BN 260 FINAL EXAMINATION May 9 2001 (1.5 hours to complete) 8 Pages, 150 Points

I. In the space provided, name the labeled structure or feature. (15 points)

1. corpus callosum (genu)
2. caudate
3. fornix
4. claustrum
5. lateral ventricle (posterior horn)
6. third ventricle
7. septum pellucidum
8. lateral ventricle (anterior horn)
9. internal capsule
10. insula
11. putamen
12. globus pallidus
13. caudate
14. hippocampus
15. cerebellum (vermis)
II. Place the ONE letter from the figure next to the function or phenomenon BEST associated with the structure indicated. A letter may be used once, more than once, or not at all. (10 points)

K. A lesion here would cause ataxia and pendular knee jerks. Cerebellum/penumbria

E. A lesion here would cause ataxia and a Romberg sign. 

B. Primary taste afferents located here. 

C. A lesion here would interrupt or reduce blinking when ipsilateral cornea touched. 

D. Cerebellar climbing fibers arise here. 

A. Damage here would cause hoarseness. 

F. Lesion here would paralyze contralateral arm and leg. 

H. A lesion here could result in piosis, miosis and anhydrosis. 

A lesion here would interrupt pain and temperature signals from contralateral arm and leg. 

G. These axons arise from the most caudal somatic motor nucleus of the brainstem.
III. MULTIPLE CHOICE. Circle ALL correct answers or completions. There may be one, more than one or no correct completion for a given question. (Think of these questions as multiple true-false; points are lost if a correct completion is not circled or an incorrect completion is circled.) (60 points)

1. Mr. Botz is spun repeatedly while sitting upright on a special stool with his head tilted forward 30 degrees. When he **STOPS** spinning, he is observed to have horizontal *nystagmus* with the quick phase to the right. From this you can infer that

   a. his eyes are diverging and converging
   b. before he was stopped he was spinning to the left
   c. there is now more neural activity in the right than in the left VIIth nerve (vestibular component)
   d. the axons of internuclear neurons in the left and right medial longitudinal fasciculi are being activated in alternation, i.e. first one side and then the other
   e. discharge rates in the IIIrd nerve on the right and the VIth nerve on the left rise and fall together

2. As he sits in a chair, **cold** water is flushed into Mr. Botz’s left **external** ear canal. Nystagmus with the quick phase to the right results.

   a. His head is tilted back and he is looking at the ceiling when this occurs
   b. There is utriculopedal flow of endolymph in his left lateral semicircular canal
   c. There is utriculofugal flow of endolymph in his right lateral semicircular canal
   d. Neurons of Scarpa’s ganglion innervating the utricle and saccule on the left are silent, i.e. discharge no action potentials assuming his head is still has no linear Accele...
   e. Mr. Botz has a lesion of the brainstem

3. The muscle cells of a single **motor** unit in the gastrocnemius muscle

   a. are each innervated by a different alpha motor neuron
   b. share the same biochemical and mechanical properties
   c. will all atrophy if their alpha motor neuron is cut
   d. contract simultaneously when the muscle is fibrillating
   e. outnumber those of a typical motor unit in an **intrinsic** hand muscle

4. Flaccid paralysis might be caused by

   a. interference with neuromuscular transmission
   b. a hemorrhage in the internal capsule
   c. damage to the cerebellum
   d. a disease that kills motor neurons
   e. a disease that interferes with conduction in peripheral nerves

5. Activation of **gamma** motor neurons

   a. allows the muscle spindle to shorten as the extrafusal fibers shorten
   b. can change the correlation between Ia discharge frequency and muscle length
   c. can be abnormally high in spasticity
   d. can result in increased depolarization of alpha motor neurons via the gamma loop
   e. has the same effect as activation of Renshaw cells

6. The neural circuit responsible for the **myotatic reflex**

   a. can automatically adjust muscle force to changes in load
   b. is only activated involuntarily
   c. allows the extraocular muscles to stabilize the eye’s position in the orbit
   d. is interrupted with damage to the corticospinal tract
   e. is contained within a single spinal cord segment
7. Spinal reflexes evoked by painful stimulation of the skin
   a. involve circuitry distributed over multiple segments of the spinal cord
   b. activate excitatory, but not inhibitory, interneurons within the spinal cord
   c. can result in coordinated movements of both the ipsilateral and contralateral limbs
   d. can override the antigravity function of the myotatic reflex
   e. employ neural circuits involved in the generation of patterned limb movement during locomotion

8. Descending somatic motor pathways (long motor tracts) that enter the spinal cord
   a. include the axons of cells of the caudate nucleus
   b. synapse only on alpha and gamma motor neurons
   c. include the axons of certain cells in the cerebral cortex, midbrain, pons and medulla
   d. have all decussated somewhere in the brainstem
   e. travel in the dorsal columns of the cord

9. Loss of the ability to make independent (fractionated) movements of the fingers of the right hand would follow damage to the
   a. hand area of the left primary motor cortex
   b. left cerebellar hemisphere
   c. right half of the spinal cord at the first (highest) cervical segment
   d. right red nucleus
   e. left vestibular nucleus

