Brain Cutting Basics

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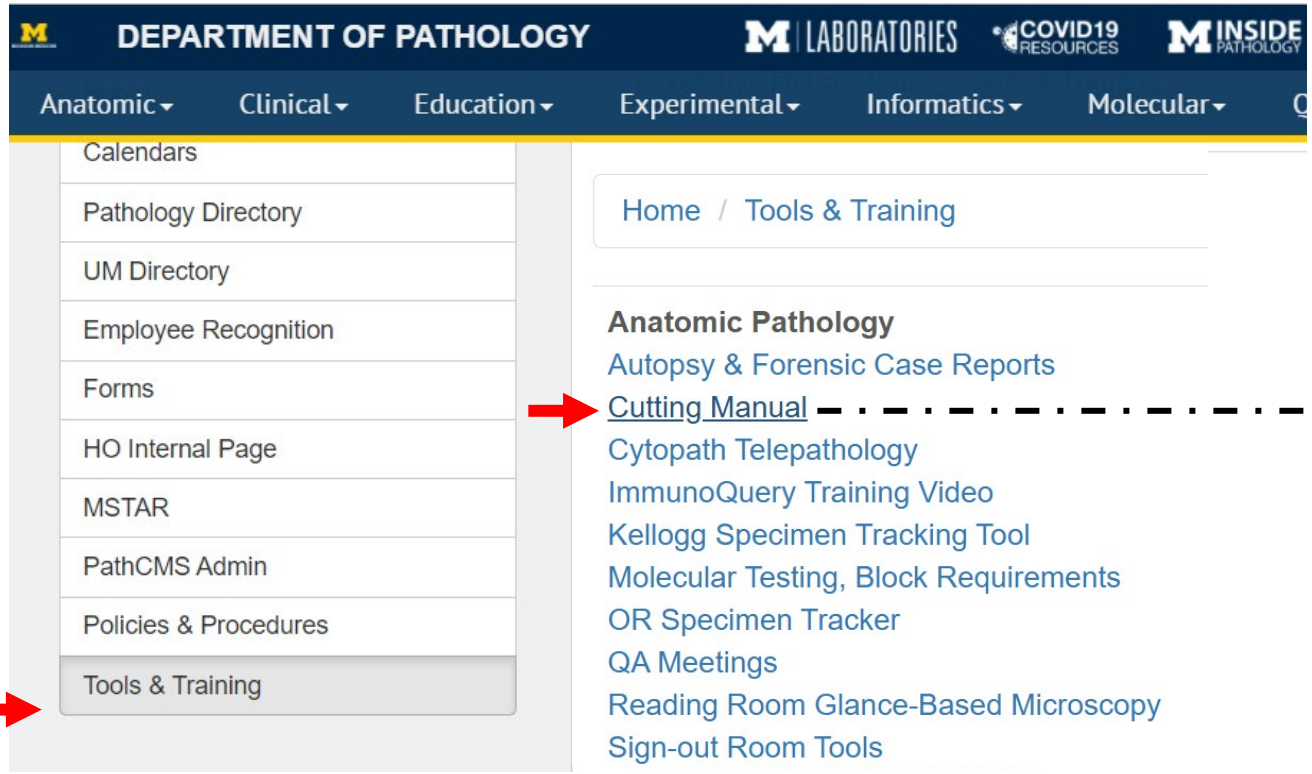
Neuropathology Resources

