Week 8 CNS: Brain Disorders

Convulsions: involuntary muscle contractions, may or may not be associated with seizures

Convulsions

- No specific pathology but a variety of potential causes. More a symptom than a condition
- Rapid muscle twitching or a broader extremity tremor.
- Can affect all muscle groups, including unconsciousness, or be seen focally, w/t loss of consciousness
- Possible causes: fever, infection (meningitis, encephalitis), head injury, stroke, reaction to certain meds, drugs, or toxins. A mental health issue may be the cause and must be treated with respect and dignity.
- Safety is the priority.
- Detailed information needed: duration, movement, body parts involved, preceding events. Ex.: eye closure during a convulsion is a reliable sign of a psychogenic nonepileptic seizure.

Patho of Seizure

- Uncontrolled electrical activity in the brain is caused by excessive neuron discharges.
- Caused by neuronal injury, metabolic or chemical changes, medication toxicities, or electrolyte imbalances.
- Ischemia: causes acidosis and potential electrolyte abnormality leading to seizure. Increased Ox demand during seizure leads to hypoxemia, depletion of glucose, and an increase in lactic acid.
- Electrolytes: Na, K, and others can lead to a decrease in the action potential threshold, causing increased depolarization. It also causes uncontrolled electrical activity, especially if hypoNa
- Direct trauma: causes edema, and changes in electrolytes, and pH. Need meds to prevent seizure
- Neurotransmitter: Because medications are often used to increase or decrease neurotransmitter activity, toxicities can lead to seizure activity. Serotonin syndrome, caused by medications that increase serotonin levels, has a potential adverse reaction to seizures.

A seizure does not equal a diagnosis of epilepsy. A seizure syndrome is confirmed by the presence of documented seizures on an electroencephalogram (EEG) or magnetic resonance imaging (MRI). According to the International Leagues Against Epilepsy (2022), criteria for diagnosing epilepsy include the following:

- two or more unprovoked (or reflex) seizures occurring more than 24 hours apart
- one unprovoked (or reflex) seizure and a probability of further seizures similar to the general recurrence risk (at least 60%) after two unprovoked seizures occurring over the next 10 years
- diagnosis of a seizure syndrome

Types of Seizure

- **Focal** seizures (partial seizures)
  - **Simple** partial seizures: The individual remains conscious and aware during the seizure. Symptoms involve twitching or sensory changes (such as taste, smell, or visual disturbances).
  - **Complex** partial seizures: These involve a change or loss of consciousness. Individuals may seem dazed and confused, perform repetitive actions, and not remember the seizure afterward.
- **Generalized** seizures
  - **Absence** seizures (petit mal): Brief, sudden lapses in attention or staring spells that might be mistaken for daydreaming. These are **more common in children**.
  - **Tonic** seizures: **Muscles** in the body become **stiff**, especially in the extremities, **leading to a fal**l if the person is standing.
  - **Clonic** seizures: **Repetitive, rhythmic jerks** that involve both sides of the body.
  - **Tonic-clonic** seizures (grand mal): Characterized by a **sudden loss of consciousness, body stiffening and sha**king, and sometimes loss of bladder control or biting the tongue.
  - **Atonic** seizures (drop): **Loss of muscle control, causing the person to collapse suddenly.**
  - **Myoclonic** seizures: **Sudden brief jerks or twitches of the arms and legs**.

Etiology of Seizure

- **Genetic inheritance**: Seizure disorders like epilepsy appear to be inherited in some families.
- **Structural brain abnormalities**: Space occupying tumors or blood outside the vascular space can cause an increased possibility of seizure activity, as seen in a **TBI**.

