops, immediate reduction in volume of one or more of these components (brain tissue, blood, or water) must occur to prevent ICP from rising and compressing brain tissue
Nervous System Assessment

• Treatment
  – Begins with primary survey
  – Use systematic approach for examining these patients
    • Helps to ensure that signs and symptoms that may indicate an urgent condition are not overlooked

Nervous System Assessment

• Goals of emergency care
  – Control of airway
  – Stabilization and support of cardiovascular system
  – Intervention to interrupt ongoing cerebral injury
  – Protection of patient from further harm while at scene and during transport

Primary Survey

• Begin primary survey by determining patient’s level of consciousness
• Open and patent airway also must be ensured
• If patient is unconscious when paramedics arrive and there is reason to suspect cervical spine injury, patient’s airway should be opened with spinal precautions and cervical spine should be immobilized
Primary Survey

• Unconscious patient is unable to maintain airway
  – Airway adjuncts (including placement of advanced airways) may be indicated
• Closely monitor for respiratory arrest, which may result from increased ICP
  – Closely watch for vomiting or aspiration of stomach contents
  – Suction should be readily available

Primary Survey

• Support of breathing and administration of supplemental O₂ should be provided for most patients experiencing neurological emergency
  – Increased Pco₂ or decreased Po₂ results in dilation of blood vessels
    • Occurs presumably because of increase in cerebral metabolic needs
    • As Pco₂ drops, blood volume and blood flow to brain are reduced

Physical Examination

• Patient with neurological illness may be difficult to assess
  – Particularly true if patient’s mental function is impaired
• Key elements of physical examination may offer clues to cause of neurological emergency
  – Patient history
  – History of event
  – Vital signs
  – Respiratory patterns
History

• After any life-threatening problems have been identified and managed, paramedic should attempt to compile thorough history
• Information can be obtained from patient (when possible) or from family members or bystanders

History

• Six important elements of patient history
  – Patient’s chief complaint
  – Details of presenting illness
  – Pertinent underlying medical problems
    • Cardiac disease
    • Lung disease
    • Neurological disease (e.g., multiple sclerosis)
    • Previous stroke
    • Chronic seizures
    • Diabetes
    • Hypertension

History

• Six important elements of patient history
  – Alcohol or other drug use
  – Previous history of similar symptoms
  – Recent injury (particularly head trauma)
How could a history involving one of these problems cause an alteration in a patient’s neurological status?

History
• If loss of consciousness was involved, ascertain events that led up to unconscious state
  – May include
    • Patient’s position (sitting, standing, lying down)
    • Whether person complained of headache
    • Whether seizure activity or fall occurred

History
• At times no history is available
  – Assume onset of unconsciousness was acute
  – Assume intracranial hemorrhage is likely
  – Be alert for any environmental clues
    • Evidence of current prescribed medications
    • Medical alert identification
    • Recreational drugs
    • Alcohol
    • Drug paraphernalia
Vital Signs

• Should be checked and recorded often
  – May change rapidly in patients with neurological emergency
• Patient’s ECG should be monitored for dysrhythmias

Vital Signs

• When ICP begins to rise, conscious patient may complain of headache, nausea, and vomiting
• Cushing’s reflex
  – Progressive hypertension associated with bradycardia and diminished respiratory effort is response to lethal increases in ICP

Vital Signs

• Late stages of increased ICP are marked by
  – Increase in systolic pressure
  – Widened pulse pressure
  – Decrease in pulse and respiratory rate
Vital Signs

• In terminal stages, as ICP continues to rise and brain tissue is compressed, pupils become unequal and body temperature usually remains elevated
  – Pulse rate generally decreases and BP falls, particularly after herniation occurs
  – Hypotension is late and ominous sign

Respiratory Patterns

• Respiratory pattern of patient with a neurological emergency may be normal or abnormal
  – In absence of respiratory arrest caused by damage to lower respiratory centers in medulla, respiratory abnormalities of respiratory rate and rhythm may occur
  – These abnormalities may provide clues as to which area of brain is involved
  – May indicate severity of neurological problem
Respiratory Patterns

• Apnea can occur with loss of consciousness, even with relatively minor head trauma
  – Acute respiratory arrest usually results from involvement of medullary respiratory center (brain stem compression or infarct)
  – Damage to neural pathways (anywhere from cortex down to medulla) more often produces problems with respiratory rhythm rather than respiratory arrest

Which respiratory control center is likely affected if the patient has ataxic or apneustic respirations?

Respiratory Patterns

• Abnormal respiratory patterns
  – Cheyne-Stokes respiration
  – Central neurogenic hyperventilation
  – Ataxic respiration
  – Apneustic respiration
  – Diaphragmatic breathing
Neurological Evaluation

• Some neurological complications are obvious (e.g., paralysis), others subtle (e.g., decreasing level of awareness)
  – Sudden or rapidly worsening level of consciousness is single most suggestive sign of serious neurological condition
  • Mnemonic device AVPU (alert, verbal, painful, unresponsive) can help determine patient’s baseline neurological status
  • Glasgow Coma Scale should also be used during initial assessment
  • Evaluations should be repeated and recorded often
  • Allows changes in patient’s mental state to be detected quickly

Neurological Evaluation

• When evaluating patient’s neurological status, report and record patient information with descriptive terms
  – Be specific to responses to certain stimuli
  – Use clear descriptions of patient’s response
  • Allows others involved in patient’s care to follow progression of condition

Posturing, Muscle Tone, and Paralysis

• Significant neurological emergencies may be associated with abnormal or unusual posturing, paralysis of limb or several limbs, or both
• Generally, disturbances of posture result from flexor spasms, extensor spasms, or flaccidity
  – Decorticate rigidity
    • Abnormal flexor response of one or both arms with extension of legs
Posturing, Muscle Tone, and Paralysis

- Abnormal posturing results from damage to cortex of brain
  - Decerebrate rigidity
    - Abnormal extensor response of arms with extension of legs
    - Has worse prognosis than decorticate rigidity
    - Results from damage to subcortical areas of brain
    - Flaccidity usually caused by brain stem or cord dysfunction
    - Has dismal prognosis

Posturing, Muscle Tone, and Paralysis

- Abnormal reflexes are not uncommon with decorticate or decerebrate rigidity
  - Associated with this may be Babinski’s sign (plantar reflex)
    - Abnormal extensor reflex in adults
    - Dorsiflexion or extension of great toe with or without fanning or abduction of other toes when outer edge of foot is scratched
    - Indicates neurologic injury
    - Patient with severe injury may also have relaxation of sphincter tone and may be incontinent of urine or feces or both
Pupillary Reflexes

• Examination of pupils is very important in unconscious patient
  – Often diagnosis of drug use can at least be suspected based on appearance and reaction of pupils
  – If deviations from normal (in relative symmetry, size, and prompt reaction to light) are observed, crucial to note whether these deviations are unilateral or bilateral
  – If both pupils are dilated and do not react to light, brain stem has probably been affected
    • May also occur with severe cerebral anoxia

Pupillary Reflexes

• Pupillary constriction is controlled by parasympathetic fibers
  – Fibers originate in midbrain and accompany oculomotor nerve (cranial nerve III)
  – Pupillary dilation involves fibers that travel entire brain stem and return in cervical sympathetic nerves
  – Midbrain injury interrupts both pathways
    • Results in fixed, midsize pupils
  – Compression of third cranial nerve interrupts parasympathetic nerve actions
    • Manifested by a unilateral, fixed, dilated pupil
Which cranial nerves control eye movements?

Pupillary Reflexes

- Any unconscious patient who suddenly develops fixed, dilated pupil probably has suffered significant neurological event
  - Requires immediate transport

Extraocular Movements

- Conscious patients should be able to move their eyes in full directional ranges
- Evaluate extraocular movements by asking patient to follow finger movements
  - For this test, paramedic moves finger to extreme left and then up and down and to extreme right and then up and down
  - Any deviations from normal should be recorded
Extraocular Movements

- Deviation of both eyes to either side (conjugate gaze) at rest implies damage to brain tissue (lesion)
  - Lesion may have irritative focus in which eyes look away from lesion
  - Alternatively, may have destructive focus where they look toward lesion
  - Deviation of eyes to opposite sides (dysconjugate gaze) at rest implies damage to brain stem
Learning Objective

• Describe the pathophysiology, signs and symptoms, and specific management techniques for each of the following neurologic disorders: coma, stroke and intracranial hemorrhage, seizure disorders, headaches, brain neoplasm and brain abscess, and degenerative neurological diseases.

