Neurology

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I. INTRODUCTION

PCCN Test Plan

*Neurology, Multisystem, Behavioral: 15%*

a. Cerebrovascular Malformation (including aneurysm, AV malformation)
b. Encephalopathy (e.g., hypoxic-ischemic, metabolic, edema, infectious, hepatic)
c. Intracranial Hemorrhage (e.g., subarachnoid, epidural, encephalitis)
d. Seizure Disorders
e. Stroke (cerebrovascular accident)
   - Ischemic (embolic)
   - Hemorrhagic
   - Transient Ischemic Attack (TIA)

II. ANATOMY & PHYSIOLOGY

a. Skull
b. Brain
c. Meninges: Dur Mater, Arachnoid, Pia Mater
d. Cerebrum
e. Brain Stem
f. Cerebellum
g. Cranial Nerves
h. Blood Vessels
i. Cerebral Spinal Fluid
j. Spinal Cord
k. Peripheral Nerves

III. NEURO ASSESSMENT (Included for Review)

a. Level of Consciousness (LOC)
b. Glasgow Coma Scale (GCS) 3-15
   - Eye Opening - 1- 4 points
   - Best Verbal Response – 1- 5 points
   - Best Motor Response – 1- 6 points
c. Pupils
- Size: Sympathetic & Parasympathetic, CN II & III
- Shape
- Symmetry
- Reaction to Light
- Extra Ocular Movement: CN III, IV
- Abnormal Pupillary Findings
  o Nonreactive, midposition: Midbrain Damage
  o Nonreactive Pinpoint: Pons Damage
  o Reactive, Small & Equal: Damage Affecting Sympathetic Innervation
  o One Fixed & Dilated Pupil: Same side CN III compression or injury
  o Bilateral Fixed & Dilated Pupils: Severe Brain Compression, Ischemia and/or Anoxia

d. General Observation
- Behavior
- Mood/Affect
- Appearance
- Communication Pattern and Style
- Organized Flow of Thoughts

e. Motor & Sensory

f. Cognitive Function
- Orientation
- Memory & Retention
- Attention
- Abstract Reasoning
- Judgment

g. Language & Communication
- Aphasia
  o Expressive Aphasia (Brocca’s) – Dominant Frontal Lobe
  o Receptive Aphasia (Wernicke’s) – Dominant Temporal Lobe

h. Respiratory Patterns
- Cheyne-Strokes Breathing: Problem in Cerebral Hemispheres, Diencephalon or Basal Ganglia
- Neurogenic Hyperventilation: Midbrain or Upper Pons Problems
- Apneustic Breathing: Pons Lesion (prolonged inspiration with pauses)
### Cranial Nerves

