FINAL EXAM, May 16, 2005  
BN 260  
7 pages, 142 points

I. MULTIPLE CHOICE. Think of these as multiple true-false questions. For each set there may be one, more than one, or no correct answers. On the scantron sheet, mark A for true, or B for false. You may also mark your answer on these pages, but the scantron sheet is the one that counts if there is a discrepancy. (75 points)

Oculomotor mechanisms that tend to **stabilize** images on the retina include
- 1. the vestibulo-ocular reflex
- 2. smooth pursuit
- 3. optokinetic movements - **stabilize background**
- 4. physiological nystagmus
- 5. saccades

The semicircular canals of the vestibular labyrinth
- 6. can be excited by rotation in one direction and inhibited by rotation in the opposite direction
- 7. are filled with perilymph
- 8. have otoliths
- 9. when damaged, may trigger nystagmus
- 10. respond well to the force of gravity

The withdrawal reflex (i.e. the flexor and crossed extensor reflex)
- 11. involves Ia fibers
- 12. is triggered by nociceptive stimuli
- 13. will often activate flexors ipsilateral to the stimulus, and activate extensors contralaterally
- 14. involves both excitatory and inhibitory spinal interneurons
- 15. involves multiple spinal segments

You examine a patient who has a hemiparesis involving the face, arm and leg on the **right**. Both the arm and leg are spastic, with marked stretch reflexes and hypertonia. Sensory exam shows a loss of two point discrimination on the right side as well. These observations are consistent with
- 16. occlusion of branches of the right middle cerebral artery
- 17. a lesion in the left internal capsule
- 18. a lesion in the mid to upper levels of the medulla on the right
- 19. a tumor that has destroyed the midbrain tectum on the left
- 20. a lesion of the mid cerebral spinal cord on the right

The transition from wakefulness to nonREM (slow wave sleep) in adults normally includes:
- 21. a decrease in the frequency and an increase in the amplitude of the EEG
- 22. a widespread increase in the synchronization of cortical electrical activity
- 23. almost complete cessation of eye movements
- 24. a decrease in the activity of locus coeruleus (noradrenergic neurons) and raphe nuclei (serotonergic neurons).
  - **Going into SWS or REM?**
- 25. an increase of the metabolic rate of the brain
  - **REM sleep**

A right homonymous hemianopia may result from
- 26. sagittal transection of the optic chiasm
- 27. occlusion of the left middle cerebral artery **MCA**
- 28. complete section of the left optic nerve
- 29. occlusion of the left posterior cerebral artery **PCA**
- 30. occlusion of the left anterior cerebral artery **ACA**
Alpha motoneurons:

- (31) receive monosynaptic excitatory inputs from corticospinal tract axons
- (32) receive monosynaptic excitatory inputs from Ia axons - monosynaptic reflex synapse on a MN
- (33) receive inhibitory inputs from spinal interneurons - Renshaw cells
- (34) receive inputs from other segments of the spinal cord
- (35) receive inputs from neurons on the contralateral side of the cord - flexor-crossed extensor reflex

A patient complains of left facial paralysis. On examination you notice that he is unable to contract muscles of the left lower face but has no problems his left upper face. The right side of his face is fine, and there are no other physical findings. Which of the following are consistent with this patient’s condition?

- (36) Bell’s palsy (severing of cranial nerve VII fibers at the point of exit)
- (37) damage to left corticobulbar tract - decussating tract to intranuclear damage need to injure after LMN to get ipsilateral signs
- (38) damage to right motor cortex in the face region
- (39) this patient will show fasciculation of muscles of the lower left face
- (40) damage to right corticospinal tract

The primary motor cortex on the left side receives its blood supply from both the anterior and posterior cerebral arteries.

