

CANADIAN SOCIETY OF CLINICAL NEUROPHYSIOLOGISTS (CSCN)

EEG EXAMINATION 2009

***** Note: This document was revised April 8, 2009. *****

OUTLINE OF CONTENT: TERMS and CONCEPTS

INTRODUCTION

The following outline is intended to assist candidates in preparation for the CSCN EEG examination. The list is not intended to be "all inclusive" but rather a "guide" to topics that may be covered in the examination.

I. TECHNOLOGY

1. Basic electricity and electronics
 - Ohm's law
 - Measurement and definitions of current, voltage, resistance
 - Capacitors
 - Resistance in series; parallel circuits

2. Electrodes
 - Types
 - Material Characteristics
 - * UPDATE *** Measurement of resistance/impedance; what is the difference?
 - Nomenclature and rationale of the "10-20" system: how to measure; naming of electrodes including expanded nomenclature and "non-standard" positions.

3. Amplifiers
 - Sensitivity/gain
 - Differential amplifier
 - Common mode rejection ratio
 - Calibration in analog and digital systems
 - Filters
 - High frequency (low pass)
 - Low frequency (high pass)
 - Notch filter
 - Cutoff frequency
 - Roll-off and "order" with digital filters
 - Types of digital filters
 - Finite impulse response (FIR)
 - Infinite impulse response (IIR)
 - Frequency domain filtering; fast Fourier transform (FFT)
 - Frequency response curves related to filters

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4. Principles of acquisition of digital EEG
 - Analog to digital conversion
 - Nyquist theorem
 - Aliasing
 - Amplitude resolution and number of "bits"
 - Screen resolution
 - Sample skew
 - System reference and principles of montage reformatting
5. Artifacts
 - Types and "troubleshooting"
 - Physiologic
 - Non-physiologic
 - * **UPDATE** * "Noise"
6. Electrical Safety
 - Leakage current
7. Polarity convention and application to localization
8. * **UPDATE** * Montage design (bipolar, referential, Common average, Laplacian) and comprehension of strengths/weaknesses of each montage)
9. * **UPDATE** * Published society guidelines (Canadian Society of Clinical Neurophysiology; American Clinical Neurophysiology Society); see "Reading List"
10. Infection control (with particular reference to electrodes)

II. PHYSIOLOGY

1. Physiology of normal neurons
 - * **UPDATE** * Resting membrane potential; ionic types; Nernst equation
 - Synaptic potentials (EPSPs, IPSPs)
 - Action potentials
 - Membrane depolarization and hyperpolarization
 - Voltage gated channels and ligand gated channels
 - * **UPDATE** * Neurotransmitters (type; function, synthesis)
 - * **UPDATE** * Gap junctions

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2. Physiology of normal EEG
 - Volume conduction
 - "Sources and sinks"
 - Neuroanatomy-physiology of normal EEG rhythms
 - Thalamo-cortical circuits
 - * **UPDATE** * Neurophysiology of normal sleep; anatomic structures; effects on epileptic spikes
3. Pathophysiology of abnormal EEG
 - Delta; theta (focal; generalized)
 - Paroxysmal depolarization shift
 - * **UPDATE** * Epileptiform abnormalities (spikes and sharp waves; focal and generalized); excitation and inhibition determining which components of spikes and slow waves; what part(s) of cortex, thalamus involved.
4. * **UPDATE** * Neurophysiology and anatomy of temporal lobe-hippocampus
 - Trisynaptic pathway: origins and connections
 - Perforant pathway
 - Schaffer collaterals
 - Long term potentiation
 - Kindling

III. CLINICAL EEG

1. Normal EEG (from prematurity to the elderly)
 - Alpha rhythm and its variants
 - Mu rhythm and breach rhythms
 - Beta
 - Theta
 - Posterior rhythms (posterior slow of youth; lambda waves)
 - Normal drowsy rhythms
 - Sleep patterns (posterior occipital sharp transients of sleep; vertex waves, K complexes, sleep spindles, REM sleep)
 - Activation procedures
 - Hyperventilation responses
 - Photic stimulation
 - "Benign" transients and rhythms
 - Benign epileptiform transients of sleep
 - Rhythmic temporal theta burst of drowsiness
 - Six per second spike and wave
 - 14 and 6 positive spikes
 - Wicket spikes
 - SREDA (sub clinical rhythmic electrographic discharge of adults)

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2. Abnormal EEG in adults and children

“Nonspecific” Patterns

- (a) Theta (focal, generalized)
- (b) Delta
 - Polymorphic Delta (focal; generalized)
 - Intermittent rhythmic delta (frontal intermittent rhythmic delta; occipital intermittent rhythmic delta; temporal intermittent rhythmic delta)
- (c) Asymmetries and suppression
- (d) Photo convulsive (photoparoxysmal) patterns

Inter-Ictal Epileptiform Patterns

- (a) Generalized
 - “Slow” sharp and slow wave complexes (“slow” spike and wave)
 - 3 per second spike and wave
 - Poly spike and wave
 - “Fragments” of generalized spike and wave
 - Generalized paroxysmal fast activity
- (b) Focal spikes
 - Various lobes
 - Rolandic
 - Multifocal

3. Ictal Patterns

- (a) Hypsarrhythmia
- (b) Focal
- (c) Generalized; including recruiting rhythms, generalized paroxysmal fast

4. Other Characteristic EEG patterns

- (a) Triphasic waves
- (b) Periodic lateralized epileptiform discharges (PLEDs)
- (c) Periodic generalized sharp waves (as in creutzfeldt Jakob disease)
- (d) Coma patterns (including burst suppression, alpha- theta coma, spindle coma, coma with diffuse beta; SIRPIDS (stimulus induced rhythmic, periodic, or ictal discharges); isoelectric EEG)

5. Neonatal

- (a) Normal patterns
 - Trace alternans; trace discontinu
 - “Brushes”
 - Encoches frontales
 - Quiet (non-REM) verses active (“REM”) sleep
- (b) Abnormal Neonatal

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6. Abnormal EEG in adults and children

"Nonspecific" Patterns

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- (b) Delta
 - Polymorphic Delta (Focal; generalized)
 - Intermittent rhythmic delta (frontal intermittent rhythmic delta; occipital intermittent rhythmic delta; temporal intermittent rhythmic delta)
- (c) Asymmetries and suppression
- (d) Photo convulsive (photoparoxysmal) patterns

Inter-Ictal Epileptiform Patterns

- (c) Generalized
 - "Slow" sharp and slow wave complexes ("slow" spike and wave)
 - 3 per second spike and wave
 - Poly spike and wave
 - "Fragments" of generalized spike and wave
 - Generalized paroxysmal fast activity
- (d) Focal spikes
 - Various lobes
 - Rolandic
 - Multifocal