CNS Disorders Pathophysiology and Management

• Disorders of the nervous system have many causes
  – Structural and metabolic coma
  – Stroke and intracranial hemorrhage (including transient ischemic attack)
  – Seizure disorders
  – Headaches
  – Brain neoplasm and brain abscess

Coma

• Abnormally deep state of unconsciousness where patient cannot be aroused by external stimuli
• Only two mechanisms produce coma
  – Structural lesions: depress consciousness by destroying or encroaching on reticular activating system in brain stem
  – Toxic metabolic states: presence of toxins or lack of oxygen or glucose
Coma

• Either mechanism may result in depression of cerebrum, with or without depression of reticular activating system
  – Within these two primary mechanisms there are six general causes of coma
  – Mnemonic aid that may be useful for remembering common causes of coma is AEIOU-TIPS

Coma

• Causes
  – Structural origin
    • Intracranial bleeding
    • Head trauma
    • Brain tumor or other space-occupying lesion
  – Metabolic system
    • Anoxia
    • Hypoglycemia
    • Diabetic ketoacidosis
    • Thiamine deficiency
    • Kidney and liver failure
    • Postictal phase of seizure

Coma

• Causes
  – Drugs
  – Barbiturates
  – Narcotics
  – Hallucinogens
  – Depressants
  – Alcohol
Coma

• Causes
  – Cardiovascular system
    • Hypertensive encephalopathy
    • Shock
    • Dysrhythmias
    • Stroke
  – Respiratory system
    • COPD
    • Toxic inhalation
    • Infection
    • Meningitis
    • Sepsis

Structural vs. Toxic-Metabolic Coma

• Structural and toxic-metabolic causes of coma differ in two major ways
  – In patients with coma of structural origin, neurological signs often are one sided, or asymmetrical
  – In toxic-metabolic coma, neurological findings often are same on both sides of body
    • Often slow in onset whereas structural lesions occur acutely

Structural vs. Toxic-Metabolic Coma

• Structural and toxic-metabolic causes of coma differ in two major ways
  – Changes in pupil responses are most important physical sign in distinguishing between causes
    • Normal pupil responses suggest that coma has a toxic-metabolic cause
    • Unresponsive or asymmetrical pupils suggest structural cause
Structural vs. Toxic-Metabolic Coma

- Unlike metabolic coma, structural coma follows progressive pattern of deterioration
  - Caused by focal pressure or compression in brain
  - Often sudden in onset with asymmetrical examination such as muscle weakness on one side of body (hemiparesis)

Structural vs. Toxic-Metabolic Coma

- Structural lesions damage reticular activating system as result of increased ICP and herniation of brain
  - This type of injury requires rapid surgical correction
  - Knowledge of difference between toxic-metabolic coma and structural coma can help paramedic to anticipate course of patient’s condition

Assessment and Management

- Regardless of cause of coma, prehospital care is directed at
  - Support of vital functions
  - Prevention of further deterioration of patient’s condition
  - Administration of medications
  - IV fluids
  - Airway maintenance and ventilatory support with supplemental high-concentration O₂ are first priorities in patient care
  - Rapid transport for definitive care may be indicated
Assessment and Management

• If respirations are abnormally slow or shallow, ventilations should be supported
• If patient is unconscious and has no gag reflex, trachea should be intubated

Assessment and Management

• After securing airway
  – Establish IV line to keep vein open or to manage hypotension (if present)
  – Monitor patient’s ECG
  – Per protocol, draw blood sample for laboratory analysis
    • if hypoglycemia is suspected, use glucometer or other device to measure serum glucose levels
    • Administer 50 percent dextrose if indicated (per protocol)
    • If alcohol is suspected as cause of coma, administration of thiamine before glucose should be considered

Assessment and Management

• After securing airway
  – If no response is obtained with glucose administration, administer naloxone per protocol
    • Rules out or reverses narcotic depression
  – If patient remains in comatose state, transport person in a lateral recumbent position (if not contraindicated)
    • Aids drainage of secretions
    • Minimizes chance of aspiration of stomach contents
    • Closely monitor patient’s airway
    • Have suction readily available
    • Protect patient’s eyes from corneal drying by gently closing them and covering lids with moist gauze pads
Stroke and Intracranial Hemorrhage

• Also known as cerebrovascular accident (CVA) or “brain attack”
  – Sudden interruption in blood flow to portion of brain that results in neurological deficit
  – Serious disease that affects more than 700,000 Americans each year
  – Associated with 30-day mortality of about 10 to 15 percent

• Also known as cerebrovascular accident (CVA) or “brain attack”
  – Third leading cause of death in U.S.
  – Frequently leaves survivors severely disabled
  – AHA: individuals more likely to suffer stroke have prior risk factors that can be classified as modifiable and nonmodifiable

• Modifiable risk factors
  – High blood pressure
  – Cigarette smoking
  – Transient ischemic attacks
  – Heart disease
  – Atrial fibrillation
  – Diabetes mellitus
  – Hypercoagulopathy
  – High red blood cell count and sickle cell anemia
  – Carotid stenosis
Stroke and Intracranial Hemorrhage

• Nonmodifiable risk factors
  – Age
  – Gender (men are at greater risk than women)
  – Race (African-Americans are at greater risk than Caucasians)
  – Prior stroke
  – Heredity

Stroke Pathophysiology

• Blood reaches brain through four major vessels
  – Two carotid arteries
    • Provide about 80 percent of cerebral blood flow
  – Two vertebral arteries
    • Combine to form single basilar artery (supplying remaining 20 percent of CBF)
  – Two systems are interconnected at various levels
    • Principal level is circle of Willis

• Collateral blood flow can be supplied to brain through connections from blood vessels in face and scalp to dura and arachnoid coverings of brain
  – Amount of collateral circulation varies from individual to individual
  – Beyond this, no collateral circulation in depths of brain
    • Occlusion of any one of more distal vessels may result in ischemia and infarction
Stroke Pathophysiology

• Normally, CBF is maintained through autoregulation of cerebral vessels
  – Constrict or dilate to preserve perfusion pressure even when patient is hypotensive
  – Arterial cerebral perfusion is regulated by level of O$_2$ and glucose supplied (ischemia and acidosis are profound vasodilators)

• Vessel occlusion or hemorrhage causes sudden cessation of circulation to portion of brain
  – Autoregulatory mechanisms cannot readily correct
  – Uncorrected ischemia that results within short period of time leads to neuronal dysfunction and death
  – Onset and symptoms of stroke depend on area of brain involved

How much oxygen and glucose can the brain store for emergency situations?
Stroke Types

• Neurological manifestations of critical decrease in blood flow to portion of brain, regardless of cause
• AHA has defined two primary categories of stroke
  – Ischemic stroke or occlusive stroke
    • Those caused by clots
  – Hemorrhagic stroke
    • Those caused by bleeding

Stroke Types

• Ischemic stroke
  – Cerebral thrombosis
  – Cerebral embolism
• Hemorrhagic stroke
  – Intracerebral hemorrhage
  – Subarachnoid hemorrhage

Stroke Types

• Determining origin of stroke frequently is difficult and often unnecessary in prehospital setting
  – Best care for all stroke patients is support of vital functions and rapid transport for definitive care
  – Paramedic who understands various signs and symptoms of each type of stroke is better equipped to anticipate course of patient care
  – Documenting thorough history and physical examination also helps others involved in patient’s care
Ischemic Stroke

• About 85 percent of strokes are ischemic
  — Caused by cerebral thrombosis
    • Thrombosis occurs as result of atherosclerotic plaques or pressure from mass in brain itself
    • Usually associated with long history of blood vessel disease
    • Most of these patients are older
    • Most have evidence of atherosclerotic disease in other areas of body (angina pectoris, claudication, previous strokes)
    • Signs and symptoms of thrombotic stroke usually are slower to develop than those of cerebral hemorrhage

Ischemic Stroke

• Signs and symptoms of thrombotic stroke
  — Hemiparesis or hemiplegia on side of body opposite lesion
  — Numbness (decreased sensation) on side of body opposite lesion
  — Aphasia
  — Confusion or coma
  — Convulsions
  — Incontinence
  — Diplopia (double vision)

Ischemic Stroke

• Signs and symptoms of thrombotic stroke
  — Monocular blindness (painless visual loss in one eye)
  — Numbness of the face
  — Dysarthria (slurred speech)
  — Headache
  — Dizziness or vertigo
  — Ataxia
Cerebral Embolus

• Stroke caused by embolus results when intracranial vessel is blocked by foreign substance
  – Vessel is occluded by fragment of foreign substance originating outside CNS
  – Common sources of cerebral emboli include atherosclerotic plaques (originating from large vessels of head, neck, or heart)
  – Thrombi that develop on valves or in chambers of heart are very common in patients with heart valve disease and atrial fibrillation
  – Other, rare causes include air embolism from chest injury and fat embolism after long bone injury

Cerebral Embolus

• Bacterial and fungal infections of heart also can produce emboli
  – Women taking oral contraceptives and patients with sickle cell disease have increased risk of developing stroke (by both thrombotic and embolic origin)
  – Signs and symptoms of cerebral embolus are similar to those of thrombotic stroke
  – Embolic signs and symptoms develop more quickly
    • Often associated with identifiable cause (e.g., atrial fibrillation)