https://www.pathology.med.umich.edu/internal/tools-training

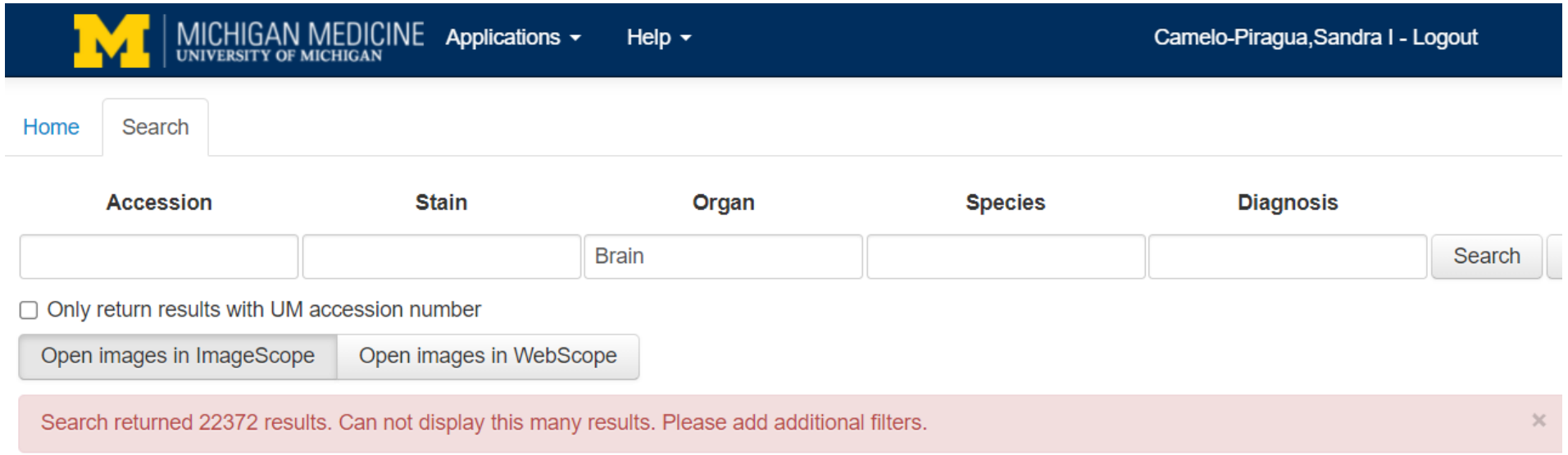


Neuropathology, Muscle and Nerve

- Brain Cutting Manual 2021-2022
- CJD Biopsy Procedure
- Grossing of Nerve Biopsy
- MiOncoSeq Brain Tumor Protocol
- Muscle Freezing and Grossing Procedure
- Muscle Preparation for the House Clinicians
- Nerve Preparation for in house clinicians
- Temporal Artery Grossing and Processing
- Temporal Lobectomy for Epilepsy

Neuropathology Resources

https://labportal.med.umich.edu/portal/apps/tumor_boards/search



Brain Cutting Workflow

Full Adult Medical Autopsy

Is there any neuro abnormality by clinical history or at the time of extraction?

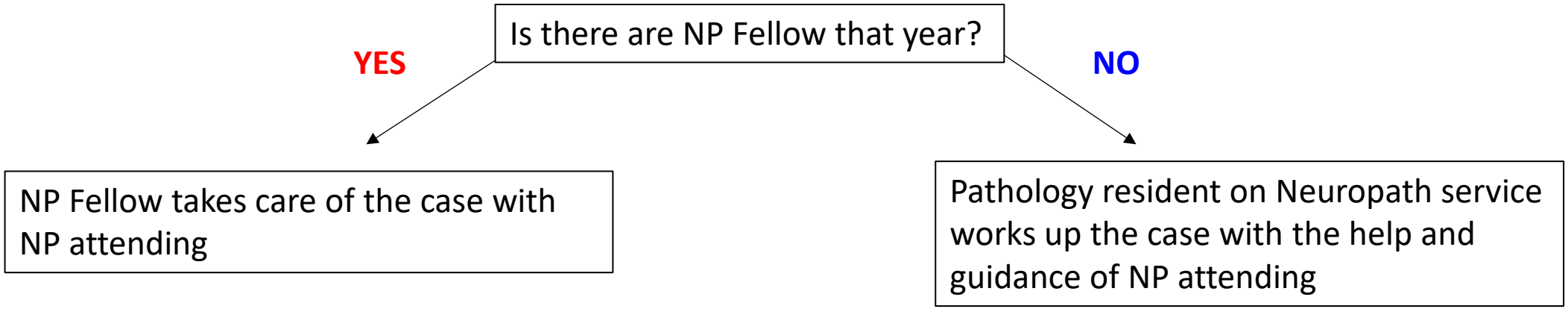
YES

- Fix brain in Formalin X 1 week
- Brain Schedule for Brain Cutting
- Resident is responsible to submit a one paragraph summary with pertinent clinical data and neurologic question the week before Brain cutting to NP Admin
- Resident is expected to attend brain cutting, present case, take notes of gross findings. If there is a NP fellow, he/she will compete the gross description with the notes taken. If there is no NP fellow, the resident is responsible for completing gross description and send to the faculty no later than the Friday of the conference.
  Review **slides** with NP attending and/or fellow

NO

- Cut Fresh with Autopsy attending and take sections.
- Fix sections in formalin x 2d before submitting.
- Review sections with autopsy attending if any question consult the NP attending on surgical service that week.
- If NP attending consults on the slides send micro and final neuro to NP attending for editions