<table>
<thead>
<tr>
<th>#</th>
<th>Cranial Nerve</th>
<th>function</th>
<th>assessment</th>
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<tbody>
<tr>
<td>I</td>
<td>Olfactory</td>
<td>• Smell</td>
<td>• Evaluate Ability to Identify Odors</td>
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<tr>
<td>II</td>
<td>Optic</td>
<td>• Vision</td>
<td>• Evaluate Sight</td>
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<tr>
<td>III</td>
<td>Occulomotor</td>
<td>• Eye Movement</td>
<td>• Evaluate Eye Movement</td>
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<tr>
<td></td>
<td></td>
<td>• Pupil Constriction</td>
<td>• Towards Nose</td>
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<td></td>
<td></td>
<td>• Elevation of Eye Lid</td>
<td>• Up and In, Down and In</td>
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<td>IV</td>
<td>Trochlear</td>
<td>• Eye Movement</td>
<td>• Evaluate Eye Movement</td>
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<tr>
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<td></td>
<td>• Downward and Inward</td>
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<tr>
<td>V</td>
<td>Trigeminal</td>
<td>• Sensation to Face</td>
<td>• Tighten Jaw (Clench Teeth)</td>
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<tr>
<td></td>
<td></td>
<td>• Muscles of Mastication</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Corneal Reflex</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Abducens</td>
<td>• Eye Movement</td>
<td>• Evaluate Eye Movement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Laterally Outward</td>
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<tr>
<td>VII</td>
<td>Facial</td>
<td>• Muscles of Face</td>
<td>• Demonstrate Facial Expressions</td>
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<tr>
<td></td>
<td></td>
<td>• Taste Anterior Tongue</td>
<td>• Show Teeth</td>
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<tr>
<td>VIII</td>
<td>Acoustic</td>
<td>• Vestibular – Balance</td>
<td>• Evaluate Hearing</td>
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<tr>
<td></td>
<td></td>
<td>• Cochlear – Hearing</td>
<td></td>
</tr>
<tr>
<td>IX</td>
<td>Glossopharyngeal</td>
<td>• Pharyngeal Reflex (gag)</td>
<td>• Swallow</td>
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<td></td>
<td></td>
<td>• Taste Posterior Tongue</td>
<td>• Evaluate Gag</td>
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<td></td>
<td></td>
<td>• Swallowing</td>
<td></td>
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<tr>
<td>X</td>
<td>Vagus</td>
<td>• Parasympathetic Innervation</td>
<td>• Assessed with Glossopharyngeal</td>
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<td></td>
<td></td>
<td>• Swallowing</td>
<td></td>
</tr>
<tr>
<td>XI</td>
<td>Spinal Accessory</td>
<td>• Sternocleidomastoid &amp; Trapezius Muscle Movement</td>
<td>• Shrug Shoulders</td>
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<td>• Rotate Head</td>
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<tr>
<td>XII</td>
<td>Hypoglossal</td>
<td>• Movement of Tongue</td>
<td>• Check Speech</td>
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### IV. STROKE: TIME IS BRAIN

#### Definitions

a. **Stroke**: Permanently impaired central nervous system (CNS) tissue/functioning due to impaired cerebrovascular perfusion
b. **Transient Ischemic Attack (TIA)**: Lasts for minutes to hours. No detectable dysfunction or tissue damage
c. **Penumbra**: Viable but not functioning neuronal cells. This area may recover and not progress to stroke
Risk Factors

a. Age
b. Hypertension
c. Atrial Fibrillation
d. Dyslipidemia
e. Diabetes Mellitus
f. Coronary Artery Disease
g. Sedentary Lifestyle
h. Smoking
i. Obesity
j. Valvular Disease

Causes of Ischemic Stroke

a. Thrombotic
   • Atherosclerosis
   • Vasculitis
   • Arterial Dissection
   • Hematologic Disorders
b. Embolic
   • Cardiogenic
   • Athero-thrombotic Arterial Source
   • Unknown Source: Hypercoagulable State

Initial Assessment

a. Goals
   • Rapid Assessment
   • Initiate Treatment
b. Assessment
   • ABC’s
   • Vital Signs
   • Cardiac Monitor
   • Accurate Event History
   • Presentation (language, motor, sensory)
c. Common Stroke Signs: Sudden
   • Rarely Loss Consciousness
   • Asymmetrical Facial Expression
   • Weakness on One Side of the Body
   • Numbness on One Side of the Body
   • Difficulty Speaking or Understanding
• Difficulty Walking
• Visual Difficulty: Homonymous Hemianopia, visual field cut same side as stroke
• Severe, Unexplained Headache
d. Tests
• CT Scan (no contrast)
• MRI
• Transcranial Doppler
• Blood Work

**Ischemic Stroke Care**

a. Hypertension
   • Normal Response to Stroke
   • Usually Resolves in 3-4 days
   • Some HTN is Good
   • Only tx if SBP >220, DBP > 140 or MAP >130
   • Unless t-PA: SBP > 185, DBP > 110
b. Do Not Lower Blood Pressure > 10 % per hour
c. Activase (alteplase or rt-PA)
   • Only FDA Approved Drug Therapy
   • Within 3 Hrs of Onset and 4.5 Hrs for some patients
   • Dose 0.9 mg/kg
   • 10% Bolus Over 1 Minute
   • Remainder of Dose Over 1 Hour
   • No ASA, Heparin, etc x 24 Hours
d. Interventions
   • Treat Hypotension
   • Treat Hyperthermia (Keep < 37.5^° C)
   • Maintain Serum Glucose 80 - 150
   • Monitor ABG’s and Pulse Ox
   • Protect Airway
   • Initially Flat Until Hemodynamically Stable ➔ HOB > 45^°
   • NPO ➔ Swallowing Study