Hemorrhagic Stroke

• Cerebral hemorrhage accounts for about 15 percent of all strokes
  – May occur anywhere in brain and its structures
    • Epidural
    • Subdural
    • Subarachnoid
    • Intraparenchymal
    • Intraventricular spaces
Hemorrhagic Stroke

- Most common causes
  - Cerebral aneurysms
  - Arteriovenous (AV) malformations
  - Hypertension
    - Cerebral aneurysms and AV malformations are congenital anomalies, can run in families
    - Often are asymptomatic until they rupture
  - Cerebral hemorrhages are fatal in 50 to 80 percent of cases

Hemorrhagic Stroke

- Often occur during stress or exertion
- Cocaine and other sympathetic-type drugs also may contribute to intracranial hemorrhage by drug-induced rapid elevation of blood pressure

Hemorrhagic Stroke

- Onset of stroke is sudden
  - Often begins with headache (sometimes described as a “thunderclap headache” or worst headache of patient’s life)
  - Headache is accompanied by nausea, vomiting, progressive deterioration in mental status
  - Some will complain of stiff neck
Hemorrhagic Stroke

• Onset of stroke is sudden
  – Often patient loses consciousness or experiences seizure at time of hemorrhage
  – As hemorrhage expands, intracranial pressure (ICP) increases
  – As this occurs, patient becomes comatose, with increasing hypertension, bradycardia, and diminished respiratory effort (Cushing’s reflex)

Why do you think mortality is higher for hemorrhagic versus embolic stroke?

Transient Ischemic Attack (TIA)

• Often referred to as mini stroke
  – Episodes of cerebral dysfunction that affect specific portion of brain
  – May last minutes to several hours
  – Patient returns to normal within 24 hours without permanent neurological deficit
• Most important indication of impending stroke
  – About 5 percent of patients who have a TIA go on to have complete stroke within one month if untreated
  – Most important forecaster of brain infarction
Transient Ischemic Attack (TIA)

- Signs and symptoms
  - Weakness
  - Paralysis
  - Numbness of face
  - Speech disturbances
- All correspond to vascular occlusion of specific cerebral artery
  - Most patients are hospitalized for close observation, evaluation, and treatment of vascular disease (e.g., endarterectomy, anticoagulant or antiplatelet therapy)

Paramedic Role in Stroke Care

- In stroke care, paramedic’s role is to
  - Quickly identify stroke event
  - Notify medical direction
  - Rapidly transport

Paramedic Role in Stroke Care

- Key points in stroke management
  - 7 Ds
    - Detection
    - Dispatch
    - Delivery
    - Door
    - Data
    - Decision
    - Drug
Stroke Assessment

- Primary survey
  - Follows same sequence as for any other ill or injured patient in emergency setting
  - Priorities
    - Maintain patent airway
    - Provide adequate ventilatory support with appropriate supplemental oxygen
    - If patient is conscious and able to speak, thorough history should be obtained

Stroke Assessment

- Important components of patient history for these patients
  - Time of symptom onset
  - Previous neurological symptoms (TIAs)
  - Previous neurological deficits
  - Initial symptoms and their progression
  - Alterations in level of consciousness
  - Precipitating factors
    - Dizziness
    - Palpitations

Stroke Assessment

- Components of patient history
  - Significant past medical history
    - Hypertension
    - Diabetes mellitus
    - Cigarette smoking
    - Oral contraceptive use
    - Cardiac disease
    - Sickle cell disease
    - Previous stroke
Cincinnati Prehospital Stroke Scale

• In addition to abnormal neurological signs and symptoms described previously, other methods can be used to diagnose stroke
  – Cincinnati Prehospital Stroke Scale (CPSS)
    • Evaluates three major physical findings: facial droop, arm drift, and speech
    • Helps identify stroke patient who needs rapid transport to hospital
    • Allows for prearrival notification of receiving hospital
    • Has sensitivity of 59 percent and specificity of 89 percent when scored by prehospital personnel

Los Angeles Prehospital Stroke Scale

• Another way to diagnose stroke
  – Requires examiner to rule out other causes of altered level of consciousness (e.g., hypoglycemia or seizure)
  – Must identify asymmetry (right versus left) in facial smile/grimace, grip, and arm strength
    • Asymmetry in any category indicates possible stroke
  – Can be used quickly in prehospital setting
  – Has specificity of 97 percent and sensitivity of 93 percent

Stroke Management

• Once diagnosis of stroke is suspected, time in field must be reduced because limited time to begin therapy
  – Less than 4 hours from onset is required for use of fibrinolytics
    • Some centers have expanded this timeframe to 6 hours or more in certain cases
Stroke Management

- Once diagnosis of stroke is suspected, time in field must be reduced because limited time to begin therapy
  - Whenever possible, establish time of onset of stroke signs and symptoms
    - If patient awoke with symptoms, time of onset should be recorded as last time they were known to be normal (last seen well)
    - Important for determining whether fibrinolytics can be administered

Stroke Management

- Prehospital care is directed at
  - Managing patient’s airway, breathing, and circulation
  - Monitoring vital signs
  - Besides life support, most important care paramedic can provide stroke victim is quick identification of possible stroke and rapid transport
Airway

- Paralysis of muscles of throat, tongue, and mouth can lead to partial or complete airway obstruction
  - Major problem in acute stroke
  - Frequent suctioning of oropharynx and nasopharynx is required to prevent aspiration of saliva
  - If possible, patient should be positioned to aid drainage of oral secretions

How can you detect paralysis of the muscles of the throat, tongue, and mouth during your physical examination of patients?

Breathing

- Inadequate ventilation should be managed with supplemental O2 and positive-pressure ventilation
  - Hypoxia and hypercarbia can occur as result of inadequate ventilation, contributing to cardiac and respiratory instability
  - Supplemental O2 should be given to stroke patients who are hypoxic (an O2 saturation less than 92 percent) and to those patients where O2 saturation is unknown
  - Medical direction also may recommend that O2 be given to patients with stroke who are not hypoxic
Circulation

• Cardiac arrest is uncommon
  – May result from respiratory arrest
  – Cardiac dysrhythmias occur frequently
    • Patient’s ECG and BP require constant monitoring
    • Difference in BP readings in upper extremities of 10 mm Hg or more may indicate aortic dissection and compromise of brain’s blood supply

Other Supportive Measures

• If airway is patent and patient’s condition permits, individual should be kept supine
  – Head should be elevated 15 degrees to aid venous drainage

Other Supportive Measures

• Other patient care measures en route
  – Initiate IV line of lactated Ringer’s solution or normal saline (50 mL/hour)
  – Draw blood sample for laboratory analysis per protocol
  – Perform serum glucose analysis (50 percent dextrose should be administered only if indicated)
  – Protect paralyzed extremities
  – Maintain normal body temperature
  – Control seizure activity with benzodiazepines
  – Provide comfort measures and reassurance
  – Provide gentle transport to receiving hospital
Other Supportive Measures

- Stroke patients have experienced catastrophic event, one that may seriously affect their quality of life
  - Often are frightened, embarrassed, confused, and frustrated with their inability to move or communicate
  - Patients have special physical and emotional needs
  - Deserve compassionate, caring approach

In-Hospital Treatment

- On arrival at emergency department, non-hemorrhagic stroke patient is evaluated as possible candidate for fibrinolytic therapy
  - Includes emergency neurological stroke assessment, which identifies patient's level of consciousness
  - Also identifies type, location, and severity of stroke

In-Hospital Treatment

- Assessment aided by use of Glasgow Coma Scale and other standardized scales
  - Helps to measure neurological function
  - Correlates with severity of stroke and long-term outcome
  - Helps to identify stroke patients who would benefit from fibrinolytic therapy
  - Rapid evaluation of computed tomography (CT) scan is critical to rule out intracranial hemorrhage
  - Intracranial hemorrhage is contraindication for fibrinolytic therapy
  - Fibrinolytics have potential adverse effects
Seizure Disorders

• Brief alteration in behavior or consciousness
• Caused by abnormal electrical activity of one or more groups of neurons in brain
• 300,000 people in U.S. experience a first-time seizure each year
  – Highest incidence is among feverish children under 5 years of age

What feelings may parents experience after witnessing their child having a febrile seizure? How should you respond to those feelings?

