CANADIAN SOCIETY OF CLI N ICAL NEUROPHYSIOLOGISTS (CSCN)

EEG EXAMINATION

*** * * Note: This document was revised April 2021. * * ***

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
   - 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
   - "Noise"

6. Electrical Safety
   - Leakage current

7. Polarity convention and application to localization

8. Montage design (bipolar, referential, Common average, Laplacian) and comprehension of strengths/weaknesses of each montage)

9. 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
   - Resting membrane potential; Ion types; Nernst equation
   - Synaptic potentials (EPSPs, PSPs)
   - Action potentials
   - Membrane depolarization and hyperpolarization
   - Voltage gated channels and ligand gated channels
   - Neurotransmitters (type; function, synthesis)
   - 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
   - Neurophysiology of normal sleep; anatomical structures; effects on epileptic spikes

3. Pathophysiology of abnormal EEG
   - Delta; theta (focal; generalized)
   - Paroxysmal depolarization shift (PDS)
   - 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. 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 (positive 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 (photo-paroxysmal) patterns

Inter-Ictal Epileptiform Patterns

(a) Generalized
    "Slow" sharp and slow wave complexes ("slow" spike and wave)
    3 per second spike and wave
    Polyspike 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
(d) Status epilepticus

4. Other Characteristic EEG patterns

(a) Triphasic waves
(b) Periodic lateralized epileptiform discharges (PLEDs / LPDs)
(c) Periodic generalized sharp waves (as in Creutzfeldt Jakob disease)
(d) Coma patterns (including burst suppression, alpha coma, theta coma, spindle coma, coma with diffuse beta)
(e) SIRPIDS (stimulus induced rhythmic, periodic, or ictal discharges)
(f) BIRDs (brief ictal/interictal repetitive/rhythmic discharges); BERDs (brief electrographic rhythmic discharges); BRDs (brief rhythmic discharges)
(g) Isoelectric EEG
(h) Ictal-interictal continuum

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5. Neonatal

(a) Normal and maturational patterns for pre-term and term neonates
- Trace alternans
- Trace discontinu
- "Delta Brushes"
- Encoches frontales
- Quiet (non-REM) versus active ("REM") sleep

(b) Abnormal Neonatal
- Interictal
- Ictal