**Hemorrhagic Stroke (Intracerebral Hemorrhage)**

a. Bleeding into Tissue/Parenchyma
b. Commonly From Hypertension
c. Signs & Symptoms
   • Severe Headache, N/V, Loss of Consciousness
   • Retinal Hemorrhage
   • Similar to Ischemic Strokes
   • Localized Blood Seen on CT
Neurology

d. Bleeding into the Subarachnoid Area
e. Often Due to a Ruptured Aneurysm or AVM
f. Often Due to Trauma
   • Epidural – Arterial
   • Subdural – Venous: Acute, Subacute, Chronic
   • Intercranial
   • Subarachnoid
   • Hematomas

Aneurysm
a. Types
   • Fusiform
   • Berry
   • Saccular
b. Rupture
   • Bleeds into the Subarachnoid Space
   • Bleeding Continues Until Tamponade Occurs and Thrombus Forms

Arteriovenous Malformation (AVM)
A congenital abnormal linkage between an artery and vein. When ruptured or leaking will present the same as an intracerebral hemorrhage.

Assessment
a. “Worst Headache of My Life”
b. N/V
c. Loss of Consciousness
d. Nucal Rigidity and Photophobia
e. Focal Deficits
f. Clinical Findings Similar to Ischemic Strokes
g. Ventricular and/or Subarachnoid Blood Seen on CT
h. CSF from LP Positive for Blood
i. Hydrocephalus Might Occur
j. Hyponatremia Might Occur
   • SIADH
   • DI

Medical Management
a. Diagnostic Work up
   • CT/MRI
   • Cerebral Angiogram
   • MRA
   • Transcranial Doppler
   • Lumbar Puncture
   • Laboratory Assessment
b. Strict Control of Blood Pressure

c. Pre-Repair -- MAP 80-90, BPS < 140
   - Sodium Nitroprusside (Nipride)
   - Normodyne (Labetalol)
   - Hydralazine (Apresoline)
   - Aneurysm Precautions
   - Pain Relief

d. Post-Repair: Vasospasm – Major Concern
   - Triple H Therapy (trending out of favor 2012)
     - Hypertensive -- MAP 120-150
       - Phenylephrine (Neosynephrine)
       - Dopamine Hydrochloride (Dopamine)
       - Norepinephrine Bitartrate (Levophed)
     - Hemodilutional -- Hct of 30-33
     - Hypervolemic -- CVP of 8-12
   - Calcium Channel Blockers
   - Nimodipine: 60 mg PO q 4 hours for 21 days
   - NO Heparin, Coumadin, or ASA

V. ENCEPHALITIS: INFLAMMATION OF THE BRAIN

Etiology (usually viral)

a. Herpes Simplex 1
b. Arbovirus (Mosquitoes)
c. West Nile, Eastern and Western Equine, St. Louis
d. Enterovirus
e. Polio, Coxsackie's
f. Measles, Mumps, Rabies
g. Cytomegalovirus, Varicella-Zoster
h. Immunocompromised

Clinical Presentation

a. Personality Changes
b. Behavioral Changes
c. Altered LOC
d. Focal Neurologic Deficits
e. Hallucinations (olfactory and gustatory)
   - Classic Sign of Herpes Encephalitis
Management

a. ABCs
b. Supportive Care
c. Herpes Simplex 1 Encephalitis, Acyclovir
d. Seizure Management
e. Fever Management
f. Pain Management

VI. ENCEPHALOPATHY
Generalized or Global Mental Status Dysfunction

Etiology

a. Direct Pathology in Brain
   • Cerebral Blood Flow Disruptions
   • Structural Changes/Injuries
   • Concussive Brain Injury
   • Electrical Activity Changes
   • Neurotransmitter Changes
   • Ischemic Injuries to Tissue
b. Indirect Pathology
   • Toxin Buildup (renal, Hepatic)
   • Metabolic Imbalance
   • Severe Systemic Hypertension
   • Hypo/Hyper Glucose (acute and chronic)
   • Chronic Alcohol Abuse (Wernicke’s)