Seizure Disorders

• Underlying cause not well understood
  – Believed to result from structural lesion or problems with brain metabolism
    • Results in changes in brain cell's permeability to sodium and potassium ions
    • When such changes occur, neurons' ability to depolarize and emit electrical impulse sometimes results in seizure activity
Seizure Disorders

• Causes
  – Stroke
  – Head trauma
  – Toxins (including alcohol or other drug withdrawal)
  – Hypoxia
  – Hypoperfusion
  – Hypoglycemia
  – Infection
  – Metabolic abnormalities
  – Brain tumor or abscess
  – Vascular disorders
  – Eclampsia
  – Drug overdose

• In prehospital setting, determining cause is less important than managing complications and recognizing whether seizure is reversible with therapy

• Tendency to have recurrent seizures is called epilepsy
  – Does not include seizures that arise from correctable or avoidable causes, such as alcohol withdrawal

Seizure Types

• All seizures are pathological and never considered to be normal
  – May arise from almost any region of brain and therefore have many clinical manifestations
  – Two most common types are generalized seizures and partial (focal) seizures
Generalized Seizures

• Does not have definable origin (focus) in brain, although focal seizures may progress to generalized seizures

• Includes
  – Absence seizures
  – Atonic seizures
  – Myoclonic seizures
  – Tonic-clonic seizures

Generalized Seizures

• Absence seizures (also known as petit mal seizures)
  – Occur most often in children between ages of 4 and 12
  – Characterized by brief lapses of consciousness without loss of posture
  – Often no motor activity is seen
  – Some children have eye blinking, lip smacking, or isolated contraction of muscles
  – Usually last less than 15 seconds
  – Patient is unaware of surroundings
  – Followed by patient’s immediate return to normal
  – Most patients have remission by age 20 but later may develop generalized tonic-clonic (grand mal) seizures

Generalized Seizures

• Atonic seizures
  – Produce abrupt loss of muscle tone, loss of posture, or sudden collapse (“drop attacks’’)
  – Can result in physical injury from falls
  – Children and adults will sometimes wear protective headgear
  – Tend to be resistant to drug therapy
Generalized Seizures

• Myoclonic seizures cause brief muscle contractions that usually occur at same time and on both sides of body
  – Occasionally involve one arm or one foot
  – Those who have disorder compare sensation to sudden jerk of foot during sleep

• Tonic-clonic seizures
  – Common
  – Associated with significant morbidity and mortality
  – May be preceded by aura
    • Olfactory or auditory sensation
    • Often patient recognizes aura as warning of imminent convulsion
  – Characterized by sudden loss of consciousness associated with loss of organized muscle tone

• Tonic-clonic seizures
  – Tonic phase is marked by sequence of extensor muscle tone activity (sometimes flexion) and apnea
  – Tongue biting and bladder or bowel incontinence may occur
  – Phase lasts only seconds
    • Followed by bilateral clonic phase (rigidity alternating with relaxation)
    • Usually lasts 1 to 3 minutes
Generalized Seizures

- Clonic phase
  - Massive autonomic discharge occurs
    - Results in hyperventilation, salivation, and tachycardia
  - After seizure, patient usually experiences period of drowsiness or unconsciousness
    - Resolves over minutes to hours

- Postictal phase
  - On regaining consciousness, patient often is confused and fatigued
  - May show signs of transient neurological deficit
  - Status epilepticus
    - Tonic-clonic seizures may be prolonged or may recur before patient regains consciousness

What could cause death following a grand mal seizure?
Partial Seizures

- Arises from identifiable cortical lesions
- Classified as simple or complex
  - Simple
    - Result mainly from seizure activity in motor or sensory cortex
    - Usually manifest as clonic activity limited to one body part

Partial Seizures

- Simple sensory seizures
  - Result in symptoms such as:
    - Tingling or numbness of body part
    - Abnormal visual, auditory, olfactory, or taste symptoms

Partial Seizures

- Patients generally do not lose consciousness
  - Usually maintain somewhat normal mental status
  - Seizure focus may spread and lead to generalized tonic-clonic seizure
  - Jacksonian seizure
    - Activity that spreads in orderly way to surrounding areas
Partial Seizures

- Complex partial seizures
  - Arise from focal seizures in temporal lobe (psychomotor seizures)
  - Manifest mainly as changes in behavior
  - Preceded by aura
  - Followed by abnormal repetitive motor behavior (automatisms)
    - Lip smacking, chewing, or swallowing

Partial Seizures

- Complex partial seizures
  - Patient will have no memory of event
  - Usually are brief, lasting less than 1 minute
    - Patient usually regains normal mental status quickly
  - May progress to generalized tonic-clonic seizure

Seizure Assessment

- Assessment process is determined by patient’s seizure state
  - In most cases, patient’s seizure has ended before paramedics arrive
  - If possible, assessment should include thorough history and physical examination, including neurological evaluation
History

• If patient is in postictal phase of seizure, information can be gathered from family members or bystanders who witnessed event
  • Components
    — History of seizures
      • Frequency
      • Compliance in taking prescribed medications (e.g., phenytoin, phenobarbital)
      • Use of home medicines to control seizures (herbal medicines, vitamins)

History

• Components
  — Description of seizure activity
    • Duration of seizure
    • Typical or atypical pattern of seizure for the patient
    • Presence of aura
    • Generalized or focal
    • Incontinence
    • Tongue biting

History

• Components
  — Recent or past history of head trauma
  — Recent history of fever, headache, nuchal rigidity (neck stiffness with flexion, suggesting meningeal irritation)
  — Past significant medical history
    • Diabetes
    • Heart disease
    • Stroke
Physical Examination

• During physical examination, maintain patent airway
• Be alert for signs of trauma (head and neck trauma, tongue injury, oral lacerations)
  – Injuries may have occurred before or during seizure
  – Inspect patient’s mouth for gingival hypertrophy (swelling of gums)
    • Sign of chronic phenytoin therapy

Physical Examination

• Other components
  – Level of sensorium, including presence or absence of amnesia
  – Cranial nerve evaluation, particularly pupillary findings
  – Motor and sensory evaluation, including coordination (abnormalities may be caused by metabolic disturbances, meningitis, intracranial hemorrhage, and drug use)

Physical Examination

• Other components
  – Evaluation for hypotension, hypoxia, and hypoglycemia
  – Presence of urine or feces (suggesting bladder or bowel incontinence)
  – Automatisms
  – Cardiac dysrhythmias
What are signs and symptoms of phenytoin toxicity?

**Syncope vs. Seizure**

- **Syncope**
  - Complete loss of consciousness caused by temporary reduction in cerebral blood flow
- **May be difficult to determine whether patient has experienced syncopal episode or seizure**
- **Main difference is in symptoms patient experiences before and after event**

**Seizure Management**

- **Protect patient from injury**
  - Remove obstacles in patient’s immediate area
  - If necessary, patient can be moved to safe environment such as a carpeted or soft, grassy area
  - At no time should patient with seizure activity be restrained, nor should objects be forced between patient’s teeth to maintain an airway
Seizure Management

- Restraining activity may harm patient or paramedic crew
  - Forcing objects into oral cavity in effort to secure airway or prevent patient from biting tongue may evoke vomiting, aspiration, or spasm of larynx
  - Placement of a nasopharyngeal airway along with end-tidal CO₂ monitoring should be considered

Seizure Management

- Most patients with isolated seizure can be properly managed in postictal phase by being placed in lateral recumbent position
  - Allows drainage of oral secretions and aids suctioning (if needed)
  - Administer supplemental O₂ via nonrebreather mask
  - Patient should be moved to quiet place (away from onlookers)
    - Often are embarrassed or self-conscious after seizure, especially if incontinence has occurred
    - Be sensitive to physical and emotional needs of patient

Seizure Management

- All seizure patients should be encouraged to seek care
  - Some patients should always be transported to emergency department for care and evaluation by physician
    - Includes patients who have history of seizures but who experienced seizure that is different from usual one, and patients with seizure that is complicated by unusual event (e.g., trauma)
    - All patients who have experienced seizure for first time should be transported to emergency department for evaluation by physician
Seizure Management

• All seizure patients should be encouraged to seek care
  – Depending on patient’s status and seizure history, IV line may be necessary to administer drug therapy
  • Few patients who experience isolated seizure require drug therapy in prehospital setting

Status Epilepticus

• Ongoing seizure activity that lasts 30 minutes or longer
• Term also refers to recurrent seizures without period of consciousness between them
• True emergency
  – Without immediate management, can result in
    • Permanent neurological damage
    • Respiratory failure
    • Death

Status Epilepticus

• Associated complications
  – Aspiration
  – Brain damage
  – Fracture of long bones and spine
• Most common cause in adults is failure to take prescribed anticonvulsant medications
Status Epilepticus Management

• Priorities include
  – Securing airway and providing ventilatory support
  – Protecting patient from injury
  – If indicated, transporting patient to medical facility for evaluation by physician
  – Stopping seizure activity with anticonvulsant medications (e.g., diazepam, lorazepam, or midazolam)

• After airway has been secured with oral or nasal adjuncts (or with intubation of trachea during flaccid period between seizures)
  – Administer high-concentration O₂
  – Support ventilation with bag-valve device
  – Establish IV line to keep vein open and secured well with tape and roller bandage
  – Draw sample of patient’s blood for laboratory analysis (per protocol)

