NeuroTrace Study Guide

Domain: Domain III – EEG Patterns & Clinical Correlation
Section: Epileptiform Discharges
Style: Morphology-driven, exam-focused, clinical

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1. Core Principles (Must Know)

Definition

- **Epileptiform discharges reflect cortical hyperexcitability**
- Abnormal EEG waveforms associated with increased seizure risk
- Interictal (between seizures), not seizures themselves
- Presence suggests but does not prove epilepsy

Clinical Significance

- **Presence increases seizure risk** but is not diagnostic alone
- Must correlate with clinical history and findings
- Absence does not exclude epilepsy
- EEG supports diagnosis, does not diagnose alone

Key Principle

- **EEG supports the diagnosis of epilepsy; it does not diagnose epilepsy alone**
- Clinical history is essential
- EEG findings must correlate with symptoms
- Never diagnose epilepsy based on EEG alone

Practical Application

- Identify epileptiform morphology accurately
- Differentiate from artifacts and normal variants
- Correlate with clinical presentation
- Understand limitations of EEG in epilepsy diagnosis

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2. Epileptiform Morphology

Spikes

Characteristics

- **Duration: < 70 ms** (very brief)
- **Sharp contour** (distinct from background)
- **High spatial gradient** (sharp rise and fall)
- Pointed, spiky appearance
- Distinct from background activity

Recognition

- Very brief duration (< 70 ms)
- Sharp, pointed morphology
- Stands out from background
- May be followed by slow wave
- Focal or generalized distribution

Clinical Correlation

- Suggests cortical irritability
- Associated with increased seizure risk
- May localize to specific brain region
- More significant if frequent or in runs

Sharp Waves

Characteristics

- **Duration: 70–200 ms** (longer than spikes)
- **Similar morphology to spikes** (sharp contour)
- **Longer duration** distinguishes from spikes
- Blunt or rounded peak possible
- Distinct from background

Recognition

- Longer duration than spikes (70-200 ms)
- Sharp contour, similar to spikes
- Stands out from background
- May be followed by slow wave
- Focal or generalized distribution

Clinical Correlation

- Similar significance to spikes
- Suggests cortical irritability
- Associated with increased seizure risk
- May localize to specific brain region

Spike-and-Wave Complexes

Characteristics

- **Spike followed by slow wave** (characteristic complex)
- **Often generalized** but may be focal
- Repetitive pattern
- Stereotyped morphology
- Distinct from background

Recognition

- Spike component (< 70 ms)
- Followed by slow wave (200-500 ms typical)
- Repetitive, stereotyped pattern
- May occur in bursts or continuously
- Generalized or focal distribution

Clinical Correlation

- **Generalized:** Suggests generalized epilepsy syndromes
- **Focal:** Suggests focal epilepsy
- Frequency may correlate with seizure type
- 3 Hz spike-and-wave: typical absence epilepsy
- Slower frequencies: other syndromes

Polyspikes

Characteristics

- **Multiple spikes in rapid succession**
- No slow wave component (or minimal)
- Fast, repetitive spikes
- May be generalized or focal
- High-frequency appearance

Recognition

- Multiple spikes in sequence
- Fast repetition
- No or minimal slow wave
- May be brief or prolonged
- Generalized or focal

Clinical Correlation

- Associated with myoclonic epilepsy
- May correlate with myoclonic jerks
- Juvenile myoclonic epilepsy (JME)
- Other generalized epilepsy syndromes

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3. Distribution & Localization

Focal Discharges

Characteristics

- **Localized to specific brain region**
- May show phase reversal in bipolar montages
- Consistent localization across montages
- Suggests focal cortical irritability

Clinical Significance

- **Suggest focal epilepsy** (temporal, frontal, etc.)
- **Often structural correlation** (lesion, scar, etc.)
- May guide imaging studies
- Important for surgical planning

Common Locations

- **Temporal:** Most common (temporal lobe epilepsy)
- **Frontal:** Second most common
- **Parietal/Occipital:** Less common
- **Rolandic:** Benign rolandic epilepsy (children)

Generalized Discharges

Characteristics

- **Bilateral, synchronous** (both hemispheres)
- **Symmetric or asymmetric** (asymmetry may indicate focal onset)
- Suggests generalized epilepsy syndromes
- May be frontally predominant

Clinical Significance

- **Suggest generalized epilepsy syndromes**

- Idiopathic generalized epilepsy (IGE)
- Childhood absence epilepsy (CAE)
- Juvenile absence epilepsy (JAE)
- Juvenile myoclonic epilepsy (JME)

ABRET Emphasis

- **Localization depends on persistence across montages**
- Must see consistent localization in multiple montages
- Phase reversal helps localize focal discharges
- Generalized discharges are bilateral and synchronous

