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9.01 Introduction to Neuroscience
Fall 2007

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9.01 Recitation (R02)

RECITATION #8: Tuesday, November 27th, 2007

Outline of Recitation:

- I. Review of Material:
 - a. **CHEMICAL CONTROL OF BRAIN** (Professor Bear)
 - Lecture: 11/14
 - Readings: Chapter 15
 - b. **ALZHEIMER'S DISEASE** (Professor Tsai)
 - Lecture: 11/19
 - Readings: PowerPoint Presentation (on MIT server)
 - c. **EATING & MOTIVATION** (Professor Bear)
 - Lecture: 11/26/07
 - Readings: Chapter 16
- II. Practice Exam Questions

CHEMICAL CONTROL OF THE BRAIN:

Patterns of communication in the nervous system:

- (1) **Point-to-point systems** → neuron synapses on a few neurons
- structure that uses point-to-point: dorsal thalamus to neocortex

(2) Hormones released by the hypothalamus

Overview:

- *Secretory hypothalamus* regulates *homeostasis* (maintenance of the body's internal environment including temperature, blood volume, pressure, O₂ conc., etc)
- By secreting chemical directly in the bloodstream, the secretory hypothalamus can influence functions throughout brain and body

Pathway:

- *Periventricular zone* of hypothalamus has *neurosecretory cells* that send axons to the *pituitary gland*
- *Magnocellular neurosecretory cells* extend into the **posterior pituitary**

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- *Parvocellular neurosecretory cells* extend into the **anterior pituitary**
- *the anterior pituitary is an actual gland; while the posterior pituitary is part of the brain

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(3) Networks of neurons of ANS activate tissues in the body

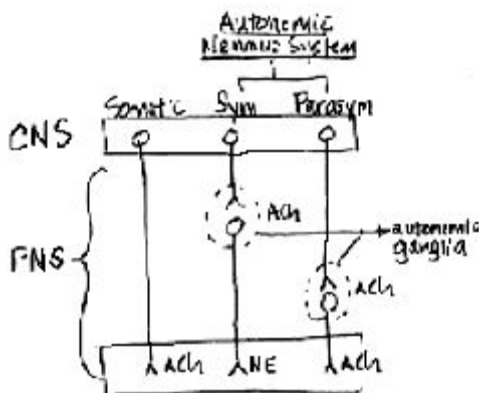
Overview:

- *Periventricular zone* of hypothalamus also controls the **Autonomic Nervous System (ANS)**
- Actions of ANS are usually carried out without conscious control, and are typically multiple, widespread and relatively slow (in comparison to somatic motor system).

Pathways:

- **Sympathetic vs. Parasympathetic divisions**

	Sympathetic	Parasympathetic
General effect	Fight, flight, fear, sex Increases heart rate Decreases digestion	Rest, digestion Decreases heart rate Increases digestion
Point of origin	Middle of spinal cord (thoracic / lumbar)	Brain stem, sacral spinal cord
Ganglion location	Closer to cord	Closer to target organ
Neurotransmitter	Preganglionic: Acetylcholine Postganglionic: Norepinephrine (except adrenal medulla, where it's both Norepinephrine and Epinephrine)	Preganglionic: Acetylcholine Postganglionic: Acetylcholine



- **Also Enteric Division**

Controls physiological process of transport and digestion of food. Neural system found in lining of esophagus.

(4) Diffuse modulatory systems have divergent axonal projections

- Core system of small set of neurons (most from brain stem) influence many other neurons (axons may contact with more than 100,000 pathways)
- Not classical synapse, synapse releases neurotransmitter into extracellular fluid can diffuse to many neurons

Diffuse Modulatory Systems:					
Neurotransmitter:	Origin → Target	Function	Disorder associated w/it	Treatment	Drugs that affect it
Norepinephrine (NE)	Locus Coeruleus (pons) → all over brain	novelty detector wakefulness	Depression	MAO inhibitors tricyclics	
Dopamine (DA)	Ventral tegmental (midbrain) → nucleus accumbens	motivating behavior	Schizophrenia	haloperidol	Amphet, Heroin, Nicotine
	Substantia nigra → striatum	movement	Parkinson's	L-dopa	
Serotonin (5HT)	Raphe nuclei (brain stem) → all over brain	mood, pain control, wakefulness	Depression	MAO inhibitors fluoxetine tricyclics	LSD
Acetylcholine (ACh)	Basal Nucleus Meynert → cortex Medial septal nuclei → hippocampus Pons/midbrain tegmentum → thalamus	learning, memory modulates sensory stimuli	Alzheimer's		