• Medications administered in prehospital setting may include
  – 50 percent dextrose by slow IV infusion (controversial unless hypoglycemia is confirmed) to replace blood glucose lost during seizure activity or to correct hypoglycemia that caused seizure
  – Lorazepam, diazepam, or midazolam (IV route preferred) to stop spread of seizure focus
    • If vascular access cannot be established, lorazepam may be given IM
    • Preferred drug choice followed by diazepam and then midazolam
Status Epilepticus Management

• While administering drugs, closely monitor patient’s BP and respiratory status
  – Be prepared for respiratory arrest
  – If BP begins to fall or if respiratory rate or effort decreases, stop drug therapy and consult with medical direction

Headache

• Headaches are painful and bothersome
  – Most are minor health concerns and are easily managed with analgesics
• Headaches are categorized according to underlying cause

Headache

• Types
  – Tension headache
  – Migraine
  – Cluster headache
  – Sinus headache
Headache

- Therapies
  - Prescription and over-the-counter medications
  - Herbal remedies
  - Meditation
  - Acupressure
  - Aromatherapy

Headache

- Extremely common medical complaint
  - 40 percent of all Americans will have serious headache at some time during their lives
- Pain associated with headaches arises from meninges and from scalp and its blood vessels and muscles

Headache

- Tension headaches
  - Caused by muscle contractions of face, neck, scalp
  - Causes
    - Stress
    - Persistent noise
    - Eyestrain
    - Poor posture
Headache

• Tension headaches
  – Pain (usually described as dull, persistent, and nonthrob) may last for days or weeks
  – Can cause variable degrees of discomfort
  – Can be short-lived and infrequent, or chronic in nature
  – Most can be managed effectively with analgesics such as aspirin, acetaminophen, ibuprofen

Headache

• Migraines
  – Severe, incapacitating headaches
  – Often preceded by visual and/or GI disturbances
  – Usually begin with intense, throbbing pain on one side of head that may spread
  – Often accompanied by nausea and vomiting
  – Symptoms associated with constriction and dilation of blood vessels that may be brought on by imbalance of serotonin or hormone fluctuations

Headache

• Migraines
  – Can be triggered by excessive caffeine use, various foods, changes in altitude, and extremes of emotions
  – Medications prescribed
    • Beta blockers
    • Calcium channel blockers
    • Antidepressants
    • Serotonin-inhibiting drugs
Headache

• Cluster headaches
  – Occur in bursts (clusters)
  – Often begin several hours after person falls asleep
  – Pain may be severe
    • Usually located in and around one eye
    • Generally accompanied by nasal congestion and tearing
  – Painful episode often lasts 30 minutes to 2 hours
  – Then diminishes or disappears, recurring day or so later
  – May occur every day for weeks or months before going into long periods of remission

Headache

• Cluster headaches
  – Also known as histamine headaches
    • Associated with release of histamine from body tissues
  – Marked by symptoms of
    • Dilated carotid arteries
    • Fluid accumulation under eyes, tearing or lacrimation
    • Rhinorrhea

Headache

• Cluster headaches
  – Managed with
    • Antihistamines
    • Corticosteroids
    • Calcium channel blockers
  – Seem to be more common in heavy smokers than in nonsmokers
  – Alcohol consumption and certain foods also may be implicated
  – Vast majority of sufferers are men
Headache

• Sinus headaches
  – Characterized by pain in forehead, nasal area, eyes
  – Often produce feeling of pressure behind face
  – Allergies or inflammation or infection of membranes lining sinus cavities usually are responsible for discomfort
  – Managed with medications such as analgesics, antihistamines, antibiotics to treat infection

Headache Management

• Important assessment findings
  – Patient’s general health
  – Previous medical conditions
  – Medications used
  – Previous experience with headaches
  – Time of onset

Headache Management

• Prehospital care is mainly supportive
  – Transport of patient for evaluation by a physician may be indicated
    • These patients will often have light sensitivity
    • Lights in ambulance should be dimmed
Lesson 25.3
Neoplasm, Brain Abscess, and Degenerative Neurological Disease

Learning Objective

• Describe the pathophysiology, signs and symptoms, and specific management techniques for each of the following neurologic disorders: coma, stroke and intracranial hemorrhage, seizure disorders, headaches, brain neoplasm and brain abscess, and degenerative neurological diseases.

CNS Tumors

• Include both brain tumors and spinal cord tumors
• Incidence of tends to increase up to age 70 and then decreases
• Second most common group of tumors in children
CNS Tumors

- Brain tumor, or neoplasm, is mass in cranial cavity
  - Mass may be either malignant or benign
  - Heredity may play a role in development of brain tumors
  - Associated with several risk factors
    - Exposure to radiation
    - Tobacco use
    - Dietary habits
    - Some viruses
    - Use of some medications

CNS Tumors

- Effects of tumor depend on its size, location, and growth rate, and whether any evidence of hemorrhage or edema exists
- Brain tumors may cause local and generalized manifestations
  - Local effects are caused by destructive action of tumor on particular site in brain and by compression, which reduces cerebral blood flow
CNS Tumors

• These effects are varied and may include the following
  – Seizures
  – Visual disturbances
  – Unstable gait
  – Cranial nerve dysfunction

CNS Tumors

• Lesions inside cranial vault produce pain by distending or stretching arteries and other pain-sensitive structures of head and neck
  – Headache may be present but often is late finding in absence of hemorrhage, which may cause a sudden onset of pain
  – Main treatment for cerebral tumor is surgical or radiosurgical excision
  – Surgical decompression may be used if total excision is not possible
  – Chemotherapy and radiation also may be used

CNS Tumors

• Brain abscess
  – Accumulation of purulent material (pus) surrounded by capsule within brain
  – Develops from bacterial infection that often begins in nasal cavity, middle ear, or mastoid cells
  – May develop after surgery or penetrating cranial trauma, especially when bone fragments are retained in cranial tissue
  – Clinical manifestations are associated with intracranial infection (e.g., fever)
  – Associated with expanding intracranial mass (e.g., nausea, vomiting, seizures, and changes in mental status)
CNS Tumors

- Brain abscess
  - Headache is most common early symptom
  - Removal of fluid accompanied by antibiotic therapy generally is recommended to manage
  - Incidence is about 1 per 100,000 hospital admissions
  - Two times as common in men as in women
  - Median age for abscess formation is 30 to 40 years

CNS Tumors

- Spinal cord can also become compressed
  - In absence of trauma, compression of spinal cord can occur from bone, blood, abscesses, tumors, or a ruptured disk
  - Compression of cord can disrupt normal functions from pressure exerted on roots of spinal nerves
  - Can occur suddenly, causing immediate symptoms
  - May also occur gradually over weeks to months

CNS Tumors

- Slight compression may cause mild symptoms
  - Back pain (with or without radiation to leg or foot)
  - Slight muscle weakness
  - Tingling in extremities
  - In men, difficulty in urinating and erectile dysfunction may occur
  - If cause of compression is cancer, abscess, or hematoma, back may be tender to touch in affected area
CNS Tumors

- Slight compression may cause mild symptoms
  - Significant compression of cord may block nerve impulses
    - Can result in severe muscle weakness, numbness, retention of urine, and loss of bladder and bowel control
    - If all nerve impulses are blocked, paralysis and complete loss of sensation may result

CNS Tumors

- Definitive care is determined by cause of compression
- Physician care may include high doses of IV steroids to reduce inflammation, antibiotics, radiation, and other therapies
- Surgery may be required to relieve compression and prevent permanent nerve damage

CNS Tumor Management

- Prehospital care
  - Provide comfort and emotional support during patient transport to managing seizure activity
  - Provide airway, ventilatory, and circulatory resuscitation
  - Focused history should be obtained and neurological evaluation should be performed
CNS Tumor Management

• Elements of focused history
  – Past significant medical history (e.g., surgical removal of a tumor, radiation therapy)
  – History and description of any headache
  – Dizziness or loss of consciousness
  – Seizure activity

CNS Tumor Management

• Elements of focused history
  – GI disturbances (vomiting, diarrhea)
  – New onset of incoordination, difficulty walking, or maintaining balance
  – Behavioral or cognitive changes
  – Weakness or paralysis
  – Vision disturbances

Degenerative Neurological Diseases

• Some diseases may involve:
  – Schwann cells
  – CSF
  – Axons of CNS
• Others may result from circulatory and immunological disorders and exposure to bacterial toxins and chemicals
Degenerative Neurological Diseases

- Specific neurological diseases
  - Dementia
  - Alzheimer’s disease
  - Pick’s disease
  - Huntington’s disease
  - Creutzfeldt-Jakob disease
  - Muscular dystrophy
  - Multiple sclerosis
  - Guillain-Barré syndrome

Degenerative Neurological Diseases

- Specific neurological diseases
  - Dystonia
  - Parkinson disease
  - Cranial nerve disorders
  - Bell’s palsy
  - Amyotrophic lateral sclerosis
  - Peripheral neuropathy
  - Spina bifida