Asymmetric Generalized

- **Bilateral but asymmetric** (one side more prominent)
- May indicate focal onset with secondary generalization
- Asymmetry suggests focal component
- Important for syndrome classification

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4. Epileptiform vs Normal Variants

Feature	Epileptiform	Normal Variant
Sharp contour	Yes	May appear sharp
Field	Physiologic (appropriate distribution)	Limited (specific location)
Reactivity	Persistent (across states)	State-dependent (sleep/wake)
Clinical relevance	Increased seizure risk	Benign (no increased risk)
Morphology	Stereotyped	Variable
Distribution	May be widespread	Localized
Following slow wave	Common	Rare or absent

Key Distinctions

Epileptiform Discharges

- **Physiologic field** (appropriate for brain region)
- **Persistent across states** (wake and sleep)
- **Stereotyped morphology** (consistent appearance)
- **Increased seizure risk** (clinical significance)
- **May have following slow wave** (spike-and-wave)

Normal Variants

- **Limited field** (specific location, e.g., central, temporal)
- **State-dependent** (may only appear in sleep)
- **Variable morphology** (less stereotyped)
- **Benign** (no increased seizure risk)
- **No following slow wave** (or minimal)

Common Normal Variants to Distinguish

- **Rolandic spikes** (benign, central-temporal, children)

- **Wicket spikes** (benign, temporal, adults)
- **14 and 6 Hz positive spikes** (benign, posterior, sleep)
- **Small sharp spikes (SSS)** (benign, temporal, sleep)

ABRET Application

- Given sharp waveform → distinguish epileptiform vs variant
- Use field, reactivity, and morphology to distinguish
- Understand clinical significance of each
- Know which variants are benign

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5. Activation Effects

Sleep

Effect

- **Enhances epileptiform activity** (increases diagnostic yield)
- Many epileptiform discharges appear or increase in sleep
- Sleep deprivation increases yield further
- NREM sleep (especially stage 2) most activating

Clinical Application

- Sleep-deprived EEG increases diagnostic yield
- Sleep recording essential for epilepsy evaluation
- Many focal epilepsies show discharges only in sleep
- Document sleep state when discharges appear

ABRET Emphasis

- Sleep increases diagnostic yield
- Many discharges appear only in sleep
- Sleep-deprived EEG is standard for epilepsy evaluation
- Document sleep state for discharges

Hyperventilation

Effect

- **Activates generalized discharges** (especially 3 Hz spike-and-wave)
- Provokes absence seizures in susceptible patients
- Increases diagnostic yield for generalized epilepsies
- Less effective for focal epilepsies

Clinical Application

- Standard activation for absence epilepsy
- Provokes typical absence seizures
- Increases yield for generalized epilepsies
- Document response to hyperventilation

ABRET Emphasis

- Hyperventilation activates generalized discharges
- Essential for absence epilepsy evaluation
- Provokes clinical and EEG changes
- Document response

Photic Stimulation

Effect

- **May provoke photic-induced discharges** (photoparoxysmal response)
- Can activate generalized epileptiform activity
- Provokes seizures in photosensitive patients
- Less common than sleep or hyperventilation activation

Clinical Application

- Standard activation for photosensitive epilepsy
- Provokes photoparoxysmal response
- May activate generalized discharges
- Document photic response

ABRET Emphasis

- Photic stimulation can activate discharges
- Photoparoxysmal response is significant finding
- Provokes seizures in photosensitive patients
- Document response

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6. Common ABRET Exam Traps

Trap 1: Mistaking Artifact for Spikes

- **Reality:** Artifacts can mimic spikes (electrode pop, muscle)
- Artifacts change with montage, true spikes persist
- Artifacts don't correlate with clinical findings
- Must compare across montages to distinguish

Trap 2: Overcalling Benign Variants

- **Reality:** Normal variants can appear sharp
- Benign variants are state-dependent, epileptiform persists
- Benign variants have limited field, epileptiform has physiologic field
- Must know which variants are benign

Trap 3: Assuming All Spikes Equal Epilepsy

- **Reality:** Spikes increase risk but don't diagnose epilepsy
- Clinical history is essential
- EEG supports diagnosis, doesn't diagnose alone
- Absence of spikes doesn't exclude epilepsy

Trap 4: Ignoring State of Occurrence

- **Reality:** State matters for interpretation
- Sleep-activated discharges are significant
- Wake-only discharges may be less significant
- Must document state when discharges appear

Trap 5: Not Correlating with Clinical Findings

- **Reality:** EEG must correlate with clinical presentation
- Discharges without clinical correlation are less significant
- Clinical history guides interpretation

