The Advanced Neurologic Exam Principles and Practice

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Objectives

• Students will perform a:
  • Detailed and comprehensive neurologic examination,
  • With optimized positioning and phrasing,
  • Based upon hypotheses from history and prior observations,
  • To build evidence for a finding or system to be reliably present/absent,
  • By interconnecting historical and examination components,
  • With an appreciation of sensitivity/specificity, subjectivity/objectivity,
  • While ensuring the big picture makes sense.
Transferability of Hypothesis Generation

• Clinical and scientific approach to:
  • Bedside Diagnosis in Medical and Surgical Specialties
  • Image Review and Interpretation
  • Operations and Procedures more Efficient with Fewer Complications
  • Histopathology Review and Interpretation

• Critical Thinking and Deductive Reasoning
  • Developing and Going through Your Process
  • Searching for Clues
  • Maintain an Open and Nimble Mind
  • Building a Case, Recognizing Pros/Cons, Typical/Atypical
  • Determining Best Approach to Proceed
Approach

• Take your time, there is no need to do a 5 minute neuro exam
• The history should include functional elements to preview the exam
• Bring your hypotheses to the exam, so you can scrutinize your findings

• Make a cheat sheet/scoring sheet
• After the history, pause:
  • Where do I localize their symptoms?
  • What diseases occur in those locations?
  • What am I expecting to find on exam?
    • UMN, LMN, motor, cerebellar, sensory, extrapyramidal, etc
• After each section of the exam, document and pause:
  • Does this make sense with regards to the big picture?
  • Am I confident in the findings I elicited? Do any need repeating?
  • Any additional maneuvers I should consider based upon localization and differential, or indeterminant/inconsistent findings?
Increasing Reliability

• Patient positioning
  • Sitting vs. lying, limb position

• Clinician positioning
  • Where to stand, where to put arms

• Technique
  • How to hold, how to swing, how fast to move

• Instructions
  • How to tell patient the maneuver

• Demeanor/Cooperation
  • Keeping the patient engaged with full effort

• Proactive evaluation
  • What do you expect to find?

• Confirmation
  • Is it reproducible, are there redundant techniques to confirm, does it fit a pattern, what else should I be looking for
Redundancy is Good

Signs of Corticospinal Tract Dysfunction

• Pronator drift
• Orbiting
• Slowed finger sequencing and foot tapping
• Reduced strength in UMN pattern
  • UE extensors, LE flexors
• Hyper-reflexia/asymmetry, + Babinski
• Increased spasticity
• Decreased stance time, increased tone, foot drop, leg instability
• Decreased hopping
Subjectivity and Objectivity – It Depends

**Subjective**
- Pin Sensation
- Clear instructions: Do repeat trials with sharp/dull or sharp/reduced/dull

**Mix**
- Vibration
- Clear instructions: Repeat Trials for consistency starting at different thresholds

**Objective**
- Reflexes
- Three in a row, more than one joint
Order

• Regional
• Start with high sensitivity, objective, uni-modality testing
• Follow-up with maneuvers that are more specific, more subjective, multi-modal testing
• Reliability = repeatability
• Validity = measuring what it is supposed to measure
  • Pain limiting motor testing
Regions

1. Head and Neck
2. Upper Extremities I – Functional Testing
3. Lower Extremities I – Functional Testing
4. Motor (Ext II)
5. Reflexes (Ext III)
6. Sensory (Ext IV)
7. Stance
8. Gait
9. Balance/Coordination
Phrasing

• Clear and simple
• Balancing providing explanation vs. making things confusing
• Instruct in patient’s frame of reference
  • “Pull in”, “Pull towards yourself”
• Include the outcomes of interest in the instructions
  • Rapid alternating movements: assess speed and rhythm
  • Slap your hand on your palm big, fast, and loud
• Give a visual
  • Demonstrate, point
• Encourage them to keep up effort and speed
  • Self selected speeds may help with compensation
• Give them praise, tell them when they got it right
1. Head and Neck

**II:**
- *Read near card at 14+ inches each eye.
  - Best corrected, glasses or pinhole, good lighting, push until 2 errors
- Screen for scotoma (face or Amsler grid)†
- *VFs to finger count or red object
- *Fundi exam
- *Pupils roundness and direct and consensual reactions

**III, IV, VI:**
- *Smooth pursuits in big “H” in arc
- Saccades between central/lateral objects (15-20 degrees)†
- Saccades between lateral objects (40-50 degrees)†

**V:**
- *Sensation to touch in 3 distributions
- Corneal reflex†

**VII:**
- *Smile, raise eyebrows, eye closure
- If unsure, activation asymmetry and facial strength†
- Check neck flexors/extensors if suspect facial diplegia†

**VIII:**
- *Rub fingers, ask which side; or whisper addition problem

**IX:**
- Gag on both sides of palate†

**X:**
- *Visualize palate elevating symmetrically

**XI:**
- *Shrug shoulders while palpating/visualizing trapezii

**XII:**
- *Wiggle tongue side-to-side, big and fast

*Required
†Additional
Redundacy: If there is an APD, what else do you expect to find?