- (41) can be easily activated by transcranial magnetic stimulation
- (42) is a site of origin of cortico-cortical, corticostriatal, cortico-ponto-cerebellar, and corticospinal fibers
- (43) is located in the postcentral gyrus
- (44) is critically involved in the production of skilled finger movements on the right side

Localized damage to the cerebellum can lead to the following:

- (45) ipsilateral decrease in muscle strength
- (46) ataxia that is worsened when the eyes are closed
- (47) resting tremor
- (48) hypotonia
- (49) micrographia

Spasticity can result from

- (50) a lesion of the internal capsule
- (51) a stroke affecting the parietal cortex
- (52) damage to alpha motor neuron axons
- (53) damage to primary sensory axons
- (54) a tumor leading to compression of the cerebral peduncles

A narcoleptic patient

- (55) never enters REM sleep directly from the waking state
- (56) has frequent epileptic seizures
- (57) is most susceptible to cataplexy during periods of emotional excitement
- (58) may abruptly lose most muscle tone while still conscious
- (59) rarely has periods of slow-wave sleep
Which of the following cells regularly turn over (i.e. die and regenerate) throughout life?

- 61. hair cells of the vestibular macula
- 62. olfactory receptor neurons
- 63. gamma motoneurons
- 64. taste receptor cells
- 65. retinal photoreceptors

A patient with Wernicke’s (fluent) aphasia

- 66. is usually acutely and obviously aware of his language deficits
- 67. is usually dysprosodic
- 68. usually has poor comprehension of spoken words, but good comprehension of written words
- 69. usually has no trouble repeating words spoken to him
- 70. rarely uses paraphasias when speaking

Match the lesion with the clinical picture to the right (for this question, mark the correct letter, from A to E, for each question)

- E 71. Lesion of the left PPRF ⇒ horizontal deviation of the right eye (cranial nerve VI)
- A 72. Lesion of the right abducens nerve
- C 73. Lesion of the left MLF (medial longitudinal fasciculus) ⇒ right MR doesn’t work
- B 74. Lesion of the right abducens nucleus
- D 75. 1 ½ syndrome (left MLF and left abducens nucleus lesion)

II. List four appropriate neural structures or regions under each heading (8 points)

<table>
<thead>
<tr>
<th>Tonotopically organized</th>
<th>Somatotopically organized</th>
</tr>
</thead>
<tbody>
<tr>
<td>basilar membrane</td>
<td>1° somatosensory cortex</td>
</tr>
<tr>
<td>1° auditory cortex (A1)</td>
<td>spinal gray matter</td>
</tr>
<tr>
<td>MGN of the thalamus</td>
<td>VPL of the thalamus</td>
</tr>
<tr>
<td>inferior colliculus</td>
<td>dorsal column nuclei (cuneate, gracilis)</td>
</tr>
</tbody>
</table>
III. In the space provided (i.e. a word, or short phrase), contrast REM sleep and non-REM sleep with respect to the features indicated. (10 points)

<table>
<thead>
<tr>
<th></th>
<th>REM</th>
<th>Non-REM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle tone in the limbs</td>
<td>atonia (paralysis)</td>
<td>hypotonia</td>
</tr>
<tr>
<td>EEG rhythms</td>
<td>desynchronized</td>
<td>Synchronized</td>
</tr>
<tr>
<td>Thought processes</td>
<td>vivid dreams</td>
<td>also dreaming</td>
</tr>
<tr>
<td>Eye movements</td>
<td>rapid eye movements</td>
<td>Some eye movement</td>
</tr>
<tr>
<td>Autonomic activity</td>
<td>mainly sympathetic</td>
<td>mainly parasympathetic</td>
</tr>
</tbody>
</table>

IV. In the space provided, place the number or name of the cranial nerve whose dysfunction would produce the clinical finding. Indicate which side is affected. (18 points)

<table>
<thead>
<tr>
<th>Side</th>
<th>Nerve</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>CN VII</td>
</tr>
<tr>
<td>R</td>
<td>CN VII</td>
</tr>
<tr>
<td>R</td>
<td>CN IX</td>
</tr>
<tr>
<td>L</td>
<td>CN III</td>
</tr>
<tr>
<td>L</td>
<td>CN III</td>
</tr>
<tr>
<td>R</td>
<td>CN II</td>
</tr>
<tr>
<td>L</td>
<td>CN IV</td>
</tr>
<tr>
<td>L</td>
<td>CN XI</td>
</tr>
<tr>
<td>L</td>
<td>CN XII</td>
</tr>
</tbody>
</table>

[o.d.-right eye, o.s.-left eye, o.u.-both eyes]

- Effacement of the nasolabial fold on the right
- Hyperacusis in right ear (two possibilities, either will do) o.r. CN VII on R
- Hoarseness and deviation of uvula to the left
- Ptosis and mydriasis, o.s. (left eye) CN III - spino-cerebellar tract
- Illuminate either eye, pupil of o.d. but not o.s. constriacts
- Neither pupil constriacts when o.d. illuminated, both pupils constriacts when o.s. illuminated.
- Touch left cornea, neither eye blinks; touch right cornea, both eyes blink
- Inability to rotate head to right against moderate resistance
- Tongue deviates to right on protrusion
V. Fill in the number of the appropriate structure(s). Some numbers may be used more than once; some numbers may not be used at all.