Clinical Presentation

Not a specific disease but results from neurological or systemic disorders. S&S are directly related to primary cause.
a. Change in: LOC, Behavior, Personality, Memory
b. Renal Insufficiency Symptoms
c. Liver Dysfunction Symptoms

Management

a. ABCs
b. Seizure Precautions/Prevention/Management
c. Safety Concerns/Issues
d. Behavioral Health Control
e. Identification/Management of Primary Problem
f. Supportive Care

VII. Seizures

Definitions

a. Seizure: Uncontrolled Discharge of Neurons Which Interferes With Normal Function
b. Epilepsy: Recurrent, Spontaneous Seizures
c. Status Epilepticus: Recurrent Seizures Before Recovery to Baseline

Etiologies & Predisposing Factors

a. Structural Changes
   • Trauma
   • Infections
   • Intracranial Masses
b. Cerebrovascular Disease
   • Hemorrhage
   • Ischemic Stroke
c. Metabolic Factors
   • Fluid and Electrolyte Imbalance
   • Hypoxia
   • Acidosis
   • Toxic Exposure
   • Drug Overdose/ Withdrawal

Classifications

a. Partial Seizures
   • Simple Partial
     o One Hemisphere
     o No Loss of Consciousness
   • Complex Partial
     o One Hemisphere
     o Loss of Consciousness
   • Partial Seizures Evolving into Generalized Seizures
b. Generalized Seizures
   • Absence (Petit Mal): Staring Spells
   • Myoclonic: Single Jerk
   • Atonic: Drop Attack
   • Clonic: Rhythmic Jerking
   • Tonic: Stiffening
   • Tonic-Clonic (Grand Mal)

Phases

a. Pre-ictal Phase
   • Aura
   • Nausea
   • Confusion
   • Visual or Auditory Changes
   • Precipitating Events
b. Ictal Phase
   • Assess
   • Type
   • Sequence of Events
   • Character of Movements
   • Autonomic Signs
     o V/S, Respiratory Changes, Incontinence, Salivation, Diaphoresis
   • Consciousness
c. Post-ictal
   • Level of Consciousness
   • Trauma Survey
   • Muscle Soreness
   • Headache
   • Weakness (Todd’s paralysis: post seizure hemiplegia or monoplegia, can last minutes → hours)
   • Aphasia

Assessment

a. History
b. Labs
   • CBC, Chem 20, LFTs, U/A
   • Lactic Acid, ABG
   • Tox screen
c. Imaging
   • CT
   • MRI
d. EEG
Interventions

a. ABC’s

b. Control Seizure:

Lorazepam (Ativan)
- Enhances the Inhibitory Neurotransmitter (GABA)
- Rapidly Crosses the Blood-Brain Barrier
- Remains in the Brain Longer Than Diazepam (Valium)
- Cleared by the Liver
- 2 to 4 mg IV STAT
- Maximum Dose = 8 mg

Anticonvulsants (Antiepileptic Drugs – AED)
- If Already on an AED, Draw Level
- Phenytoin (Dilantin)
- Carbamazepine (Tegretol)
- Fosphenytoin Sodium (Cerebryx)
- Remember – Whatever the Patient was on Was NOT Enough
  o Phenytoin (Dilantin) Level 10 – 20mcq/ml
- Consider Adding Additional Agents Immediately
  o Barbiturates
  o Pentobarbital (Nembutal)
  o Short Acting Anesthetic
  o Suppresses Neuronal Activity
  o Significant Respiratory Depressant
  o IV Bolus or Cont. gtt

c. Nursing Care
- Seizure Precautions
- Airway
- Safe Environment
- Don’t Restrain
- Don’t Leave the Patient
- Observe..Observe..Observe
- Monitor..Monitor..Monitor
- Reassure Patient and Family

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