10. Brain regions projecting monosynaptically to cortical area 4 (primary motor cortex) include the
    a. ventral lateral nucleus of the thalamus
    b. spinal cord
    c. cortical area 6 (PMA and SMA)
    d. dentate nucleus of the cerebellum
    e. caudate nucleus

11. Arteries supplying the cell bodies and axons of the long motor tracts include the
    a. basilar artery
    b. middle cerebral artery
    c. branches of the intercostal arteries
    d. anterior cerebral artery
    e. posterior cerebral artery

12. Dyskinesias and dystonias occur with damage or disease in the
    a. striatum
    b. cerebellar vermis
    c. subthalamic nucleus
    d. supplementary motor area of cortex
    e. substantia nigra

IV. Circle the T or the F to indicate whether the statement is True or False (1 point each) (27 total)

T  F  The subthalamic nucleus is the locus of damage in patients with hemiballismus.
T  F  The cerebral cortex can excite itself via the direct pathway through the basal ganglia.
T  F  Cerebellar lesions disturb conscious position sense on the same side as the lesion.
The fastigial nuclei are the most lateral deep cerebellar nuclei.

Cerebellar ataxia gets worse when the patient is blindfolded.

Climbing fibers to the cerebellum arise from the dentate nucleus.

The left red nucleus receives synaptic input from the right interpositus nucleus and sends its axons into the right lateral column of the spinal cord.

Cerebellar Purkinje cells inhibit those neurons on which they synapse.

Cells of the deep cerebellar nuclei receive excitatory input from collaterals of climbing fibers and mossy fibers.

The middle cerebellar peduncle arises from the pons.

The left cerebellar hemisphere is functionally connected to the left cerebral hemisphere.

Pendular knee jerks are a form of spasticity.

Optokinetic movements and the VOR act together to stabilize the direction of gaze when the head moves with the eyes open.

The MLF syndrome cannot be distinguished from the effects of cutting both medial rectus muscles.

The inferior rectus and superior oblique are both depressors of the eye.

A tumor of the pineal may result in paralysis of voluntary upward gaze.

Total paralysis of conjugate horizontal gaze to the right could result from a large lesion of the dorsal pons on the right.

A lesion of the medial geniculate nucleus of the left hemisphere would result in pure word deafness.

Fluent but incomprehensible speech is characteristic of Broca's aphasia.

Repetition is disturbed in both fluent and non-fluent aphasia.

In non-fluent aphasia, writing will only be disturbed if there is an accompanying paralysis of the right arm.

Alexia with agraphia is a fancy term for illiteracy.

The dominant EEG frequencies of the waking state are higher than those in Stage 4 sleep.

Body temperature rises in REM sleep but not in Slow-Wave sleep.

As a narcoleptic individual goes to sleep, the first sleep stage to appear is REM.

The total time spent each night in REM sleep decreases with age.

The amount of time spent in REM sleep on a given night increases if the individual has consumed alcohol prior to going to bed.
V. Matching. In the space provided write the number of the structure on the right where damage or some pathological process could lead to the clinical finding on the left. A number may be used once, more than once or not at all. (10 points)

15. spontaneous otoacoustic emissions
1. facial nerve

1. hyperacusis
2. inferior occipito-temporal cortex

11. superior quadrantanopia
3. superior cerebellar peduncle

12. fixed, dilated pupil
4. optic chiasm

8. astereognosis with preservation of primary somatic sensation modalities
5. Trochlear nucleus

4. bitemporal hemianopia
6. substantia nigra

3. dysdiadokokinesis
7. medial longitudinal fasciculus

9. afferent pupillary defect
8. posterior parietal cortex

6. cogwheel rigidity
9. optic nerve

2. prosopagnosia
10. anterior white commissure

11. Meyer's loop
12. Edinger-Westphal nucleus

13. Supplementary Motor Area
14. inferior colliculus

15. organ of Corti

VI. In the space provided define the following terms. (2 points each)

1. dissociated sensory loss
Dissociated sensory loss is when one somatic sensory modality is affected but not the other. For example, pain and temperature will be lost on 1 part of the body (e.g., arm), but touch, pressure, or position sense (DCML) intensity is maintained (or vice versa).

2. secondary hyperalgesia
Secondary hyperalgesia is the area surrounding the zone of injury, where there is increased sensitivity. Touching this area causes pain even though it is not injured, therefore the secondary hyperalgesia area has an increased sensitivity. This is due to rewiring in the spinal cord.

3. anesthesia dolorosa
Anesthesia dolorosa is a phenomenon whereby an area that is anesthetized or denervated can still feel pain. It illustrates how pain is centrally regulated.

4. hemineglect syndrome
Hemineglect syndrome is a disorder in which the patient ignores 1/2 of its body and 1/2 of the world, so stimuli from 1/2 of the environment is ignored. This is due to a lesion in the posterior parietal cortex (on the contralateral side of the neglected 1/2 of the world).

