Handout for Integrating the Neurologic Examination for the Neuropsychologist: Neuroanatomic Localization of Common Pathologies, Interventions and Higher Cognitive Functions

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- History and Examination are key to diagnosing a neurological complaint.
- Adequate knowledge of anatomy, physiology, biochemistry and clinical features of the nervous system.
- An experienced neurologist can hypothesize based on a history which neurologic findings will be present or absent.

  Neurologic examination is used to confirm or refute the hypothesis. [6]

- Chief Complaint
- History of present illness
- Past Medical History (including developmental milestones, as appropriate)
- Medications
- Family History
- Social History
- Review of Systems

  All elements are influenced by memory, intelligence, language function, social, economic, and psychiatric features.

- After completion of history, the goal is to have an anatomic localization.
- "Principle of parsimony"
- Occam's razor

- Localization

  Cortex
  Subcortex
  Brainstem and cerebellum
  Spinal Cord
  Radicular
  Peripheral nerve
  Neuromuscular junction

- Cortex

  Frontal

  Motor, fluency, prosody, attention, processing, planning, behavior/personality

  Temporal

  Memory, language, auditory function

  Parietal

  Somatosensory, sensory association function,

  Occipital

  Visual, visual association cortices

Images courtesy of Gray's anatomy and Hardin MD/images

- Subcortical

basal ganglia

caudate, putamen, globus pallidus, substantia nigra, subthalamic nucleus

thalamus

sensory relay to cortex

hypothalamus

homeostasis, endocrine, autonomic, limbic

Diagram courtesy of HOPES brain tutorial, Stanford University

- Brainstem

Cranial nerves, descending motor, sensory, and cerebellar pathways, cardiac and respiratory function
reticular activating system, midline raphe

- Cerebellum

indirectly influences motor pathways to coordinate and plan movement, regulate eye movements and balance

Spinal cord

- Radicular

31 pairs of nerves
8 cervical
12 thoracic
5 lumbar
5 sacral
1 coccygeal

- Peripheral nerves
  - motor
  - sensory
  - autonomic
- Neuromuscular junction

impairments result in motor dysfunction without sensory involvement

- Components of the neurologic examination[7]

Mental status
General behavior and appearance
Stream of talk
Mood and affective responses
Content of thought
Intellectual capacity
Sensorium
Speech
Dysphonia
Dysarthria
Dysprosody
Aphasia

- Components of the neurologic examination

Head and Face
Facial gestalt
Head abnormalities in symmetry or shape, measure circumference
Look at the eyes for ptosis, pupillary size, interorbital distance
Auscultate for bruits over neck vessels, eyes, temples

- Components of the neurologic examination

  Cranial nerves

  I—Olfactory

  use an aromatic (coffee e.g.) non irritating substance

  II--Optic

  Acuity and testing of peripheral fields by confrontation

III, IV, and VI

Pupillary light reflexes

Ocular motility

- Components of the neurologic examination

  Cranial Nerves

  V-inspect the masseter and temporalis muscle bulk

  test all three divisions of facial sensation

  corneal reflex (V-VII reflex arc)

  VII—muscles of facial expression

  VIII--hearing

- IX and X:

  listen for phonation and articulation (labial, lingual, and palatal sounds)

  XI-spinal accessory

  test head movement and shoulder shrug

  XII—hypoglossal

  tongue protrusion and inspect for atrophy

- Motor

  Muscle tone—make passive movements of joints to test for spasticity, rigidity or hypotonia. Determine if findings are upper motor neuron or lower motor neuron in origin

  Strength testing—graded on scale of 0 to 5

  0 no movement

  1 twitch

  2 some movement

  3 movement against gravity

  4 less than full power

  5 full power against resistance

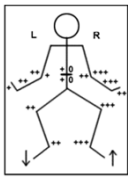
Upper motor neuron

- Weakness
- No atrophy
- No fasiculation
- Increased tone
- Hyperreflexia

Lower motor neuron

- Weakness
- Atrophy
- Fasiculation
- Decreased tone
- Decreased reflexes

- Deep tendon reflexes
  graded on a 0 to 4+ scale
  - jaw jerk (V afferent; V efferent)
  - biceps reflex (C5-C6)
  - brachioradialis (C5-C6)
  - triceps reflex (C7-C8)
  - finger flexion reflex (C7-T1)
  - knee jerk (L2-L4)
  - ankle jerk (L5-S1)



- Sensation
  - superficial sensory (light touch, temperature, pain)
  - deep sensory (joint position sense, vibration sensation
  - higher sensory function (graphesthesia, astereognosis, statognosis)

- Cerebellar
  - Eye movements
  - Finger to nose
  - Rapid alternating hand movements (dysdiadochokinesia)
  - heel to shin

- Gait
  - initiation
  - balance
  - fluidity
  - tempo
  - turns
  - adventitious movements

Formulation

- Formulation or assessment
- Several sentences synthesizing chief complaint, history, neurologic findings which localize the anatomic origin and provide a potential list of diagnoses

- Unusual presentations of common diseases are more frequent than common presentations of rare diseases
- Generation of a differential diagnosis--I VINDICATE AIDS

Iatrogenic
Vascular
Infectious
Neoplastic
Degenerative
Inflammatory
Congenital
Autoimmune
Trauma
Endocrine