10. Neurons here synthesize dopamine Substantia nigra
5. Neurons here degenerate during Huntington’s disease Caudate
9. Lesions here sometimes lead to hemiballismus Subthalamic nucleus
1. Lesions here may lead to signs of spasticity Internal capsule
5, 6. These two structures together comprise the striatum (2 numbers) Caudate, Putamen
5, 6. This structure receives dopaminergic axons from substantia nigra Striatum
4. Neurons here relay information from the basal ganglia to the cerebral cortex VLo of thalamus
8. Neurons in part of this structure receive direct inputs from the striatum GPu, GPe
10. Degeneration of neurons in this structure lead to Parkinson’s disease Substantia nigra
3, 7, 1. These three structures are not considered part of the basal ganglia (3 numbers)

VI. This is a view of the main arteries along the ventral surface of the brainstem. Write the name of the artery indicated by each arrow (10 points).
VII. List three of your favorite parts of the brain, and give two names (synonyms) for each of them (e.g. primary auditory cortex and Heschl’s gyrus). (3 points)

1. primary visual cortex  striate cortex
2. primary sensory cortex  S1
3. primary motor cortex  M1

VIII. Short answers. (8 points)

Clinical Case 1: A 67 year old right-handed gentleman with atrial fibrillation had the sudden onset of weakness of the right face and arm, as well as difficulty speaking. There was no loss of consciousness. He was transferred by ambulance to the hospital. Neurologic exam revealed:

- An asymmetric smile (the right side was weak) and a flattened naso-labial fold on the right. The eyes shut strongly and symmetrically. **CN XII, supranuclear damage**
- The left arm was strong, the right arm could barely be raised off the bed. **Paresis of R arm**
- The legs were strong bilaterally.
- A Babinski sign was present on the right.
- All commands were understood
- Speech was **halting and effortful**, but meaningful. The patient was clearly frustrated by this. **Non-fluent aphasia**
- Sensation appeared intact, and coordination was intact for the left arm and both legs (right arm was too weak to test).

Where is the lesion most likely to be? (be as specific as possible; indicate laterality)

left cortex, near Broca’s area (inferior frontal lobe near the face and arm representation in M1)

If this patient’s deficits were caused by a stroke, a branch of which artery is most likely occluded?

a branch of the Middle Cerebral Artery (MCA)
Clinical Case 2: A 24 year old woman reports that she is having trouble seeing. The difficulty started yesterday, and has worsened slightly since then. You ask her to clarify what she means, and she says that her vision is blurry AND sometimes she sees double. On your exam, everything is normal except her pupils, vision, AND her eye movements. \( \checkmark \text{diplopia} \)

- Visual acuity is 20/20 in the left eye (i.e., normal); visual acuity is 20/200 in the right eye (abnormal)
- She has a right “relative afferent papillary defect” (i.e., when you shine a light in her left eye, and then into her right eye, the eyes dilate somewhat instead of staying constricted) \( \text{right eye CN III is abnormal} \)
- Visual fields are broadly normal, but when she shuts her left eye she has non-uniform and patchy “holes” throughout her visual fields where she can’t see anything. \( \text{scotoma, O.D.} \)
- When she is looking straight ahead, she sees only one image (i.e., normal)
- When she looks left or right, she sees two images (i.e., abnormal)
- Her eye movements look like this:

Where is/are the lesion(s)? Indicate laterality(ies) and specific structure(s) where possible. She went to an optometrist before seeing you, and there was nothing wrong with her lens, cornea, or vitreous.

Both the right and left MLF (medial longitudinal fasciculi) are damaged

Optic neuritis of the right CN II

What is the appropriate medical/neurologic phrase to describe her eye movement abnormality?

Bilateral intranuclear ophthalmoplegia