- **Metabolic imbalances**: **Elevated or reduced** electrolyte levels like **Na or glucose** may lead to seizures. Seizures may also arise **when** electrolyte imbalances are **too rapidly treated.**
- **Infectious causes**: Infection in and around the brain can lead to seizures. Any type of **meningitis** caused by an infectious organism increases the client's risk for a seizure.
- **Autoimmune disorders**: Conditions such as **autoimmune encephalopathy** can cause seizures.
- **Developmental disorders**: Seizures are sometimes seen in **autism** due to abnormal brain development.
- **Exposure to toxins or heavy metals**: **Mercury, arsenic, or lead** are common substances that precipitate a seizure.
- **Drug or alcohol use**: In excess, these substances can cause seizures. This includes methamphetamines, opiates, and other illicit substances. It can also include prescription medicine taken correctly for a specific condition.
- **Febrile seizures**: High temperatures and rapidly reducing those temperatures can cause seizures.
- **Unknown causes**: Until a cause is found, seizures of unknown etiology are considered **idiopathic** seizures.

Phases of Seizure

1. Prodromal: occurs hours or days before a seizure. S/S: fatigue, malaise, headaches
2. Aura: olfactory, visual, or emotional disturbance or hallucination may be experienced. **A warning sign.** Get prepared for help or move to a safe area.
3. Ictus: symptoms may range from staring into space to full convulsions. A client may experience a tonic phase, which includes muscle contractions with excessive muscle tone, or a clonic phase, which includes alternating contractions and relaxation of muscle.
4. Postictal: usually disoriented and/or confused and may experience fatigue, headaches, or muscle soreness. Can last minutes to two hours. In some cases, the presence of this phase can help distinguish a seizure from an alternate syncopal event.

Epileptic Seizures: clinical application

- Comprehensive health hx and physical, including mental health problems
- Acknowledging the client's concerns and fears is essential to any condition.
- History: description of the event(s), including onset, duration, frequency, and a detailed description of movement and level of consciousness through the process. Any preceding factors (aura), associated symptoms (loss of consciousness, postictal state), and potential triggers should be assessed. A family history of seizures or neurological conditions is also important to ask.
- Other questions: recent infections, potential for heavy metal exposure, high fevers, history of electrolyte imbalances, previous head injuries, or other underlying medical problems.
- General physical and neurological examination: to identify underlying conditions or neuro deficits.
- Full cranial nerve exam as well.
- Testing and referral: blood work, EEG, imaging

Epileptic Seizures: Risk factors

- **Genetic predisposition**: A family history of epilepsy significantly increases the risk to the client.
- **Head trauma**: Injuries to the head can lead to post-traumatic epilepsy. This is **often due to cerebral edema** or **sheer injury to neurons** in the brain. Sometimes, **anti-seizure medications are even started as a precaution** against potential seizures.
- **Tumors**: Brain tumors are space-occupying lesions within the skull that can increase seizure risk.
- **Vascular events**: Abnormal blood vessels in the brain, bleeding into the skull cavity, or a cerebral vascular accident can be a risk factor for seizures.
- **Infections**: While meningeal infections like **meningitis** can increase the risk of seizures, other infections, including **neurocysticercosis** (a common opportunistic infection associated with HIV)
- **Developmental disorders**: Because developmental disorders can be caused by **delayed brain development or brain injury**, seizures are more likely. This can include conditions like **autism, cerebral palsy, and neurofibromatosis,** which can be associated with a higher risk of seizures.
- **Age**: **Children**, especially very young or premature infants, and **older adults** have an increased risk of seizures.
- **Alcohol or drug misuse**: Too much or a combination of some recreational or prescription drugs and alcohol can be risk factors for seizures.