• Decreased vision
• Red desaturation
• Scotoma
• Restricted fields
• Altered funduscopic exam

• What is causing the APD
  • Inflammatory: MS, NMO, MOG, sarcoid, vasculitis
  • Infectious: Crypto, TB, cat scratch disease, syphilis, Lyme
  • Ischemic: NAION, GCA
  • Cancer: Lymphoma, compressive, paraneoplastic
  • Metabolic: Thyroid, B12, Copper
  • Hereditary: Mitochondrial, SCA
  • Toxic: Amiodarone, ethambutol
Primary vs. Supranuclear/Higher Order

- Higher Order testing requires Primary System to be Intact
- Saccades
  - Prefrontal eye fields (planning)
  - Frontal eye fields (voluntary activation)
  - Basal ganglia (initiation)
  - PPRF (neuron generator)
  - CNVI, MLF, CNIII (primary nuclei)
  - Parietal eye fields (spatial representation)
  - Superior colliculi (amplitude and direction)
  - Cerebellum (accuracy and consistency)
2&3. Upper and Lower Extremities I

- Corticospinal (strength and finesse)
  - *Pronator drift
  - Finger-nose proprioceptive test
  - Orbiting
  - **Finger sequencing (big and fast and clean)**
    - Very sensitive and often lateralizing
  - **Toe tapping (from heel - big and fast and loud)**
    - Very sensitive and often lateralizing
  - *Spasticity*
  - *Bulk*

- Extrapyramidal (initiation, speed, amplitude, inhibition)
  - *Evaluation of facial expressivity, eye blinking, voice volume*
  - Hand opening/closing, pronation/supination
  - Rigidity
  - *Tremors*
    - *General observations during history and exam*
    - Rest, posture
  - Assess extra movements (asterixis, myoclonus, spasms, dystonia)

- Cerebellar (precision or motor conservation, temporalspatial accuracy)
  - *Finger-to-nose*
  - Dysemetria (an inaccurate trajectory)
  - Intention tremor (oscillation that worsens upon approaching target)
  - Dysdiadokokinesia (inability to coordinate rapid alternating movements involving bilateral or synchronous muscle groups)
  - Heel-knee-shin
  - Lap slap (synchronous bilateral slapping movements)
  - Finger tracking (inaccuracy of finger tracking)
  - Rebound (failure for antagonist muscles to stabilize displaced limb)
4. Motor

• Isometric contraction
• Side-to-side
• Individual more reliable than bilateral
• Assess force for the muscle to be overpowered/lengthen
• Gain mechanical advantage on big muscles
• Rate peak force, note activation/effort
• Sustaining effort is variable

• UPPER: Delt, bicep, tricep, finger extensors, finger abductors, opponens
• LOWER: Iliopsoas, quad, hamstring, tibialis anterior, plantar extensors
• OPTIONAL: Abductor pollicis brevis, gluts, others in case of specific nerve injuries
Judging effort

- Elicit maximal/peak tension
- Encourage not to let muscle give
- Assess activation/time slope
- Ramp up counter force similar to activation speed to reflexively encourage full activation
- Start with better side
Muscle Testing Scale

- 5: Normal
- 5-: Very difficult to overpower but some asymmetry
- 4+: High resistance; or asymmetric
- 4: Moderate resistance
- 4-: Minimal resistance; or asymmetric

- 3+: Antigravity, good range of motion, no resistance; asymmetric
- 3: Antigravity, moderate range of motion
- 3-: Antigravity, limited range of motion; asymmetric
- 2: Movement with gravity removed (horizontal plane)
- 1: Muscle contraction but no limb movement
- 0: No muscle contraction
When Patients are not Consistent

• Encourage when possible
  • “Please give me everything you’ve got so we can make our best assessment”

• Always start with the good or better side
  • “Let’s start on the good side so I know you understand the instructions”

• Traditional methods for proving non-organic are not perfect
  • If one side is strong, check bilateral to see if good side is now weak
  • Check flexion and extension repeatedly in rapid succession
  • Vary activation counter-force

• OK to put simple qualifiers in note
  • Motor strength limited due to pain, ?APD
  • Don’t put commentary/interpretation in exam section

• Document discretely
  • Motor exam “tremulous”, “shaky”, “decreased activation”, “guarded”... but at least 4/5 strength...
Reliability of Deep Tendon Reflexes

- 20 Patients scored by 3 neurologists
- 160 Total Reflexes:
  - 26% complete agreement
  - 46% had disagreement in 1/3 raters by 1 point
  - 28% had disagreement in 1/3 raters by 2+ points
- 80 reflex pairs, regarding symmetry
  - 55% complete agreement
  - 30% had disagreement in 1/3 raters by 1 point
  - 15% had disagreement in 1/3 raters by 2+ points
- Operator dependent

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<td>Just elicitable</td>
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<td>Low response</td>
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<td>Moderately low</td>
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<td>Brisk</td>
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<td>Very brisk</td>
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<td>Exhaustible clonus</td>
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<td>Continuous clonus</td>
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5. Reflexes