5. H-reflex
If they injure the right parietal cortex, the patient will ignore stimuli to his left arm when clavicle, simultaneously simultaneous.

The H-reflex occurs when you shock the muscle nerve and record from the muscle when trying to determine the integrity of the monosynaptic reflex ($I_a$). The H-reflex is due to the action potential that it is started in the $I_a$ fibers which then synapses on the o motor neuron causing an action potential to travel down the o motor neuron and depolarizes the muscle. Therefore the H reflex occurs after the M reflex.
VII. Clinical Case 1. (6 points) Mr. Jones, age 70, is admitted to the hospital after complaining of the sudden onset of light-headedness and double vision. Neurological examination on Day 1 reveals abnormalities only with motions of the eyes:

- Inability to ADduct or ABduct O.S.
- Inability to ADduct O.D. ABdution O.D. preserved
- Elevation and depression intact O.U.
- Convergence preserved

Is there evidence on Day 1 that Mr. Jones has suffered a lesion inside his CNS? If so, what is the evidence?

**Yes**

He has a $\frac{1}{2}$ syndrome affecting both MLFs. MLF lesions are localizing to inside CNS.

Where and on which side is the damage that caused Mr. Jones's deficits on Day 1?

His lesion is on the left (affecting both MLFs) and knocking out nucleus of VI (left) in the pons.

(Dorsal, left pons)

On Day 2 he complains that he cannot see. Upon examination at that time he is found to be completely blind. What might account for the evolution of the deficits on Day 2?

He could have had stroke affecting his posterior circulation. His problems on Day 1 could be due to a partial occlusion of a branch of the basilar feeding the left pons. A clot could have embolized blocking the basilar artery which would block blood from going into the posterior cerebral arteries and therefore his occipital lobe on both sides would be ischemic, leading to blindness.

Answer explanation: Could be that he has hypertension and it caused a cerebrovascular event.

VIII. Clinical Case 2, (4 points). This 60 year old female was brought to the emergency room by her daughter because of the sudden onset of inability to speak and right hand clumsiness. Her symptoms began abruptly and showed some resolution over the next few hours. Neurological examination revealed the following:

- She was able to follow simple commands and appeared to comprehend conversational speech, but her responses were effortful and limited to one-word answers. **Broca's area**
- She was unable to read aloud and could write her name but nothing else.
- Her right nasolabial fold was flattened (effaced) and her right arm was weak.
- Tendon reflexes were symmetrical in the arms but she had a Babinski sign on the right. **Corticospinal tract**

Is this patient's lesion inside or outside the CNS? What is your evidence?

**Inside the CNS:** aphasia, + Babinski

Where and on which side is the damage located?

Her lesion is in the **left cerebral cortex**, affecting Broca's area and the left motor strip (M1) (lateral).
IX. Clinical Case 3. (4 points) This 40 year old man was seen by a neurologist for a complaint of weakness in his right leg of about two weeks duration. Neurological examination revealed the following:

- Strength and tendon reflexes in arms within normal limits.
- Right leg weaker than left; no muscle wasting detected.
- Knee jerks and ankle jerks brisker on right than on left.
- Babinski sign on right.
- Perception of pin prick more vivid below the knee on the left than on the right. Touch and position sensitivity within normal limits elsewhere.

Is there damage to the CNS in this man? If so, what is the evidence?

Yes - dissociated sensory loss, crossed syndrome.

Babinski

(if he also has hyperaesthesia along ul nerve then spasticity)

You order an MRI scan as part of your investigation. Where would you expect to find an abnormality?

He has a lesion in his right spinal cord in the lumbar area.

The lesion appears to be mainly laterally, anterior lateral on the left, not affecting the 

--- corticospinal tract and anterolateral system.

X. Clinical Case 4. (4 points) Mrs. Smith, a 64-year-old housewife, was admitted to the hospital for evaluation of progressive loss of hearing in the right ear, right facial numbness, and increasing headaches. Neurological examination revealed the following:

- Bilateral papilledema. ↑ intracranial.
- Decreased pain and touch sensibility over the maxillary and mandibular divisions of the right trigeminal nerve. The corneal reflex could not be elicited by touching the right cornea and the patient did not feel touch over the cornea on the right.
- Moderate right facial weakness was present with a droop to the right corner of the mouth, a widened right palpebral fissure, and absence of blinking with the right eye.
- During the Weber test, sound was heard in the left ear and not the right.
- Motor and sensory system examinations were otherwise normal.

Is this patient's lesion inside or outside the CNS? What is your evidence?

- Outside because there is no evidence it is inside (no spatiality, homonymous hemianopia, no aphasia, no hemiparesis, no dissociated or crossed syndrome, etc.)

It appears that the patient has a tumor growing in the cerebello-pontine angle involving nerves V, VII, VIII.

Where and on which side is the lesion most likely located?

Lesion is on the right side in the CPA angle involving V, VII, VIII.