Dementia

- Slow, progressive loss of awareness of time and place
  - Usually involves inability to learn new things or recall recent events
  - Often is result of brain disease caused by strokes, genetic or viral factors, and Alzheimer’s disease
  - Irreversible
  - Eventually results in full dependence on others as result of the progressive loss of cognitive functioning
  - Patients often try to “cover up” their memory loss by confabulation (inventing stories to fill gaps in memory)
Dementia

- Sudden outbursts or embarrassing conduct may be first obvious signs of dementia
  - Eventually regress to “second childhood”
    - Need full care for feedings, toileting, and physical activity
- Present in about 50% of nursing home residents and affects, to some degree, about 20% of those over 80 years of age
- Prehospital care is primarily supportive

Alzheimer’s Disease

- Condition in which nerve cells in cerebral cortex die and brain substance shrinks
  - Most common cause of dementia
  - Responsible for majority of cases in persons over 75 years of age
  - 5.3 million Americans are living with disease
  - Does not cause death directly
    - Patients ultimately stop eating and become malnourished and immobilized
    - Prone to intercurrent infections

Alzheimer’s Disease

- Cause not known
  - Possible causes
    - Abnormalities in glutamate metabolism
    - Chronic infection
    - Toxic poisoning by metals
    - Reduction in brain chemicals (e.g., acetylcholine)
    - Genetics
Alzheimer’s Disease

• Early symptoms
  – Memory loss
  • Ability to make and recall new memories
  – As disease progresses, agitation, violence, and impairment of abstract thinking occur
  – Judgment and cognitive abilities begin to interfere with work and social relations
  – In advanced stages, patients often become bedridden and totally unaware of their surroundings

• Once patient is bedridden, bed sores, feeding problems, and pneumonia shorten patient’s life
• No cure exists
• Treatment mainly consists of medications to help slow progression of disease, and nursing and social care for patient and relatives

Pick’s Disease

• Rare neurodegenerative disease
• One of causes of frontotemporal dementia: disease associated with shrinking of frontal and temporal anterior lobes of brain
• Associated with changes in behavior or problems with language
Pick’s Disease

• Changes manifest in symptoms of behavior that can be either impulsive (disinhibited) or apathetic
  – Inappropriate social behavior
  – Lack of social tact
  – Lack of empathy
  – Distractibility
  – Loss of insight into the behaviors of oneself and others

Pick’s Disease

• Changes manifest in symptoms of behavior that can be either impulsive (disinhibited) or apathetic
  – Increased interest in sex
  – Changes in food preferences
  – Agitation or, conversely, blunted emotions
  – Neglect of personal hygiene
  – Repetitive or compulsive behavior, and decreased energy and motivation

Pick’s Disease

• Other features
  – Language disturbance, including difficulty making or understanding speech
  – Spatial skills and memory remain intact
  – Strong genetic component to disease
  – Frontotemporal dementia often runs in families
### Pick’s Disease

- Other features
  - No treatment is known to slow progression of disease and outcome is poor
  - Some patients are treated with behavior modification and antidepressants
  - Most require institutionalized care
  - Prehospital care for these patients is primarily supportive

### Huntington’s Disease

- Results from genetically programmed degeneration of neurons in brain
  - Causes uncontrolled movements, loss of intellectual faculties, emotional disturbance
  - Also known as Huntington’s chorea
  - Rare, inherited disease passed from parent to child

### Huntington’s Disease

- Early symptoms
  - Mood swings
  - Depression
  - Irritability
  - Memory loss
  - Inability to make decisions
Huntington’s Disease

- As disease progresses, concentration on intellectual and personal tasks becomes increasingly difficult
  - May be unable to feed themselves or swallow food or water
  - Rate of disease progression and age of onset vary from person to person
  - Medications are used to manage symptoms, but course of disease cannot be altered
  - Prehospital care is primarily supportive

Creutzfeldt-Jakob Disease

- Rare, fatal brain disorder
- Affects about 1 person in every 1 million people per year worldwide
  - About 200 cases per year in U.S.
  - Usually appears in later life and runs rapid course
  - Typically, onset of symptoms occurs at about age 60 and about 90 percent of patients die within 1 year

Creutzfeldt-Jakob Disease

- Characterized by rapidly progressive dementia
  - Initially have problems with muscular coordination
  - Often experience personality changes, involuntary movements, impaired memory, and poor judgment
  - Some develop blindness
  - As illness progresses, patients eventually lose ability to move and speak, some may become comatose
  - Pneumonia and other infections often occur and can lead to death
  - No treatment can cure or control disease
  - Prehospital care is primarily supportive
Muscular Dystrophy

- Inherited muscle disorder
  - Marked by slow but progressive degeneration of muscle fibers
  - Different forms of disease are classified by
    - Age symptoms appear
    - Rate disease progresses
    - Way inherited

Muscular Dystrophy

- Duchenne muscular dystrophy
  - Most common type
  - Caused by absence of dystrophin, a protein that helps keep muscle cells intact
  - Affects about 1 of every 3,500 to 5,000 male children
  - Inherited through recessive sex-linked gene
    - Only males are affected
    - Only females can pass on disease

Muscular Dystrophy

- Often first diagnosed by child’s physician, who notices that child is slow in learning to sit up and walk
  - Confirmed through
    - Blood tests that reveal high levels of enzymes released from damaged muscle cells
    - Nerve conduction studies
    - Sometimes with muscle biopsy
  - Rarely diagnosed before age 3
Muscular Dystrophy

- As disease progresses, child tends to walk with waddle and has difficulty climbing stairs
  - Muscles (especially those in calves) become bulky as wasted muscle is replaced by fat
  - By about age 12, affected children are no longer able to walk
  - Few survive their teenage years
    - Death usually results from pulmonary infections and heart failure

Muscular Dystrophy

- No effective treatment exists
- Parents or siblings of affected child should receive genetic counseling
- Some types can be diagnosed before birth
  - Done through blood analysis and amniocentesis (testing of amniotic fluid)

How can you determine a child’s baseline level of functioning?
What is the patient who has been receiving long-term steroid therapy at risk for?

Multiple Sclerosis

- Progressive disease of CNS
- Scattered patches of myelin in brain and spinal cord are destroyed
- Cause unknown
  - Thought to be autoimmune disease in which body’s defense system begins to treat myelin in CNS as foreign, gradually destroying it (demyelination), with subsequent scarring and nerve fiber damage

Multiple Sclerosis

- Most common acquired disease of nervous system in young adults
  - About 400,000 Americans have disease, each week 200+ people in U.S. are diagnosed
  - Ratio of women to men is 3 to 2
  - Symptoms vary according to parts of brain and spinal cord affected
Multiple Sclerosis

- Symptoms
  - Numbness and tingling
  - Paralysis and incontinence
  - May last several weeks to several months

Multiple Sclerosis

- Damage to white matter in brain may lead to
  - Fatigue
  - Vertigo
  - Clumsiness
  - Unsteady gait
  - Slurred speech
  - Blurred or double vision
  - Facial numbness or pain

Multiple Sclerosis

- Some patients may have mild relapses and long symptom-free periods throughout life
  - Others may gradually become disabled from first attack and are bedridden and incontinent in early middle life
- Usually diagnosed by ruling out other diseases
  - Diagnostic tests
    - Lumbar puncture
    - CT scanning
    - Magnetic resonance imaging (MRI) studies
Multiple Sclerosis

- Management
  - Medications
    - Corticosteroids
    - Antidepressants
    - Immune system medications
    - Help to control symptoms of acute episode and to prevent exacerbation
  - Physical therapy to help maintain mobility and independence
  - No cure exists

Guillain-Barré Syndrome

- Rare autoimmune disorder that affects body’s peripheral nervous system
- Initial symptoms
  - Weakness or tingling sensations in legs that may spread to arms and upper body
    - Can increase in intensity until muscles can no longer be used, causing total or near-total paralysis (“stocking and glove paralysis”)
    - At this stage, life-threatening

Guillain-Barré Syndrome

- Occurs few days or weeks after patient has had symptoms of respiratory or GI viral infection
  - Occasionally, surgery or vaccinations will trigger syndrome
  - Disorder can develop over course of hours or days, or it may take up to 3 to 4 weeks
  - Syndrome is managed by supporting patient’s vital functions
  - Some patients are treated with plasmapheresis (removal and replacement of plasma fluids) and high-dose immunoglobulin therapy
Dystonia

• Refers to local or diffuse changes in muscle tone (usually abnormal muscle rigidity)
  – Changes cause painful muscle spasms, unusually fixed postures, strange movement patterns
  – Localized dystonia may result from torticollis (painful neck spasm) or scoliosis (abnormal curvature of spine)

Dystonia

• More generalized dystonia results from various neurological disorders
  – Parkinson disease
  – Stroke
  – May be feature of schizophrenia or side effect of some antipsychotic drugs
  – Sometimes managed with medications such as benztropine or diphenhydramine
  • Help to reverse symptoms and to prevent recurrence