Neurodegenerative Cases (ADRC) or Brain only autopsies

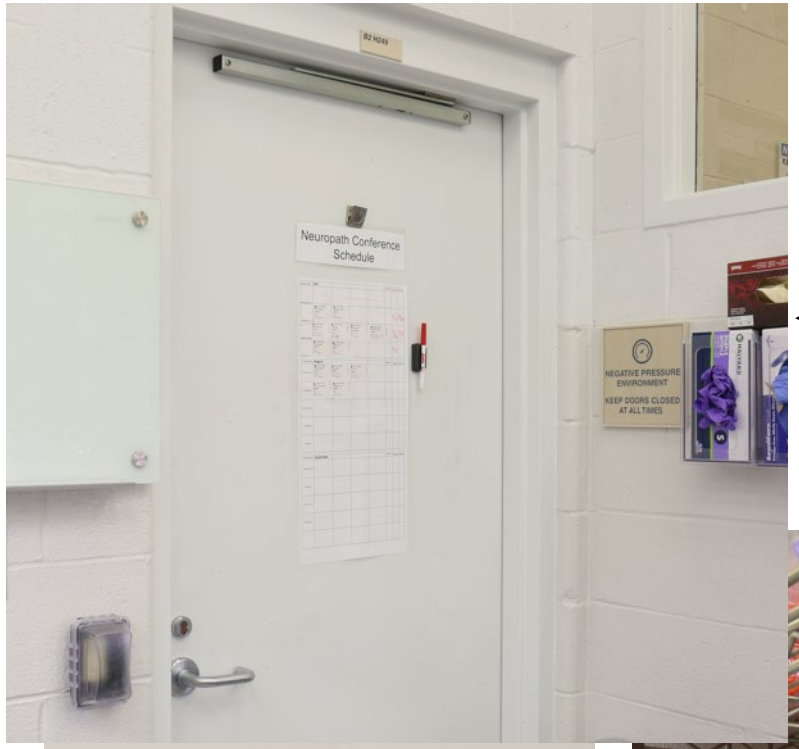


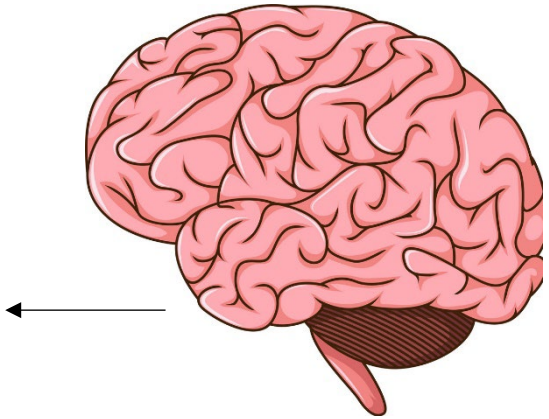
Medico-Legal Autopsy

Forensic Pathologist may decide there is Neuro question to be addressed. Fix brain in formalin

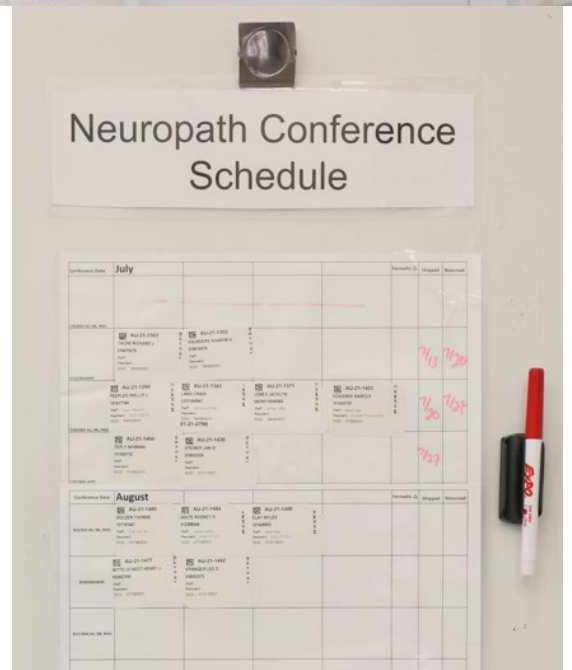
Forensic NP Brain Cutting
Thursday 1 pm at UMHS with Dr. Tashjian

- Cut Fresh with Forensic Pathology attending and take sections.
- Fix sections in formalin
- Review sections with Forensic Pathology attending. If any question consult the NP attending on surgical service that week.





UMHS
ADRC
Pedi
ME



Neuropathology: Specimens from autopsy
Brain Conference

Conference Date:

AU/ME#:

Name:

Fresh specimen weight:
Postmortem interval:

Clinical History:

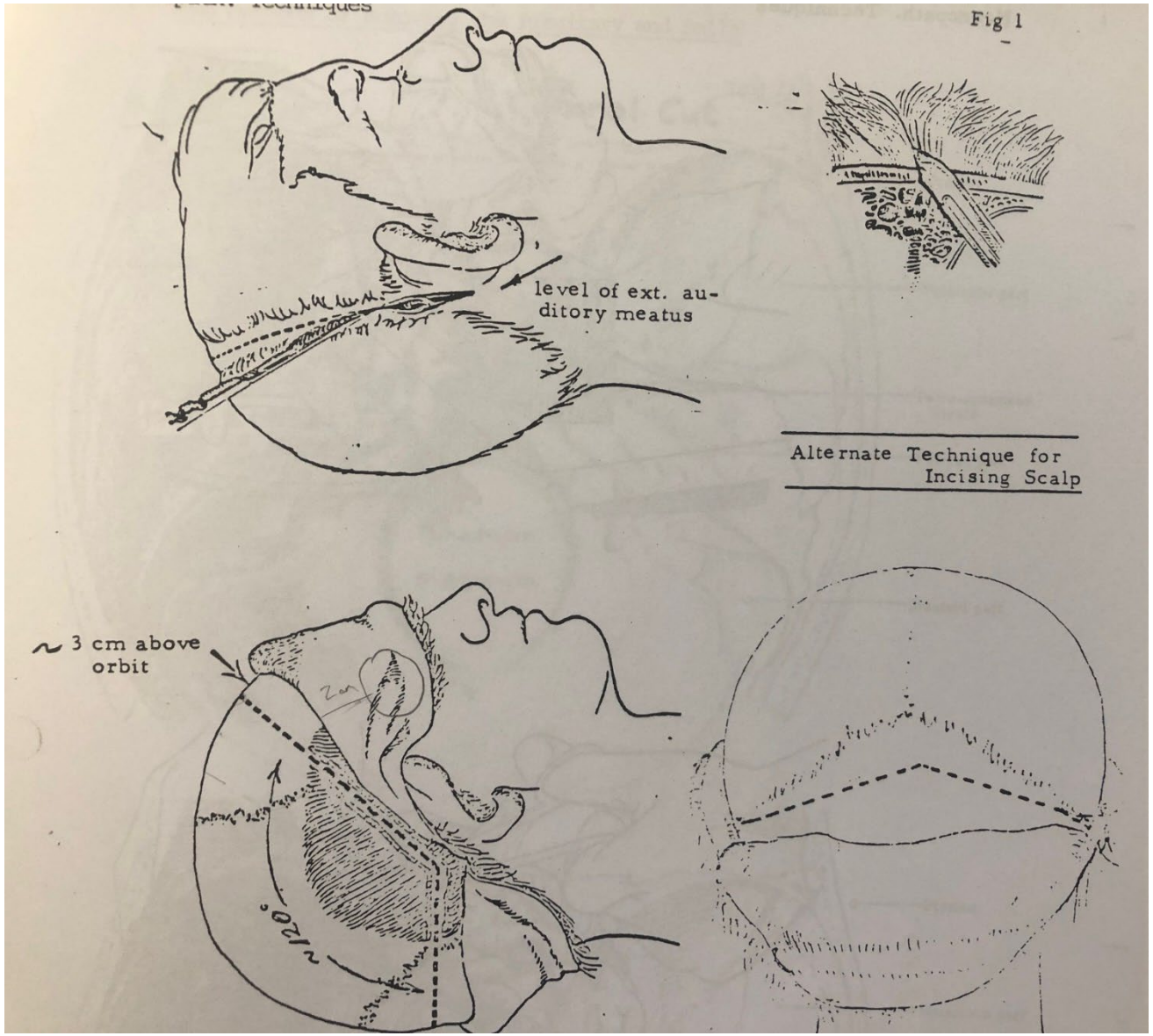
Indications:

Specific questions for neuropathology:

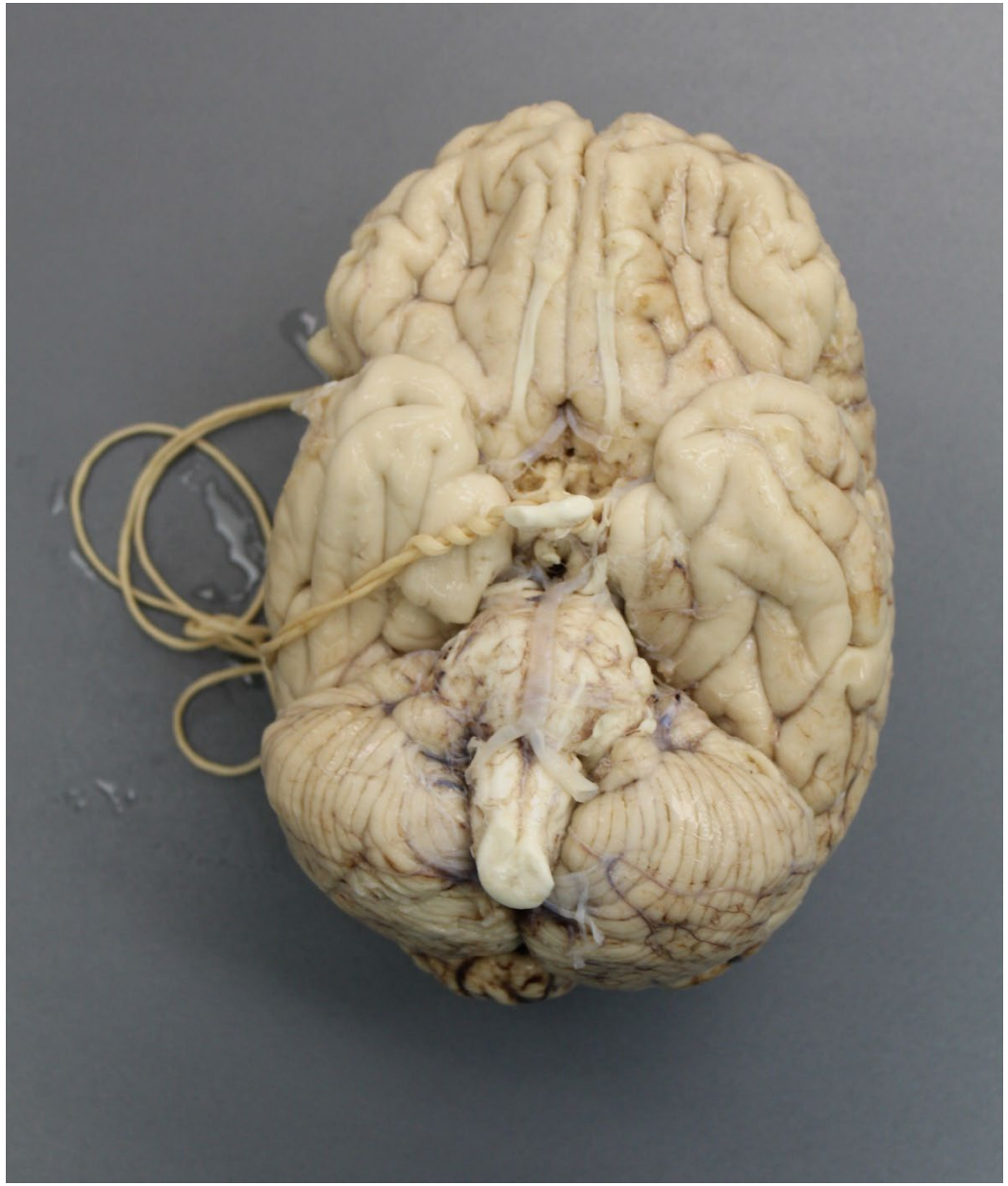
Brain cutting: Tuesday 1pm NCRC

- Fill out the NP Brain Conference form as soon as you are done with your autopsy
- Check your email to review when your case is scheduled for conference (usually 2 weeks later)
- Attend Brain cutting conference. Come prepared with clinical history and any pertinent general autopsy findings
- If no NP fellow, the resident is expected to complete Gross Neuropathologic Examination and send NP faculty no latter than Friday
- NP fellow receives slides and review with resident
- NP faculty reviews case gives feedback