Epileptic Seizures: Clinical Manifestations spontaneous or triggered

- **Triggers:** stress, alcohol, bright flashing lights (video games), loud noises, change in meds (bupropion increases the risk of seizure), cigarettes, TV/computer, hormonal imbalance
- Once triggered, **aura,** a distinct smell, taste, or sound, usually lasts a few minutes
- Symptoms depend on the type of seizure: open eye, front-to-back neck movement, unresponsive to external noxious stimuli during event
    - Generalized: tonic-clonic jerking, limb movement of the whole body
    - Absence seizure: brief loss of consciousness, often without a loss of motor function (staring off into space, or daydreaming)
    - Focal: with or without loss of consciousness. **Symptoms can be isolated**, such as twitching or jerking of one limb. There **may even be speech symptoms** if the seizure occurs in the brain's language centers.
    - Postictal state: confusion, disorientation, fatigue, headache, and/or temporary weakness or paralysis. **A key sign differentiating** a seizure from other types of loss of consciousness is the **length of the postictal state**, which typically lasts **five to ten minutes**.

Epileptic Seizures: Dx

- Blood tests: electrolyte imbalance (**Na and glucose)**, infection (high WBC), heavy metal (arsenic, lead, mercury), drug and alcohol testing
- EEG: most useful when a patient experiences a seizure during the recording. Induced seizure during recording with flashing lights or other techniques.
- MRI and CT: identify structural brain abnormalities, such as brain injury, blood vessel abnormality, tumor

Epileptic Seizures: Tx goals are cessation and prevention. Benzo (Diazepam) in acute situations and no PO meds.

- Safety first: supporting the head and body with pillows or padding. Airway patency is critical. Side-lying position
- Antiepileptic drugs: choice based on type, age, side effects, and potential drug interactions. Side effects may affect compliance. May require blood tests and dosage adjustment to maintain a therapeutic level
- Dietary therapies: The ketogenic diet, high in fats and low in carbohydrates, helps reduce seizures in some clients, particularly children.
- Education: medication adherence, lifestyle modifications, and seizure safety. NOT operating any type of motor vehicle or machinery until they have been seizure-free for a specified time and have been medically cleared.
- Vagus nerve stimulation and responsive neurostimulation: modulate brain activity through electrical stimulation to prevent seizures and can be used in clients who do not respond to other treatments.
- Surgical interventions: resection or ablation surgery may be useful for clients experiencing isolated areas of seizure activity.

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Patho of Nonepileptic Seizures

- Psychogenic nonepileptic seizures (PNES): resemble an epileptic seizure but do not share the same physiology. Instead, PNES are considered a sign of mental distress == physical manifestations of psychological conflict, stress, or trauma, without the abnormal neuronal activity seen in epileptic seizures.
- Related to faulty sensorimotor processing, emotional regulation, or neural response to stress.

Nonepileptic Seizures: clinical application

- Health history including mental health: onset, duration, context, recent stressors, traumatic events, or psychological issues.
- The absence of neuro findings in epilepsy may suggest PNES
- Diagnostic testing: hypo- or hyperthyroidism, alcohol or drug misuse, or other potential causes of a seizure.

Often, PNES is misdiagnosed and/or mistreated. The most prominent barriers to diagnosis and treatment include provider misperceptions, poor client engagement with treatment, lack of acceptance, or lack of access to care. It is essential that diagnosis and treatment are treated with empathy and respect while acknowledging client concerns and fears (Tilahun & Bautista, 2022).

Nonepileptic Seizures: Risk Factors

- psychological and/or emotional trauma
- physical and/or sexual abuse
- depression and/or anxiety
- post-traumatic stress disorder
- significant situational stress

- interpersonal conflicts
- seizures refractory to other treatments

Nonepileptic Seizures: Clinical Manifestations appear like an epileptic seizure. Potential clues that suggest a psychogenic cause include:

- **unequal or fluctuating movements** between the client's right and left side
- signs of **consciousness during** the episode; this can include intermittent consciousness
- **side-to-side neck movement**
- **breaking a fall** by holding onto a wall or furniture
- easing oneself to the ground during the event
- **eyes are closed:** closed eyes during the event are much more likely related to a psychogenic nonepileptic seizure
- **yelling** verbal phrases
- a **startle response** caused by an environmental stimulus like noise or intense light
- **no postictal confusion or sleepiness**
- may be an emotional or psychological stressor that starts the event
- Uncoordinated or exaggerated movement

