

9.14 class #33: Limbic system 2: Hypothalamus & limbic midbrain areas.

Readings:

Brodal, Per, "Chapter 18, Central autonomic system: hypothalamus", *The Central Nervous System. Structure and function*, 2nd Edition., Oxford Univ. Press, 1998, pp. 529-551.

Giesler, G. J., Jr., Katter, J.T. & Dado, R.J., "Direct spinal pathways to the limbic system for nociceptive information", *Trends in Neuroscience*, 1994, 17: 244 - 250.

Mesulam, M.-Marsel., " Chapter 1, Behavioral neuroanatomy: Large-scale networks, association cortex, frontal syndromes, the limbic system, and hemispheric specializations", *Principles of Behavioral Neurology*. Mesulam, M.-M. (ed.), Philadelphia, F.A. Davis Company, 2001, pp. 1-120
For this class, study, "The Limbic System" pp. 64-66

Abstracts of first three recommended readings (below).

Review:

Nauta & Feirtag, "chapter 8: Innervation of the viscera", pp. 108 - 119.

and/or: Brodal, "chapter 17: Peripheral autonomic nervous system", pp. 483-527.

Also recommended:

Bandler, R. & Shipley, M.T., " Columnar organization in the midbrain periaqueductal gray: modules for emotional expression?", *Trends in Neuroscience*, 1994, 17: 379 - 389.

Schwartz-Giblin, S. & McCarthy, M.M., "A sexual column in the PAG?" *Trends in Neuroscience*, 1995, 18: 129.

Arnold, A.-A. & Cepko, C.L., "Dispersion patterns of clonally related cells during development of the hypothalamus", *Dev. Biol.* 1996, 173: 148 - 161.

Mesulam, M.-Marsel., " Chapter 1, Behavioral neuroanatomy: Large-scale networks, association cortex, frontal syndromes, the limbic system, and hemispheric specializations", *Principles of Behavioral Neurology* Mesulam, M.-M. (ed.), Philadelphia, F.A. Davis Company, 2001, pp. 1-120
Pp.49-64, Paralimbic (Mesocortical) Areas; Limbic structures of the septal area, nucleus basalis, and piriform cortex; The amygdala, emotion, and affiliative behaviors: gateway into the neurology of value; The hippocampus and the binding of distributed information into explicit memory: gateway into the neurology of recollection.

Questions:

Giesler et al.:

1. Describe the methods that have been used to discover and examine the properties of the spino-hypothalamic tract. What are the advantages and disadvantages of each?
2. What besides painful stimuli may be conveyed by spino-hypothalamic tract axons?

Brodal:

3. Which major hypothalamic division can be divided into multiple distinct nuclei (e.g., by Le Gros Clark in 1936)? How can the remainder of the hypothalamus be characterized?
4. How can a circulating hormone like angiotensin II control hypothalamic neurons even though it does not pass through the blood-brain barrier?
5. What is the importance of afferents to the hypothalamus from the nucleus of the solitary tract in the hindbrain? Describe an alternate pathway.
6. The cingulate cortex (a paralimbic cortical area above the corpus callosum) projects to the hippocampal formation. Describe the pathway from there to the hypothalamus. How does a pathway go from there back to the cingulate gyrus? (The loop is called Papez' circuit.) (Note: Brodal on p. 532 summarizes a different pathway from cingulate cortex -- probably from anterior portions -- to hypothalamus *via* the septum.)
7. How does hypothalamus send influences to the cerebral cortex?
8. What is diabetes insipidus?
9. A person's mental state can influence the endocrine organs *via* the hypothalamus. The hypothalamus can also influence a person's mental state in major ways. What are some effects of disturbance of the hypothalamus during neurosurgical procedures?

Some additional questions, based on Nauta & Feirtag:

10. In Nauta's view, what is the relative importance of direct hypothalamus to spinal cord pathways vs. polysynaptic pathways? (A similar argument could be made for the spino-hypothalamic pathway.)
11. What is misleading about the names "autonomic nervous system" and "voluntary (somatic) nervous system"?
12. Contrast the styles of motor innervation of somatic muscles and smooth muscles (including the contrast between sympathetic and parasympathetic).
13. How does the innervation of the sweat glands in the skin differ from sympathetic innervation of other organs?
14. How does Nauta define homeostasis?
15. Describe Rudolf Thauer's experiments on disconnection of the hypothalamus in rabbits. How do the results support Nauta's view of the importance of polysynaptic pathways controlling visceral activities?
16. Contrast the pathways for hypothalamic control of the two divisions of the neurohypophysis (pituitary). (See also Brodal.)

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And do not forget: complete before Friday, May 3: Special assignment: Videotapes on human brain dissection by M.I.T. Prof. Walle Nauta. [Available in Reserve Book Room. Ask at desk.]

Nauta, W. J. H.," Tape 7, lesson 10: The fiber architecture of the cortical hemisphere (63 min.);
Tape 8, lesson 11: Corona radiata (15.5 min.), lesson 12 :Human brain cross sections (7.5 min.),
The gross anatomy of the human brain.

See also: Brodal text," chapter 17, Cerebral cortex", pp. 398-424. [This was previously handed out in class for session #26. Refer to the figures to see the sub-components of the large fiber systems discussed by Nauta.]