Brain Removal Adults



Brain



UHMS NEUROPATHOLOGY BRAIN CUTTING

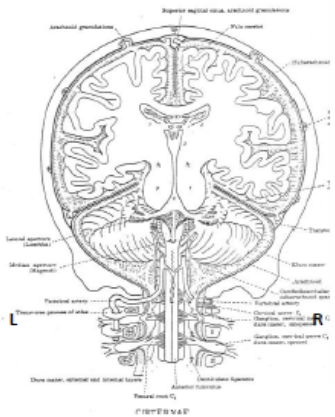
Resident/Fellow:_____ Case #: _____
Patient's name:_____ Reg#: _____
Date of Autopsy: _____ Date of Brain cutting: _____ NP Attending: _____

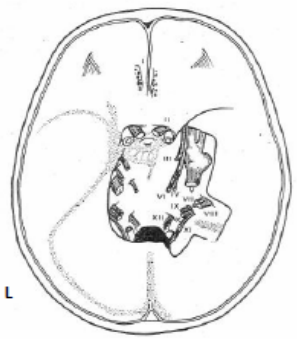
Brief summary of General Clinical History and Gross autopsy findings:

Summary of Neurological related history including CNS imaging:

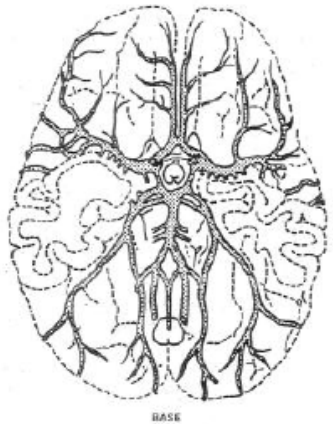
NEUROPATHOLOGY GROSS AUTOPSY FINDINGS:

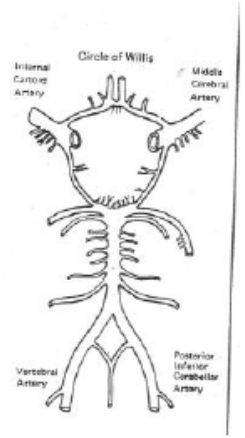
Skull, Meninges, Midline Structures



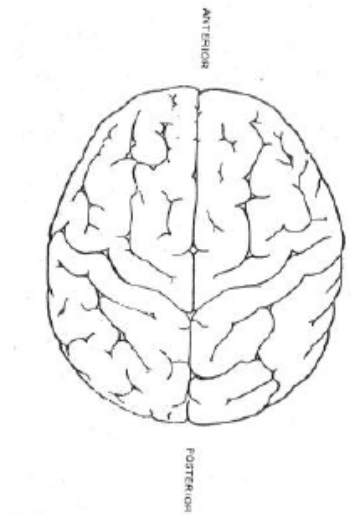


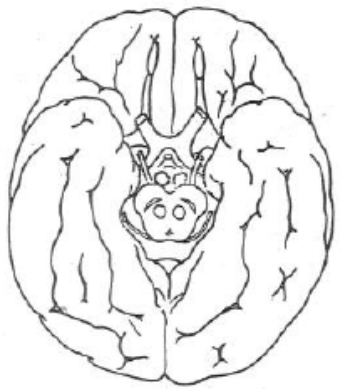
Vasculature



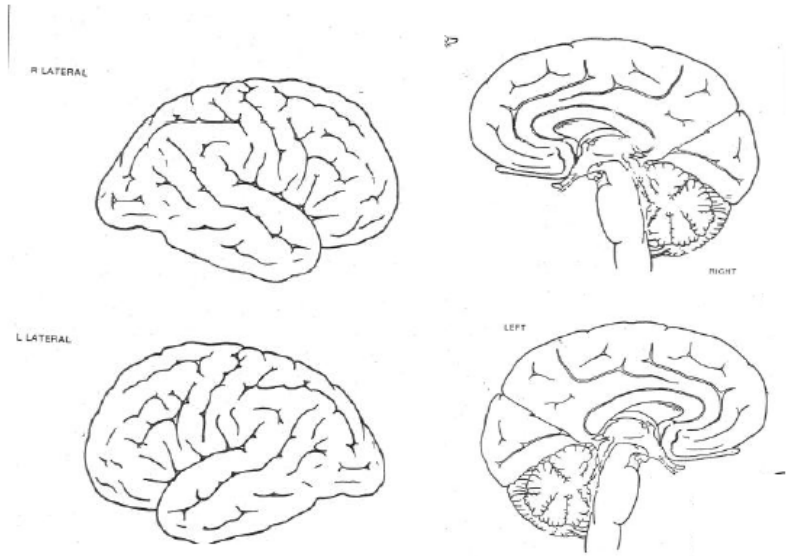


Cerebrum External Surfaces

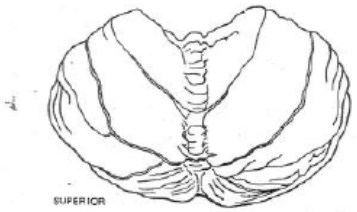


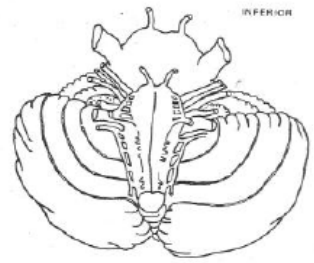