Nonepileptic Seizures: Dx ensuring these episodes are NOT caused by a neurological seizure disorder and include:

- detailed health history and physical examination
- **Video EEG monitoring, a gold standard** for diagnosis, allows for observation during an episode to assess for the presence of behaviors consistent with PNES
- **Mental health evaluation** to identify underlying stressors or psychiatric conditions with specialist referral
- **Blood work** to test for other causes of seizures, including a WBC, levels of heavy metals, and electrolyte testing
- Imaging studies to review other potential causes of seizures

Nonepileptic Seizures: Tx addresses the underlying mental health stressors and uses a non-pharm approach:

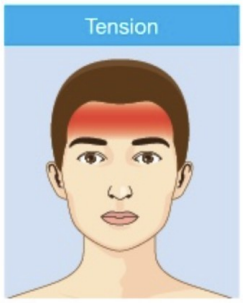
- **Psychotherapy**, especially cognitive-behavioral therapy (**CBT**), to develop coping mechanisms for stress and address any underlying mental health issues
- **Stress management and relaxation techniques** to reduce the frequency of episodes
- **Mental health treatment** for coexisting conditions such as depression or anxiety
- **Education** to reduce stigma and misunderstandings

In some cases, medications to treat coexisting mental health conditions are prescribed following a thorough evaluation by a healthcare provider experienced in treating PNES.

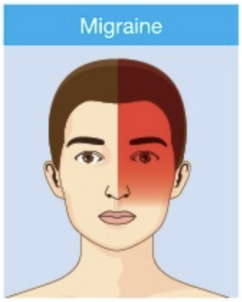
Headache Syndrome: primary and secondary

Patho of headaches

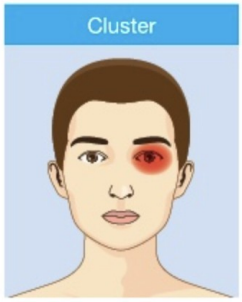
- All types of headaches result from conditions that impact the blood vessels, nerves, and muscles that support the head and neck (e.g., inflammation, and trauma). The brain itself has no pain receptors.
- **Primary**: **due to** inflammation in the blood vessels, nerves, and muscles in and around the head and neck. NOT dangerous. The most common types of primary headaches include **migraine, tension, and cluster headaches**.



Tension headache: A tension headache is often described as a tight band surrounding the head, including the forehead, ears, and occipital areas.

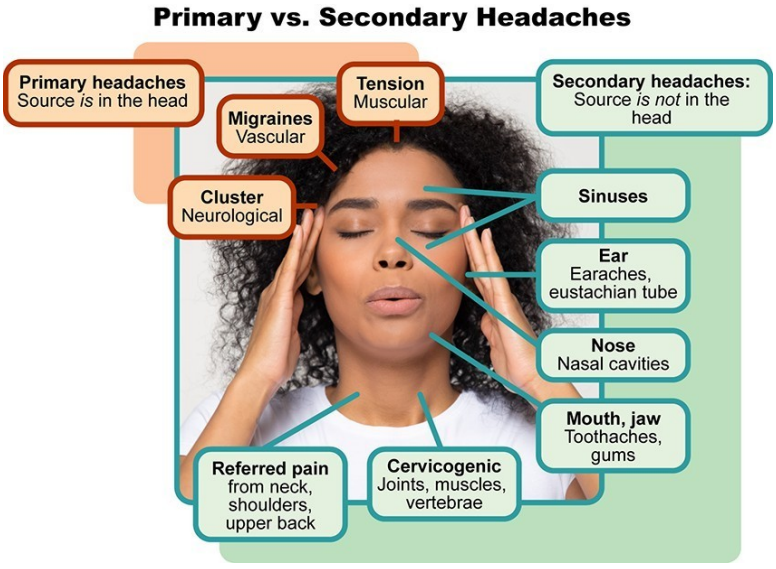


Migraine headache: Changes within the brain cause unilateral pain due to activation of the trigeminal nerve. Migraine pain can be severe, throbbing, and debilitating.



