THE UNIVERSITY OF CONNECTICUT
Graduate School
Meds 384, Mammalian Neuroanatomy
Histology of Cerebral Cortex

Barr's: Chapters 14 & 15

CELLULAR ORGANIZATION

75% of cortical neurons are pyramidal neurons (projection, principal), which contain glutamate as neurotransmitter. Elicit EPSP in target neurons.

25% are local circuit neurons (interneurons, granular cells, stellate cells), which contain GABA, Parvalbumine, CB, peptides; elicit IPSP in target neurons.

Four main types of cerebral cortex:

Archicortex- old- 2-3 layers (example: hippocampus)
Paleocortex- 3 layerd (example: olfactory cortex)
Meso or transient cortex- (example: entorhinal, retrosplenial)
Neocortex- 6 layers (in men 95% is neoCx)

Neocortex is further divided into Brodmann's areas on the bases of Nissl stain (cellular density) and layer differences.
Cortical areas in animals are different- species differences.

Subdivision of the cerebral cortex: somatic, motor, association and limbic areas. There is a high degree of localization of the function in particular region of the cortex.

Sensory areas: primary visual, somatosensory, auditory
Motor areas: area 4
Limbic: cingulate, posterior orbital cortex
All other parts belong to association cortex.

HISTOLOGY SLIDES

Compare monkey and rat cortex. Histologically they are not different but cortical areas are differentially distributed. For example, in primates associative cortex comprises 80% (prefrontal, parietal and temporal).

Vertical organization- columns define by afferent and efferent inputs.
Best known are ocular dominance strips form by inputs from one or the other eye in the visual cortex. Columns are around 500um in width, and they are observed in different species. They should not to be confused with cellular columns that are stacks of cells with common physiological properties (although they may coincide).

FIBER SYSTEMS:

Association Fiber System:
a) U fibers- short fibers between gyri
b) Long fiber bundles: superior longitudinal fascicles (arcuate fascicle-connects Occipital, temporal, parietal and frontal Cx)
inferior longitudinal fascicles (connects occipital and temporal cortex)
c) uncinate fasciculus- connects temporal and frontal cortex
d) cingulum bundle- limbic connection
e) superior and inferior occiptofrontal fasciculus-long tracts connections. They connect frontal and occipital cortex.

Commissural Fiber System
Anterior commissure –connects 2 temporal lobes and both frontal lobes (double U structure).
Corpus callosum- connects two hemispheres
Hippocampal commissuer- connection between two fornices

Projection Fiber System- go through**:**
Internal capsule
External capsule
Extreme capsule

Afferents- fibers coming into the cerebral cortex:
-monoaminergic fibers (MA): fibers from Substantia Nigra (DA), locus coeruleus (NE), raphe nuclei (5-HT)
- Acetycholine- Basal nucleus of Maynert
- Fibers from Thalamus- transmitter probably CCK (cholecystokinin)

Efferents- axons of pyramidal cells that are leaving cortex to be connected with subcortical regions (basal ganglia, pons, medulla, spinal cord)
Contain glutamate.

Intrinsic connections (local circuits): 4 peptides: vasointestinal polypeptid (VIP); somatostatin (SS), CCK and AAP (avian polypeptid), GABA.

HUMAN NEOCORTEX

The following is a list of telencephalic structures you should identify on slides:Most of the same structures are identified in each slide. If you find them once, you will see them again in the same place many times.

Slide CNS-29.
corpus callosum
neocortex
inferior horn of the lateral ventricle
subarachnoid space
tela choroidea
temporal lobe
splenium of the corpus callosum
parahippocampal cortex

rhinal fissure (collateral sulcus)

Consider the lateral ventricles. Cerebrospinal fluid flows from the lateral ventricles into the 3rd ventricle. How does the cerebrospinal fluid in the lateral ventricle avoid passage into the subarachnoid space? What structure closes the ventricle? What structure closes the top of the 3rd ventricle?

Slide CNS-34.
Identify the midbrain, thalamus, and telencephalon. Also locate:
corpus callosum
neocortex
inferior horn of the lateral ventricle
internal capsule
lateral (sylvian) fissure
parietal lobe
superior horn of the lateral ventricle
rhinal fissure (collateral sulcus)
parahippocampal cortex
temporal lobe

Slide CNS-39.
Note that very anterior structures in the thalamus are visible. The anterior thalamic nuclei are visible and receive an input from the mammillary body via the mammillothalamic tract. Outline the diencephalon before you identify the following structures:

In CNS-39 find:
corpus callosum
neocortex
rhinal fissure (collateral sulcus)
paleocortex
superior horn of the lateral ventricle
anterior commissure (descending limb)
internal capsule
lateral (sylvian) fissure
parietal lobe
temporal lobe

Slide CNS-41.
Is the thalamus present at this level? Which of the structures below are involve in the sense of smell? Locate:

anterior commissure
corpus callosum
neocortex
rhinal fissure (collateral sulcus)

paleocortex
superior horn of the lateral ventricle
insular cortex
internal capsule
lateral (sylvian) fissure
frontal lobe
temporal lobe
olfactory tract
optic nerve
olfactory tubercle

Slide CNS-42.
olfactory tract
septum pellucidum

septal area
internal capsule
frontal lobes

Slide CNS-43.
Locate the rostrum of the corpus callosum.

Test your skills on these HORIZONTAL SECTIONS

Examine CNS-44 to CNS-47. Identify the corpus callosum, internal capsule, and cerebral peduncle. Note the anterior and posterior limbs of the internal capsule in CNS-45-46. You can estimate the location of the central sulcus from the location of the genu of the internal capsule. Anterior to the genu is frontal lobes, and posterior to the genu are the parietal and occipital lobes.

Attempt to identify as many structures in these sections as possible.