Cerebrum External Surfaces



Cerebellum, Brain Stem and Cranial Nerves External Surfaces

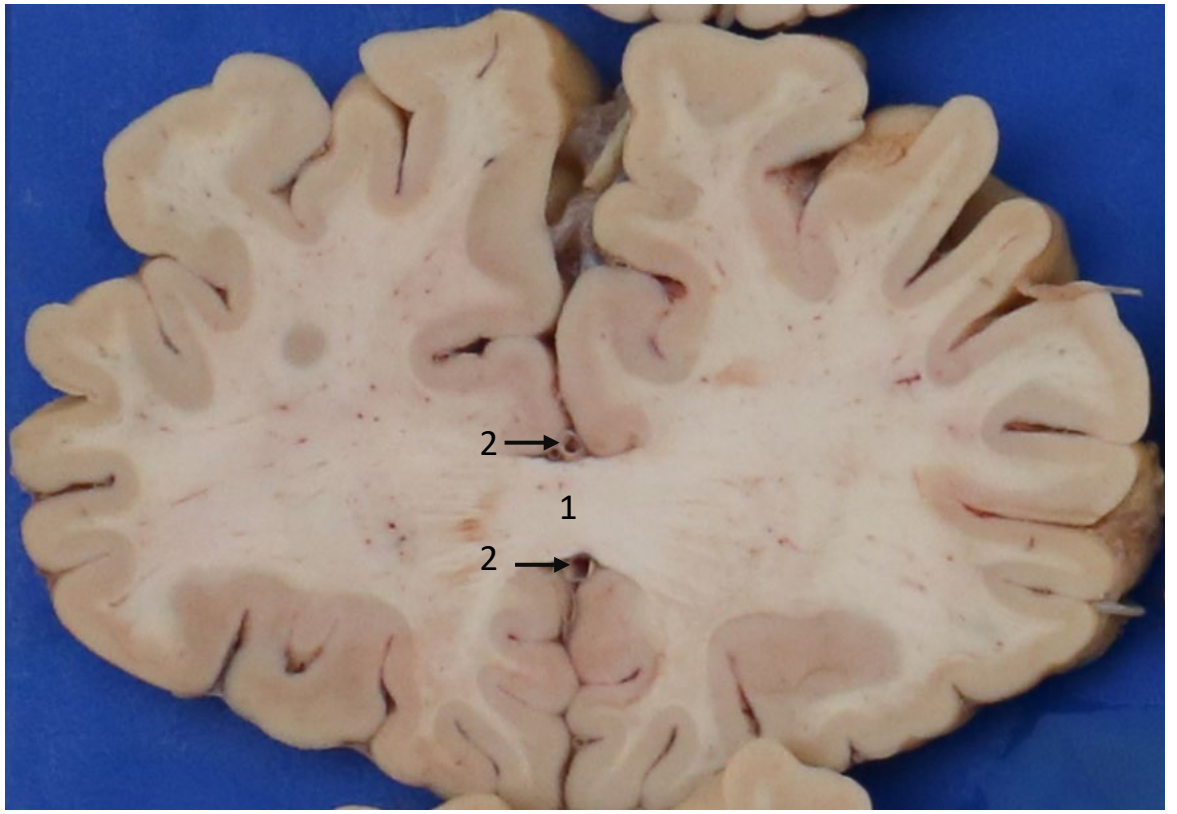




Brain Landmarks

1. At the anterior tip of the temporal lobes

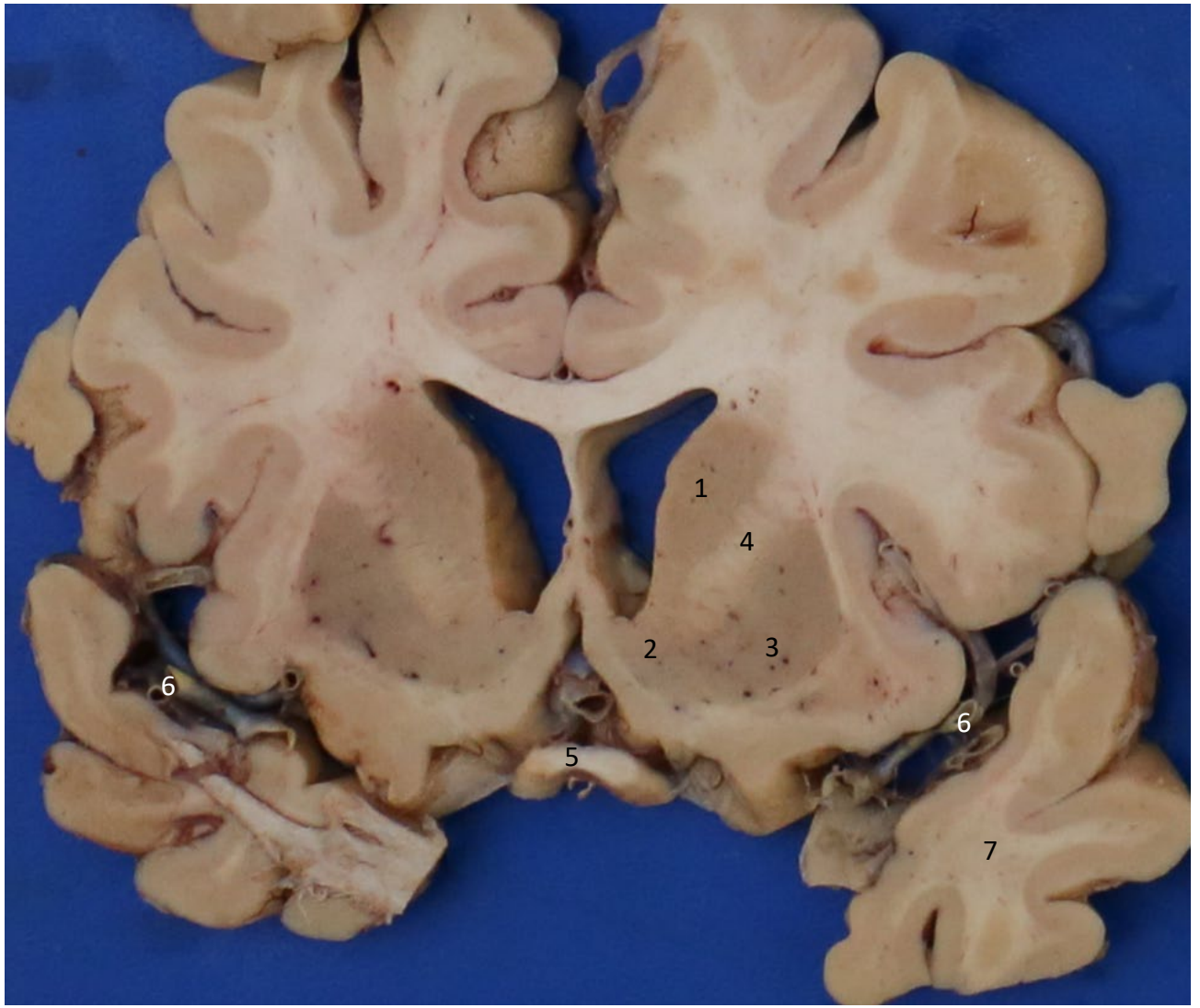
Frontal lobes



1. Genu of Corpus callosum
2. ACA

Brain Landmarks

2. At the Chiasm

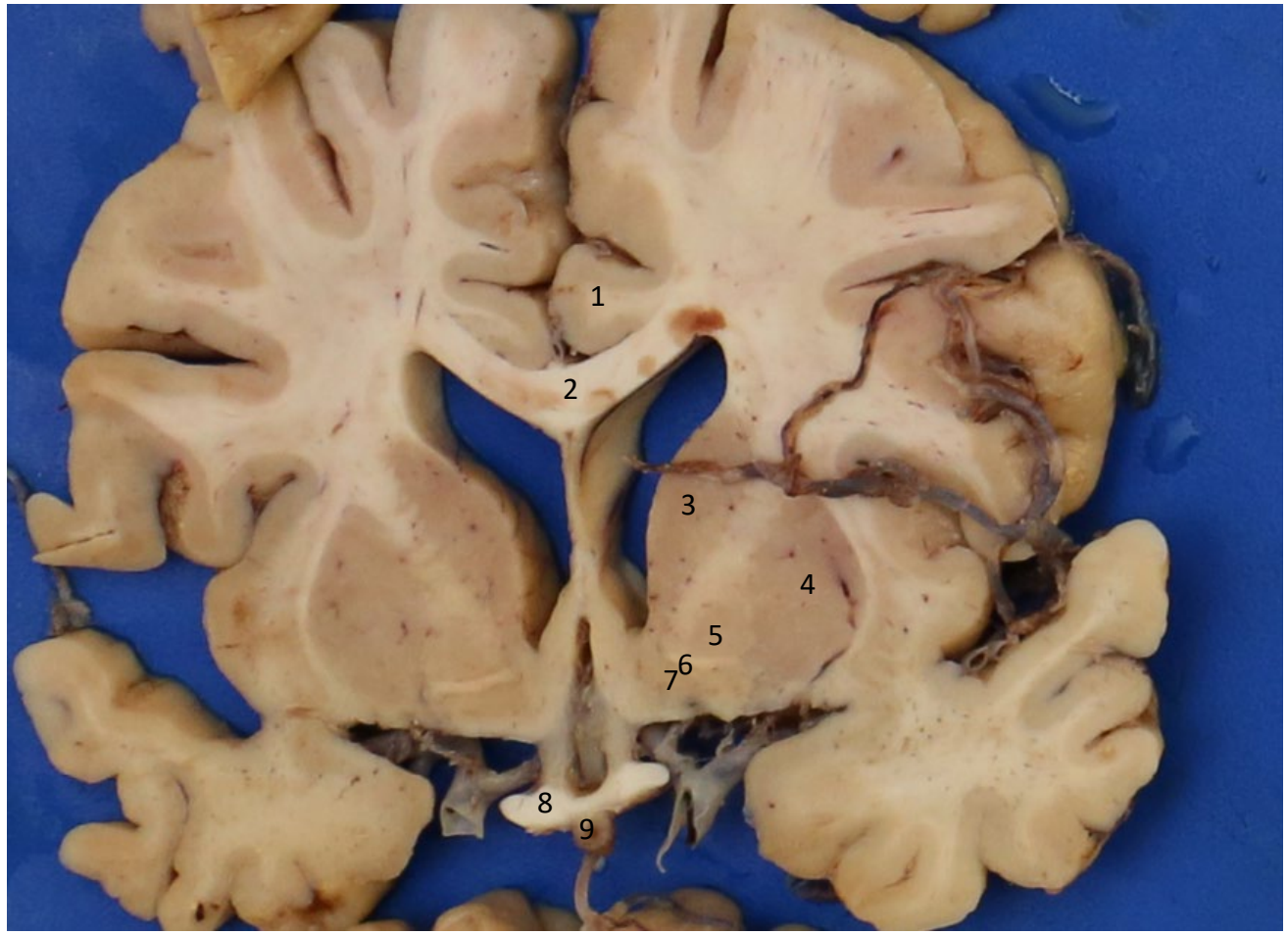