Allergic
Idiopathic
Drugs
Social

Disease and the Neurologic Examination

Neurodegenerative
Vascular
Traumatic brain injury
Epilepsy
Psychosomatic
Post surgical

- **Neurodegenerative**
  Alzheimer's disease

  Amyotrophic lateral sclerosis
  Fronto-temporal Dementia

  Parkinson's disease
  Lewy Body Disease
  Multiple System Atrophy

- Alzheimer's disease[8]
  - memory disturbance
  - subsequent language and visuospatial dysfunction
  - neuropsychiatric dysfunction
  - depression
  - delusions
  - behavioral disturbances
  - wide variation
  - most prominent abnormalities on examination are higher cognitive function

- Neurologic examination
  - frontal release signs or primitive reflexes (snout, suck, grasp)

  - gegenhalten
  - variable resistance to passive movement

  - myoclonus

  - seizures

- Amyotrophic Lateral Sclerosis

  Degeneration of motor neurons resulting in progressive weakness

  Neurologic examination classically with mixture of upper and lower motor neuron findings

- Hyperreflexia
- Increased tone
- Atrophy
- Fasciculations
- Weakness

- Overlap syndrome[9]
- 30% of ALS patients may have fronto-temporal dementia
- 15% of FTD patients may have ALS

- **Fronto-temporal dementia**[8]
  Primitive reflexes
  Clinical features reflect regional atrophy
  Frontal: Orofacial apraxia
  Perseveration
  Echolalia or palilalia
  Apathy
  Temporal: Aphasia
  Oral exploratory behavior
  Otherwise, nonfocal exam

- Parkinson's disease

  Rigidity

  Rest tremor

  Bradykinesia

  Asymmetry
  Masked fascies
  Decreased blink
  Micrographia
  Hypophonia
  Seborrhea
  Bradyphrenia

- Approximately 2/3rds of patients with PD develop cognitive deficits
- Up to 40% of patients with PD develop dementia attributed to the presence of Lewy bodies[10]

- Lewy Body Dementia

  Neurologic exam with findings of Parkinson's Disease
  Falls
  Autonomic disturbances
  Hallucinations
  40-65% of people with RBD develop LBD[12]
- Multiple System Atrophy

  Autonomic failure associated with variable manifestations of Parkinsonism, cerebellar and pyramidal dysfunction

V

- Vascular disease

  Stroke syndromes

  Arterial Territory

  Multi-infarct dementia

- Neurologic exam of middle cerebral artery strokes
  contralateral hemianopsia
  conjugate eye deviation to side of stroke
  contralateral hemiplegia
  hemianesthesia

  Dominant hemisphere involvement with aphasia
  Nondominant hemisphere involvement with hemineglect

- Neurologic examination of anterior cerebral artery strokes
  - rare--<3% of strokes
  - lower extremity weakness
  - Deviation of head and eyes toward side of lesion
  - Abulia

- Neurologic examination of posterior cerebral artery strokes
  - quadrantanopsia
  - involvement of splenium of corpus callosum results in alexia without agraphia
  - visual agnosia
  - amnesia
  - bilateral infarctions of occipital lobes result in Anton's syndrome
    - cortical blindness and denial of blindness
  - bilateral infarctions of occipito-parietal lobes result in Balint's syndrome
    - optic ataxia, oculomotor apraxia, and simultanagnosia

- Neurologic examination of multi-infarct dementia[12]
  - accumulation of defects through multiple cortical strokes
  - type of cognitive decline related to regional involvement
  - Distinction between subcortical and cortical involvement
  - Neurologically, cortical involvement will demonstrate aphasia, amnesia, visuospatial disturbances
  - Subcortical involvment accompanied by motor signs of gait disturbance, stooped posture and lack of facial features
  - Neurologic findings reveal minor findings
  - increased tone, asymmetric reflexes, extensor plantar response, visual field abnormalities, subtle hemiparesis or clumsiness

- Traumatic Brain Injury[13]
  - mild TBI/concussion
  - defined as a blow to head with loss of consciousness less than 30 minutes, amnesia peri-event and up to a one day after the injury, normal structural imaging, GCS 13-15
  - present with physical, cognitive, emotional symptoms which are self limited to 4-6 weeks
  - 10% of patients continue to complain of symptoms
  - Neurologic exam is nonlocalizing

- Epilepsy
  - Geschwind Syndrome[14]—Intense emotional life, hypergraphia, circumstantiality, hyposexuality, hyper religiosity
  - Neurologic examination is usually nonfocal
  - Subtle elements based on localization of seizure onset

- Psychosomatic
  - Symptom complex presentation without identifiable medical cause
  - Neurologic examination with multiple soft findings which are inconsistent
  - Hoover's sign
  - Astasia/abasia

Waddell's signs

- Tenderness tests: superficial and diffuse tenderness and/or nonanatomic tenderness
- Simulation tests: these are based on movements which produce pain, without actually causing that movement, such as axial loading and pain on simulated rotation
- Distraction tests: positive tests are rechecked when the patient's attention is distracted
- Regional disturbances: regional weakness or sensory changes which do not localize to neuroanatomy
- Overreaction: subjective signs regarding the patient's demeanor and reaction to testing

Neurosurgical intervention
Epilepsy

Epilepsy

temporal lobectomy

Visual field cut

Dominant lobe—word finding difficulty, memory loss

Laser ablation of hippocampus

Neurosurgical intervention
Epilepsy

- Frontal lobectomy
- Corpus callosotomy

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