Parkinson’s Disease

• Caused by degeneration of or damage (of unknown origin) to nerve cells in basal ganglia in brain
  – Causes lack of dopamine
    • Prevents basal ganglia from modifying nerve pathways that control muscle contraction
    • Result is muscles that are overly tense
    • Causes tremor, joint rigidity, slow movement
Parkinson’s Disease

• Affects about 130 in 100,000 persons, and 60,000 new cases are diagnosed in U.S. each year
• Left untreated, progresses over 10 to 15 years to severe weakness and incapacity
• Leading cause of neurological disability in people over 60 years of age
• Currently about 1 million people in U.S. have disease

Parkinson’s Disease

• Usually begins as slight tremor in one hand, arm, or leg
  – In early stages, tremor is worse while limb is at rest
  – In later stages, affects both sides of body
    • Causes stiffness, weakness, and trembling of muscles

Parkinson’s Disease

• Symptoms
  – Unusual walking pattern (shuffling) that may break into uncontrollable, tiny running steps
  – Constant trembling of hands, sometimes accompanied by shaking of head
  – Permanent rigid stoop
  – Unblinking, fixed facial expression
  – Late in disease, intellect may be affected
  – Speech becomes slow and hesitant as well
  – Depression is common
Parkinson’s Disease

- Management
  - At first, counseling, exercise, and special aids in home
  - As disease progresses, may include various combinations of drugs that either mimic or replace dopamine (e.g., levodopa)
    - Provide relief from specific symptoms
  - May include brain surgery to reduce tremor and rigidity if medication therapy fails

Cranial Nerve Disorders

- Can affect connections between cranial nerve centers within brain
  - May lead to dysfunction of smell, vision, facial sensation or expression, taste, hearing, balance, among others

Cranial Nerve Disorders

- Cause often unclear, management is sometimes difficult
- Treatment includes use of drugs to inhibit nerve impulses and sometimes surgery if cause is tumor or lesion
- Prehospital care is primarily supportive
Cranial Nerve Disorders

• Trigeminal neuralgia
  – Also known as central pain syndrome
  – Infection or disease of trigeminal nerve (cranial nerve V)
  – Patients complain of paroxysmal episodes of excruciating pain (often described as recurrent bursts of electric shock) that affect cheek, lips, gums, or chin on one side of face
  – Episode usually is very brief, lasting only few seconds to minutes, but may be so intense that person is unable to function during attack

Cranial Nerve Disorders

• Trigeminal neuralgia
  – Pain usually begins from trigger point on face
  – Can be brought on by touching, washing, shaving, eating, drinking, talking
  – Unusual in people under age 50 but may be associated with multiple sclerosis in younger people
  – Attacks occur in bouts that may last weeks

Cranial Nerve Disorders

• Acoustic neuroma
  – Non-cancerous tumor that involves vestibular portion of eighth (VIII) cranial nerve
  – Because of its position in internal auditory canal, tumor may also compress other cranial nerves
  – Usually grows slowly
    • As it grows, presses against nerves that affect hearing and balance
Cranial Nerve Disorders

- Patients may be asymptomatic or may have mild symptoms that include loss of hearing on one side, tinnitus, and vertigo
- Can be difficult to diagnose because symptoms are similar to those of middle ear infections

Cranial Nerve Disorders

- Glossopharyngeal neuralgia
  - Believed to be caused by irritation of ninth (IX) cranial nerve
  - Often source of irritation is never identified
  - Possible causes
    - Pressure by blood vessels on glossopharyngeal nerve
    - Lesions at base of skull
    - Tumors or infections of throat and mouth

Cranial Nerve Disorders

- Glossopharyngeal neuralgia
  - Symptoms include serve pain in nose, ear, and throat
    - Discomfort often triggered by coughing, chewing, laughing, or swallowing
  - Treatment aimed at pain relief
    - Medications used to manage disorder include analgesics, anticonvulsants, and antidepressants
    - In rare cases, surgery may be needed to correct underlying cause of pain
Cranial Nerve Disorders

- Hemifacial spasm
  - Neuromuscular disorder characterized by frequent involuntary contractions of muscles on one side of face
  - Most often caused by blood vessel that presses on facial nerve (cranial nerve VII)
  - Can result from injury or tumor
  - Occurs in both men and women, more frequently affects middle-aged or elderly women

Bell’s Palsy

- Paralysis of facial muscles
  - Caused by inflammation of seventh cranial nerve
  - Usually is one sided and temporary
  - Often develops suddenly
  - Most common cause of facial paralysis, affecting 1 in 60 to 70 people in lifetime
Bell’s Palsy

- Cause of inflammation unclear
  - Associated with many past or present infectious processes
    - Lyme disease
    - Herpes viruses
    - Mumps
    - Infection with HIV virus
  - Stroke should be part of paramedic’s differential diagnosis

Bell’s Palsy

- Usually causes eyelid and corner of mouth to droop on one side of face
  - Sometimes associated with numbness and pain
  - Depending on which branches of nerve affected, taste may be impaired, or sounds may seem oddly loud
  - Management may involve use of antiviral and anti-inflammatory drugs to reduce inflammation of nerve, along with analgesics
Bell’s Palsy

- Recovery usually is complete within 2 weeks to 2 months
  - Key component of therapy
  - Protect affected eye from corneal drying and injury
  - May result because paralysis prevents eyelid from closing
  - Prevention of these conditions is best accomplished through use of lubricating ointments and eye patches

Should you diagnose and release a patient in the field who has Bell’s palsy?

Amyotrophic Lateral Sclerosis

- ALS, also called Lou Gehrig disease
  - Rare disorder (motor neuron disease)
  - Nerves that control muscular activity degenerate in brain and spinal cord
  - Usually affects people over age of 50
  - More common in men than women
  - One or two cases of ALS are diagnosed each year per 100,000 people in U.S.
  - About 10 percent of ALS cases are familial
Amyotrophic Lateral Sclerosis

- Motor neuron diseases may involve deterioration of both upper and lower neuron tracts
  - When only muscles of tongue, jaw, face, and larynx are involved, considered progressive bulbar palsy
  - When only corticospinal processes are affected, considered primary lateral sclerosis
  - When only lower motor neurons are affected, considered progressive spinal muscular atrophy
  - ALS is used to describe neuron signs that predominate in extremities and trunk

Amyotrophic Lateral Sclerosis

- Patients often first notice weakness in hands and arms
  - Accompanied by involuntary quivering (fasciculations)
  - Progresses to involve muscles of all four extremities and those involved in respiration and swallowing
  - In final stages of disease, patients often are unable to speak, swallow, or move
  - Awareness and intellect are maintained

Why is there a tendency to treat patients with ALS as if they have low intelligence?
Amyotrophic Lateral Sclerosis

- Death usually occurs 2 to 4 years after diagnosis
  - Due to involvement of respiratory muscles, aspiration pneumonia, and general inanition (starvation, failure to thrive)
  - In some cases, life can be prolonged through use of feeding tubes and ventilators
  - Care aimed at providing emotional support and easing discomfort

Peripheral Neuropathy

- Diseases and disorders that affect peripheral nervous system
  - Spinal nerve roots
  - Cranial nerves
  - Peripheral nerves

Peripheral Neuropathy

- Most arise from damage to or irritation of either axons or their myelin sheaths
  - Slows or fully blocks passage of electrical signals
- Classified according to site and distribution of damage
Peripheral Neuropathy

• Some have no identifiable cause
  – Others may be related to specific causes
    • Diabetes
    • Dietary deficiencies (especially of vitamin B)
    • Alcoholism
    • Uremia
    • Lead poisoning
    • Drug intoxication
    • Viral infection
    • Rheumatoid arthritis
    • Systemic lupus erythematosus
    • Malignant tumors (e.g., lung cancer)
    • Lymphomas
    • Leukemias
    • Inherited neuropathies (e.g., peroneal muscular atrophy)

• When possible, management is aimed at underlying cause
• If management is successful and cell bodies of damaged nerves have not been destroyed, full recovery is possible

Spina Bifida

• Congenital defect in which part of one or more vertebrae fails to develop completely
  – Leaves portion of spinal cord exposed
  – Can occur anywhere on spine
  – Most common in the lower back
Spina Bifida

• Cause unknown
  – Occurs in about 1 in every 1,000 births
  – Estimated 166,000 people in U.S. living with spina bifida

Spina Bifida

• Cause unknown
  – More likely to occur with extremes of maternal age
    • Woman who has given birth to one child with spina bifida is 10 times more likely than average woman to give birth to another affected child
    • Indicates need for genetic counseling

Spina Bifida Types

• Types
  – Spina bifida occulta
  – Meningocele
  – Myelomeningocele
  – Encephalocele
• Currently has no cure
  – Treatment includes surgery, medications, and physical therapy
  – Most patients live into adulthood
Spina Bifida Types

- Spina bifida occulta
  - Most common and least serious form
  - Little external evidence of defect
- Meningocele
  - Nerve tissue of spinal cord usually is intact and covered with membranous sac of skin
  - Usually does not cause functional problems
  - Requires surgical repair early in life