- Sitting up
- Side to side
- Keep limbs at rest and similar position
- Swing hammer with wrist and fingers, let it fall naturally
- Strike “through the joint”
- Keep it simple
- Rarely have to tell them to “relax”
- **Three in a row** for consistency
- Look at muscle contraction, not limb movement
  - Speed, amplitude, duration, number of contractions, recruitment, spread
- 0: none
- Tr: maybe, not consistent
- 1: Hypoactive
- 2: Normal
- 2+: Normal but brisk
- 3: Hyperactive
- 4: Non-sustained clonus or several contractions
- 5: Sustained clonus or multiple contractions
6. Sensory

- **Safety pin**
  - Poke or scratch
  - 1 per second
  - Steady the patient limb for safety
  - Arms/hands and feet/legs distal to proximal, side-to-side
  - Lower back

- **Vibration**
  - Distal joint, can go higher if absent
  - Start in hands before feet
  - “What do you feel?”
  - “Tell me the moment you can no longer feel the vibration”
  - Can ask “Can you still feel it...how about now...”
  - Can do more than one trial for consistency

- **Scale**
  - Fingers are 5-10 seconds better than feet
  - Minimal: You can feel for 5-10 seconds longer
  - Mild: 10-15 seconds longer
  - Moderate 15-20 seconds longer
  - Severe: 20+ seconds longer
  - Absent

- **Proprioception**
  - “Tell me up or down as soon as you feel your finger move.”
  - Start in hands before feet, demonstrate same direction twice
  - Isolate the distal phalynx, hold on either side
  - 3-5 degrees for hands
  - 5-10 degrees for feet

- **Scale**
  - Mild (1-2 errors or requires slightly larger movements)
  - Moderate (misses many movements, requires full movement)
  - Severe (Unable to feel movement at that joint)
Reliability and Validity of Babinski Testing

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<th>Table</th>
<th>Interobserver reliability and validity of the Babinski sign and foot tapping</th>
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Miller TM, Johnson SC. Neurology 2005:65:1165-1168
Plantar Reflex

- Let patient know you are going to scratch the bottom of their foot to check a reflex
- Ensure entire leg is relaxed
  - Hand holding heel
  - Lying in bed
- Keep foot at approx 90 degree position
- Use tines of tuning fork
  - One tine on foot undersurface to 5th toe, then across towards big toe (Babinski)
  - One tine on lateral foot (Chaddock maneuver)
- Don’t do too fast (5-6 seconds)
- Start gentle, increase pressure
  - Originally described as noxious and painful, but not always necessary
7. Stance

- Stand with feet touching together (front and back), eyes open
  - Normal: Some movement at toes, occasional movement at ankles
  - Minimal: Relying more on ankle movement
  - Mild: More ankles plus knees/hips; sways but does not fall
  - Moderate: Unsteady after a moment
  - Severe: Unable to do without falling

- Close your eyes
  - Normal: Some movement at toes, some movement at ankles
  - Minimal: A lot of ankle movements, occasional movement at knees/hips
  - Mild: Relying more on knees/hips; sways but does not fall
  - Moderate: Unsteady after a moment
  - Severe: Unable to do without falling
General Scales - Sample

• 0: Normal
• 1: Subtle
  • May not be obvious
  • May not be consistent
  • May be normal for some
  • Patient may not be aware
• 2: Mild
  • Clearly apparent
  • Consistently present
  • May have mild difficulties that are not limiting
  • Often have corroborating findings
  • Patient sometimes aware of difference/problem

• 3: Moderate
  • Affecting some function
  • Easy to see
  • Patients often have a clinical correlate that is limiting
• 4: Severe
  • Affect most or all function
  • Very limited or non-functional
  • Patients always aware (“My useless arm”)

• Use “+” for asymmetry
  • I sometimes use + if a little worse than descriptors
  • I sometimes use range (2-3) if a lot worse but not quite at top number
  • Descriptors: “Labored”, “effortful” if not full effort
8. Gait

- Walk 25 feet up/down hallway several passes
- Initiation
- Posture
  - Trunk, upper body
- Arm swing
- Symmetry
  - Hips
- Tone
  - Hips, knee flex/ext
- Stride length
  - Shuffling, shortened
- Base of support
- Stance time (listen)
- Staggering
- Toe clearance/foot scuffing
- Steps to turn
- Comfort (antalgic, cautious, etc)
Balance/Coordination

• Walk on heels a couple steps, now walk on on toes
  • Strength test
  • Can do assisted if necessary (notate)
• Walk a straight line, heel-to-toe, 8 steps
  • Keep up speed
  • Look down at feet
  • Don’t over cross you feet
  • Touch the toes to the heel
• Hop 10 times on either foot without touching wall unless you have to
Exam Conclusions

• Take your Time, Convince Yourself that Something is Present/Absent

• Before you Begin, Pause and Consider Hypotheses and Expected Findings

• After Each Section, Pause and Consider Consistency, Reliability, and Confidence in Findings

• At the End, Consider Big Picture: Does Everything Make Sense and Fit with their Story and Function?