Figure from Brown Neuro website (Prof. Bear)

ALZHEIMER'S DISEASE:

Important points from lecture:

Pathological features of AD:

(1) Brain atrophy

(2) Amyloid plaques

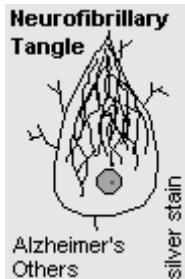
APP → Aβ → Plaques → can affect hippocampus, glutamate receptors; etc. (studies suggest)

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- important genetics of AD: missense mutation in APP and the presenilins; also ApoE4
 - **transgenic mice over expressing APP** → increased A β
 - *found transgenic mice accumulated A β *56
 - experiment: gave purified A β *56 to young rats and saw memory impairment
- IMPORTANT: know how to design experiments for exam!**

(3) Neurofibrillary Tangles (NFT)

Tau → P-Tau (phosphorylated Tau) → Tangles



- Tau usually bound to microtubules. When phosphorylated by kinases (CDK5, etc.) unbinds and aggregates.
- **Staining NFT** by silver stain, dyes, antibodies, etc.
- **Example experiment:** neurodegeneration found in an *inducible* mutant Tau transgenic mouse
- Tangles also found in other diseases

EATING AND MOTIVATION

Important points in lecture:

Hormones involved in eating: leptin, ghrelin (talked about in lecture), **insulin** (in text)

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See http://www.webhealth.com/wiki/Health_Newsletter:August_2003

Other things to know:

- **Ob gene** codes for leptin.
- **Electrical self-stimulation:** when the rat presses the lever, it receives a brief electrical current to an electrode in its brain
 - repeated self-stimulation when stimulating electrode was placed in areas of the medial forebrain bundle
 - stimulation may not be causing pleasure, but motivation to repeatedly press the lever
- **Dopamine** plays a role in motivation and addiction

PRACTICE EXAM QUESTIONS:

Review Questions for Ch. 15

1. SSRI's, a class of drugs used to treat depression, have which of the following effects on the brain:
 - a) They destroy the enzymes that degrade serotonin in the synaptic cleft.
 - b) They block the reuptake of serotonin in the presynaptic neuron.
 - c) They prevent axoplasmic transport from delivering serotonin to the axon terminal.
 - d) They increase the production of serotonin in the presynaptic neuron.
2. Which of the following is TRUE regarding the stress response:
 - a) Stress triggers the release of ACTH from the Hypothalamus.
 - b) CRH is released from the Anterior Pituitary.
 - c) Physiologic changes occur supporting the fight or flight response
 - d) All of the above
3. All of the following structures play a role in the release of cortisol into the blood stream EXCEPT
 - a) parvocellular cells of the hypothalamus
 - b) magnocellular cells of the hypothalamus
 - c) anterior pituitary
 - d) hippocampus
 - e) adrenal cortex
4. All of the following are characteristics of the diffuse modulatory systems in the brain EXCEPT
 - a) they tend to activate ionotropic receptors
 - b) axons are widely divergent
 - c) a small set of neurons form the core center for each system
 - d) most core centers are located in the brainstem
5. Which statement accurately describes some important differences between the parasympathetic and sympathetic components of the autonomic nervous system?
 - a) the parasympathetic system uses norepinephrine as its postganglionic neurotransmitter whereas the sympathetic system uses acetylcholine.
 - b) the parasympathetic ganglia are located closer to the target organ than to the central nervous system, whereas the sympathetic ganglia are located closer to the central nervous system than to the target organ.
 - c) the sympathetic nervous system is more active during non-REM sleep whereas the parasympathetic system is more active during REM sleep.
 - d) the sympathetic system can sympathize with us in our times of need, whereas the parasympathetic system is just too selfish to even care.
6. Many hallucinogens share a common structure with
 - a) dopamine
 - b) norepinephrine
 - c) serotonin
 - d) acetylcholine

Answers for Review Questions

1. B
2. C
3. B
4. A
5. B
6. C

Could not find questions on Alzheimer's and Chapter 16.