Cluster headache: A cluster headache is a group of idiopathic headaches associated with trigeminal neuralgia that occur around one eye. The pain is deep, explosive, and excruciating with a rapid onset and a length of 30 minutes to 3 hours.

- Secondary: occurs when another health condition triggers pain-sensitive areas in the neck and head. Can be more debilitating than primary. Typically **starts abruptly**, can be **excruciating**, and may be a **warning sign of a more serious underlying condition**, including a brain tumor, bleeding within the brain, infectious encephalitis or meningitis, or injury of the neck or brain. Causes:
  - Intracranial Causes
    - Tumors: Gradual onset, worsens over time
    - Hemorrhage: Sudden, severe headache
    - Infections: Associated with fever, neck stiffness, and neurological deficits
  - Vascular Causes
    - Hypertension: Dull, persistent headache
    - Subarachnoid Hemorrhage: Sudden, severe headache ("thunderclap") with vomiting
    - Temporal Arteritis: Unilateral, throbbing headache associated with scalp tenderness
  - Inflammatory Causes
    - Meningitis: Severe headache with fever, neck stiffness, and photophobia
    - Encephalitis: Headache, altered mental status, seizures
  - Cervicogenic Headaches
    - Arise from the cervical spine
    - Pain radiates from the neck to the head
    - Often triggered by neck movements
  - Medication Overuse Headaches
    - Result from overuse of analgesics or acute headache medications



    - Daily, persistent headaches

Tension Headache: Patho

- Episodic, <15 days/month, or chronic >15 days/months for > 3 months
- More likely for older teen females and adults
- Contraction of the muscles in the head or neck in response to stress, depression, injury, or anxiety causes muscular tension and pain.

Tension Headache: clinical application

- Pt % recurring headaches for 6 months, pain as constant and dull pressure around the head, often concentrated in the temples. 4-5 times per week, last about 2 hours each. Job with high stress and tight deadlines. Sleep deprivation, no regular exercise.
- Labs:
    - **CBC:** Low Hgb levels may indicate anemia, which can contribute to hypoxia and inflammation. An elevated WBC count may indicate an active brain infection or meninges infection.
    - I**nflammatory Markers**: An increased ESR)is a nonspecific marker of inflammation and may be elevated if inflammation is the cause of the headaches. James's ESR is elevated.
    - **CMP**: This panel can rule out underlying causes of the headache (e.g., electrolyte imbalances).
- Dx and Tx: tension headaches. Amitriptyline and OTC ibuprofen. Recommend moderate exercise
- Counseling and f/u: headache diary (frequency, duration, severity).

Tension Headache: Risk Factors

- Activities during which the head is kept in one position without moving for an extended time (e.g., sleeping, reading, working on the computer, sewing) can trigger a tension headache. And other triggers are:
- Emotional stress
- Alcohol consumption
- Caffeine withdrawal
- Illness (e.g., head cold, sinus infection)
- Eye strain
- Fatigue

Tension Headache: Clinical manifestations

- Characterized as a mildly to moderately painful bilateral headache with a sensation of a tight band or pressure around the head that can last from minutes to days. **Key clinical manifestations:**
- 2 out of the 4 pain characteristics below are present:
    - bilateral
    - pressure or tightening without pulsation
    - mild to moderate intensity
    - not aggravated by regular activity
- Both associated symptoms below are present:
    - diminished appetite without nausea or vomiting
    - photophobia OR phonophobia
- Before diagnosis, the presence of an underlying disorder must be excluded by a health history, physical examination, and diagnostic testing.