Spina Bifida Types

- Myelomeningocele
  - Severest form
  - Child often is severely handicapped
  - Marked by raw swelling over spine and malformed spinal cord that may or may not be contained in membranous sac
  - Legs often are deformed
  - Causes partial or complete paralysis and loss of sensation in all areas below level of defect
Spina Bifida Types

- Myelomeningocele
  - Associated abnormalities
    - Hydrocephalus (excess CSF in skull) with brain damage
    - Cerebral palsy
    - Epilepsy
    - Developmental delay

- Encephalocele
  - Very rare
  - Protrusion occurs through skull
  - Severe brain damage common
Spina Bifida Types

- Encephalocele
  - Associated abnormalities
    - Hydrocephalus (excess CSF in skull) with brain damage
    - Cerebral palsy
    - Epilepsy
    - Developmental delay

Polio

- Polio (poliomyelitis) caused by poliovirus
  - Virus attacks with variable severity
    - Not very apparent infection
    - Febrile illness without neurological aftereffects
    - Aseptic meningitis
    - Paralytic disease (including respiratory paralysis) and possibly death
  - Incidence has declined in U.S., Canada, and Europe since development of Salk and Sabin vaccines in 1950s

- May affect nonimmune adults and indigent children from other countries
  - Remains serious risk for anyone not vaccinated and traveling in southern Europe, Africa, or Asia
  - Vaccinations given during infancy
    - Usually given in doses at 2, 14, and 18 months of age in U.S.
    - Optional extra dose at 6 months and booster dose at 5 years
Polio

• People infected can pass large amounts of virus in their feces
  – May be spread directly or indirectly to others by fingers-to-food transmission and by airborne transmission

Polio

• Signs and symptoms
  – Differ in nonparalytic and paralytic forms
  – Fever, headache, sore throat, and malaise are common to both forms
  – Paralytic form
    • Generalized pain
    • Weakness
    • Muscle spasms
    • Paralysis of limbs and other muscles

Ask your older friends or relatives about their memory of the polio epidemic. How did it affect their lives?
Polio

• If infection spreads to brain stem, difficult or unable to swallow or breathe
  – Full recovery can be made from nonparalytic polio
  – Of those who become paralyzed, more than half eventually make full recovery
    • Some patients may develop “postpolio deterioration”
    • May have new weakness and pain from recovered muscles
    • Confirmed though CSF analysis, throat culture, or testing of fecal samples

Neurological Disorders
Differential Diagnosis

• Key process in differentiating is to first consider which disorders are most likely and most dangerous
• Signs and symptoms of various disorders often overlap, making diagnosis difficult
• Often little correlation between patient’s pain and seriousness of condition

Neurological Disorders
Differential Diagnosis

• Begins with obtaining thorough patient history and performing detailed physical examination
  – Combined with personal experience, will help identify signs and symptoms of primary illness
Neurological Disorders
Differential Diagnosis

• Major neurological conditions
  – Headache disorders such as migraine, cluster headache and tension headache
  – Seizure disorders
  – Neurodegenerative disorders, including Alzheimer’s, Parkinson’s, Huntington’s, and ALS
  – Cerebrovascular disease, such as transient ischemic attack and stroke
  – Cerebral palsy

Neurological Disorders
Differential Diagnosis

• Major neurological conditions
  – Infections of brain (encephalitis), brain meninges (meningitis), and spinal cord
  – Infections of peripheral nervous system
  – Neoplasms and tumors of brain and its meninges (brain tumors), spinal cord tumors, tumors of peripheral nerves (neuroma)

Neurological Disorders
Differential Diagnosis

• Major neurological conditions
  – Movement disorders such as Parkinson’s and Huntington’s
  – Demyelinating diseases of CNS, such as multiple sclerosis, and of peripheral nervous system, such as Guillain-Barré syndrome
  – Spinal cord disorders: tumors, infections, trauma, malformations
Neurological Disorders
Differential Diagnosis

- Major neurological conditions
  - Disorders of peripheral nerves, muscle (myopathy), and neuromuscular junctions
  - Traumatic injuries to the brain, spinal cord, and peripheral nerves
  - Altered mental status, encephalopathy, stupor, and coma
  - Speech and language disorders

Summary

- Human body’s ability to maintain state of balance, or homeostasis, results from nervous system’s regulatory and coordinating activities
  - Vertebral arteries and internal carotid arteries supply blood to brain
- Neurological emergencies may be related to structural changes or damage, circulatory changes, or alterations in intracranial pressure that affect cerebral blood flow

Summary

- Cerebral blood flow depends on cerebral perfusion pressure (CPP)
  - CPP decreases when mean arterial pressure (MAP) drops or when intracranial pressure increases
  - CPP = MAP − ICP
Summary

• Primary survey begins by determining patient’s level of consciousness and by ensuring an open and patent airway
  – Key elements of physical examination that may provide clues to nature of neurological emergency include patient history and history of event, vital signs, and respiratory patterns

Summary

• Neurologic exam may include assessment of AVPU, Glasgow coma scale, posturing or paralysis, reflexes, pupil size and response, and extraocular movements
• Coma is an abnormally deep state of unconsciousness
  – Patient cannot be aroused from this state by external stimuli
  – In general, two mechanisms produce coma: structural lesions and toxic-metabolic states

Summary

• Stroke is sudden interruption in blood flow to brain that results in a neurological deficit
  – Strokes can be classified as ischemic strokes or hemorrhagic strokes
  – Use stroke scale to assess for presence of stroke
  – Rapid transport to a stroke resource center (if available) is indicated
Summary

• Seizure is brief alteration in behavior or consciousness
  – Is caused by abnormal electrical activity of one or more groups of neurons in brain
  – In prehospital setting, determining cause of a seizure is not as important as other measures
    • Managing complications and recognizing whether seizure is reversible with therapy (e.g., it is caused by hypoglycemia)

Summary

• Four fairly common types of headaches are tension headaches, migraines, cluster headaches, and sinus headaches
• CNS tumor, or neoplasm, is a mass in cranial cavity or spinal cord
  – Can be either malignant or benign
  – Heredity may play a role in development of brain tumors
  – Associated with several risk factors, including exposure to radiation, tobacco use, dietary habits, some viruses, and use of some medications

Summary

• Brain abscess is a buildup of purulent material (pus) surrounded by a capsule within brain
  – Develops from bacterial infection; infection often starts in nasal cavity, middle ear, or mastoid bone
• Dementia is slow, progressive loss of awareness of time and place
  – Alzheimer’s disease is most common cause
  – Pick’s disease is another type of dementia
  – Associated with language disturbance
Summary

• Huntington’s disease causes degeneration of neurons in the brain and causes uncontrolled movements and intellectual and emotional impairment
• Creutzfeldt-Jakob disease is characterized by rapid progression of dementia
• Muscular dystrophy is an inherited muscle disorder marked by slow but progressive degeneration of muscle fibers; the cause is unknown

Summary

• Damage to white matter of the brain in multiple sclerosis may lead to fatigue, vertigo, clumsiness, unsteady gait, slurred speech, blurred or double vision, and facial numbness or pain
• Guillain-Barré syndrome is an autoimmune disorder that causes muscle weakness that progresses to paralysis that includes muscles of respiration

Summary

• Dystonia refers to local or diffuse changes in muscle tone
  – May cause painful muscle spasms, unusually fixed postures, strange movement patterns
• Parkinson’s disease usually begins as a slight tremor in one hand, arm, or leg
  – In later stages, disease affects both sides of body, causing stiffness, weakness, and trembling of muscles
Summary

- Central pain syndrome refers to infection or disease of the trigeminal nerve and causes intense pain of the face
- Acoustic neuroma is a non-cancerous tumor that affects the eighth cranial nerve and impairs balance and hearing
- Glossopharyngeal neuralgia is irritation of cranial nerve IX that causes pain in the nose, ear, and throat

Summary

- Hemifacial spasm results in involuntary contractions of muscles on one side of the face
- Bell’s palsy is paralysis of facial muscles
  - Caused by inflammation of the seventh cranial nerve
  - Usually one sided and temporary
  - Often develops suddenly

Summary

- Amyotrophic lateral sclerosis (ALS) is also called Lou Gehrig disease
  - Is one of a group of rare nervous system disorders
  - In these disorders, nerves that control muscular activity degenerate in brain and spinal cord
- Peripheral neuropathies usually arise from damage to or irritation of either axons or their myelin sheaths
  - Slows or fully blocks passage of electrical signals
Summary

• Spina bifida is a congenital defect in which part of one or more vertebrae fails to develop completely, leaving a portion of the spinal cord exposed

• Polio is caused by a virus
  – Severity of disease can range from unapparent infection, to febrile illness without neurological aftereffects, to aseptic meningitis, and finally to paralytic disease and possibly death

Questions?