- Always integrate EEG with clinical findings

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7. Clinical Correlation

Epileptiform Discharges

Increase Seizure Recurrence Risk

- Presence of discharges increases risk of future seizures
- More frequent discharges may indicate higher risk
- Localization may predict seizure type
- Important for treatment decisions

Guide Syndrome Classification

- **Focal discharges:** Suggest focal epilepsy
- **Generalized discharges:** Suggest generalized epilepsy
- **Specific patterns:** Guide syndrome diagnosis (e.g., 3 Hz = absence)
- Important for treatment selection

Absence Does Not Exclude Epilepsy

- Normal EEG does not exclude epilepsy
- Many patients with epilepsy have normal interictal EEG
- Clinical history is more important than EEG
- Repeat EEG or prolonged monitoring may be needed

Clinical Application

- Use EEG to support clinical diagnosis
- Correlate findings with seizure semiology
- Guide treatment decisions
- Understand limitations of interictal EEG

Best Practice

- Always correlate EEG with clinical findings
- Never diagnose epilepsy based on EEG alone
- Understand that normal EEG doesn't exclude epilepsy
- Use EEG to support, not replace, clinical judgment

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8. Case-Based Example

Scenario

Clinical Setting: Routine EEG for seizure evaluation
EEG Finding: Left temporal sharp waves during sleep
Clinical History: Focal impaired awareness seizures
Pattern: Sharp waves at T7, T3, maximum during sleep

Interpretation

- **Suggests focal epileptiform activity** (left temporal)
- Sharp waves are epileptiform (not artifact or variant)
- Sleep activation increases significance
- Localization matches clinical presentation (temporal seizures)

Clinical Correlation

- **Increased likelihood of focal epilepsy** (temporal lobe epilepsy)
- EEG supports clinical diagnosis
- Localization guides treatment and imaging
- Sleep activation confirms significance

Teaching Point

- **Sleep increases diagnostic yield of EEG**
- Many epileptiform discharges appear only in sleep
- Sleep-deprived EEG is standard for epilepsy evaluation
- Document sleep state when discharges appear

ABRET Application

- Given sharp waves in sleep → recognize as epileptiform
- Understand sleep activation significance
- Correlate with clinical presentation
- Know that sleep increases diagnostic yield

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9. Exam Readiness Checklist

Use this checklist to verify your understanding:

- ☐ Can identify spike vs sharp wave (duration: < 70 ms vs 70-200 ms)
- ☐ Can recognize spike-and-wave complexes (spike + slow wave)
- ☐ Can interpret localization correctly (focal vs generalized)
- ☐ Can avoid overdiagnosis (distinguish from variants and artifacts)
- ☐ Understand that epileptiform discharges increase seizure risk
- ☐ Know that EEG supports diagnosis but doesn't diagnose alone
- ☐ Recognize that sleep enhances epileptiform activity
- ☐ Understand that absence of discharges doesn't exclude epilepsy
- ☐ Can distinguish epileptiform from normal variants
- ☐ Can identify ABRET exam traps related to epileptiform discharges

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10. Internal Cross-Links

Patterns

- **Normal Variants:** Must distinguish from epileptiform discharges
- **Artifacts:** Must distinguish from epileptiform activity
- **Focal Abnormalities:** Epileptiform discharges are focal abnormalities
- **Generalized Patterns:** Generalized epileptiform discharges

Workflow

- **Montages & Referencing:** Montage comparison essential for localization
- **Artifacts:** Must distinguish artifacts from epileptiform activity
- **Activation Procedures:** Sleep, hyperventilation, photic activate discharges

Cases

- **Epileptiform EEG cases:** Cases with spikes, sharp waves, complexes

- **New-onset seizures:** Cases requiring epileptiform recognition
- **Localization cases:** Cases requiring localization of discharges
- **Pediatric vs adult epilepsy:** Cases showing age-related differences

Quizzes

- **Epileptiform discharge MCQs:** Questions on morphology, distribution, significance
- **Spike vs sharp wave:** Questions on duration and morphology
- **Localization:** Questions on focal vs generalized
- **Clinical correlation:** Questions on significance and interpretation

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Study Tips

1. **Memorize morphology:** Spikes < 70 ms, sharp waves 70-200 ms
2. **Learn distributions:** Focal vs generalized, common locations
3. **Understand activation:** Sleep, hyperventilation, photic effects
4. **Practice differentiation:** Epileptiform vs variants vs artifacts
5. **Remember the principle:** EEG supports diagnosis, doesn't diagnose alone
6. **Know the traps:** Artifacts, variants, overdiagnosis
7. **ABRET focus:** Expect questions on morphology, distribution, clinical significance

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End of Study Guide

For additional practice, complete quiz questions tagged: spike, sharp-wave, spike-and-wave, focal, generalized