Tension Headache: Dx

- History of headaches: frequency, severity, location, and characteristics of the headaches.
- Past medical History: eliminate secondary headaches, such as HTN
- Physicals: focused evaluation of the findings associated with the headaches.
- Diagnostic tests: ESR for inflammation, imaging for secondary, CT/MRI for tumor or bleeding, digital subtraction angiography (DSA) for visualization of cerebral vasculature, LP to rule out cerebral bleeding or infection

Tension Headache: Treatment: to relieve the pain quickly and safely and identify and eliminate triggers, including:

- Nonpharmacological methods

    - identify and eliminate triggers
    - electromyography (EMG) biofeedback to relax muscles
    - cognitive-behavioral techniques to relax muscles
    - physical therapy to strengthen muscles
    - dry needling therapy
    - behavioral relaxation therapy
    - hot or cold therapy to relax muscles and reduce inflammation
- Pharmacological methods
    - over-the-counter pain relievers (e.g., aspirin, ibuprofen)
    - tricyclic antidepressants
    - botulinum toxin A injection to paralyze the muscles causing headaches
- Note: Long-term use of analgesics or other drugs, such as muscle relaxants, antihistamines, tranquilizers, caffeine, and ergot alkaloids, **should be avoided.**

Migraine Headache: Patho

- 15-20% of the population, complex neurovascular disorders with multifactorial causes. Factors:
- Genetics: specific genes in predisposing individuals to migraine attacks
- Neurological and brain changes: functional magnetic resonance imaging (fMRI) and diffusion tensor imaging (DTI), have revealed changes in brain connectivity, cortical spreading depression, and alterations in the gray and white matter in an individual experiencing a migraine. These findings suggest that the **central nervous system is crucial** in initiating and propagating migraine attacks
- Neurotransmitter dysregulation: Imbalances in neurotransmitters (serotonin) are associated with migraines.
- Inflammatory and vascular mechanisms: role of inflammatory markers and cytokines in migraine attacks. Interactions between the trigeminovascular and vascular systems are suspected migraine pain mechanisms
- Environmental triggers: stress, sleep disturbances, and dietary triggers. Lifestyle modifications are part of management plan.

Migraine Headache: clinical application

- Patient % throbbing headache on the right side head, waking him form sleep. N/V, photophobia. Intensifies when walking on a busy city street and in direct sunlight
- Assessment: throbbing, pulsatingpain unilateral, moderate to severe, lasting 4 to 72 hours, N/V, photophobia, phonophobia. Reports stress, lack of sleep, and food triggers to headache.
- Tests: CBC, CMP, eye exam all normal
- Dx and plan: migraine. IV metoclopramide for nausea, IV ketoralac for pain, dark and quiet room. IV NS for hydration, monitor VS, headache and neuro status. f/u in 2 weeks.
- Education: sumatriptan PRN at the 1st sign of migraine. Lifestyle changes. Referral

Migraine Headache: Risk Factors

- Family history: Individuals with a first-degree relative (parent or sibling) with migraines are at a higher risk.
- Gender and age: more in women due to hormonal changes. Starts in adolescence or early adulthood, and decreases in frequency and intensity with age. May persist into middle age and beyond.
- Hormonal changes: menses, pregnancy (increase or decrease), or menopause
- Other medical conditions: depression, anxiety, bipolar disorder, epilepsy, and sleep disorders
- Mood and stress: Stress, anxiety, and changes in mood (emotional fluctuations) are common triggers for migraines.
- Sleep patterns: not enough, too much, or sleep pattern disturbances
- Dietary factors: alcohol (especially red wine), caffeine, chocolate, aged cheeses, and foods containing additives like monosodium glutamate (MSG).
- Environmental factors: Changes in weather patterns, exposure to strong odors, and bright or flickering lights
- Medication overuse: especially pain relievers or migraine-specific medications, can lead to a rebound phenomenon, where more frequent and severe headaches occur.

Migraine Headache: Phases and Clinical Manifestations