1. Caudate
2. Accumbens
3. Putamen
4. Internal capsule
5. Chiasm
6. MCA

7. Temporal Lobe

Brain Landmarks

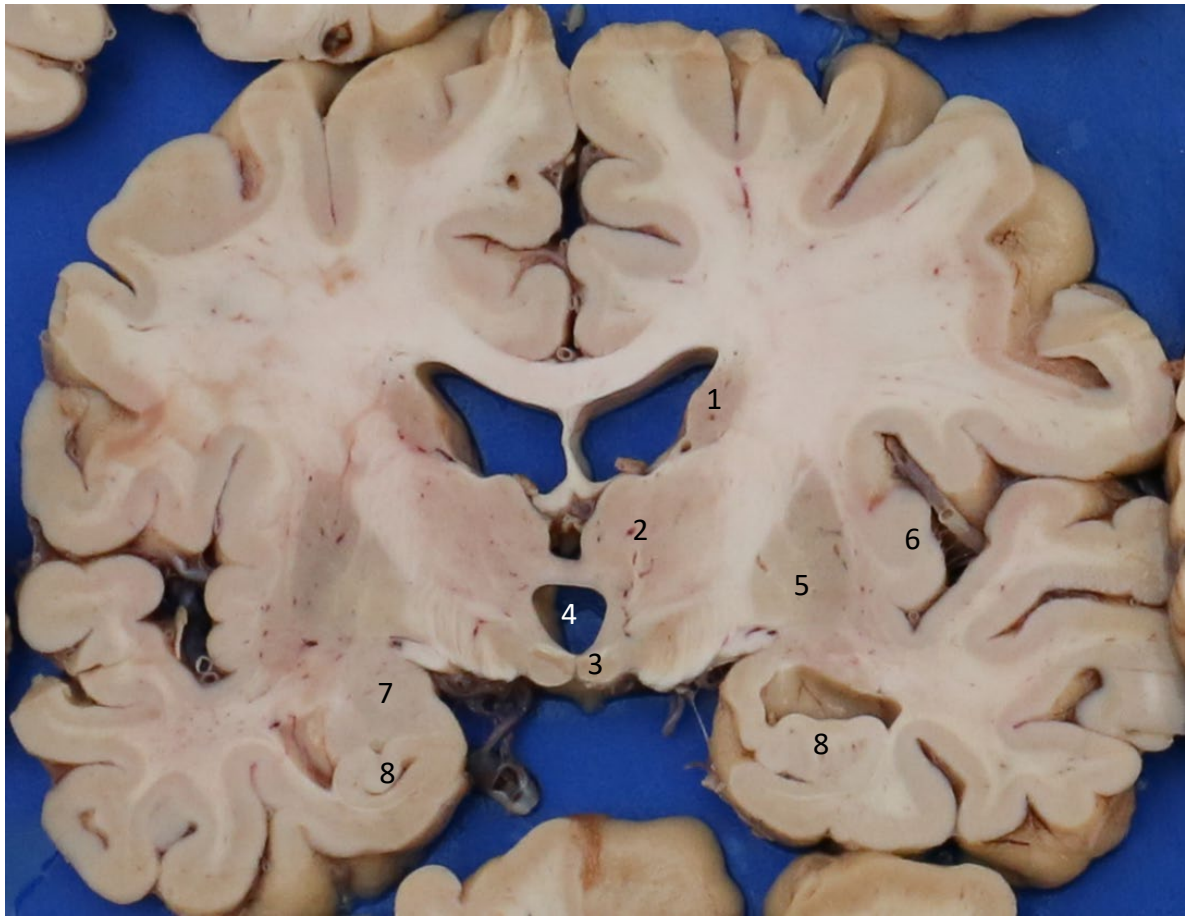
3. At the pituitary stalk



1. Cingulate
2. Corpus callosum
3. Caudate
4. Putamen
5. Globus pallidus
6. Anterior Commissure
7. Nucleus Basalis
8. Optic Tract
9. Pituitary stalk

Brain Landmarks

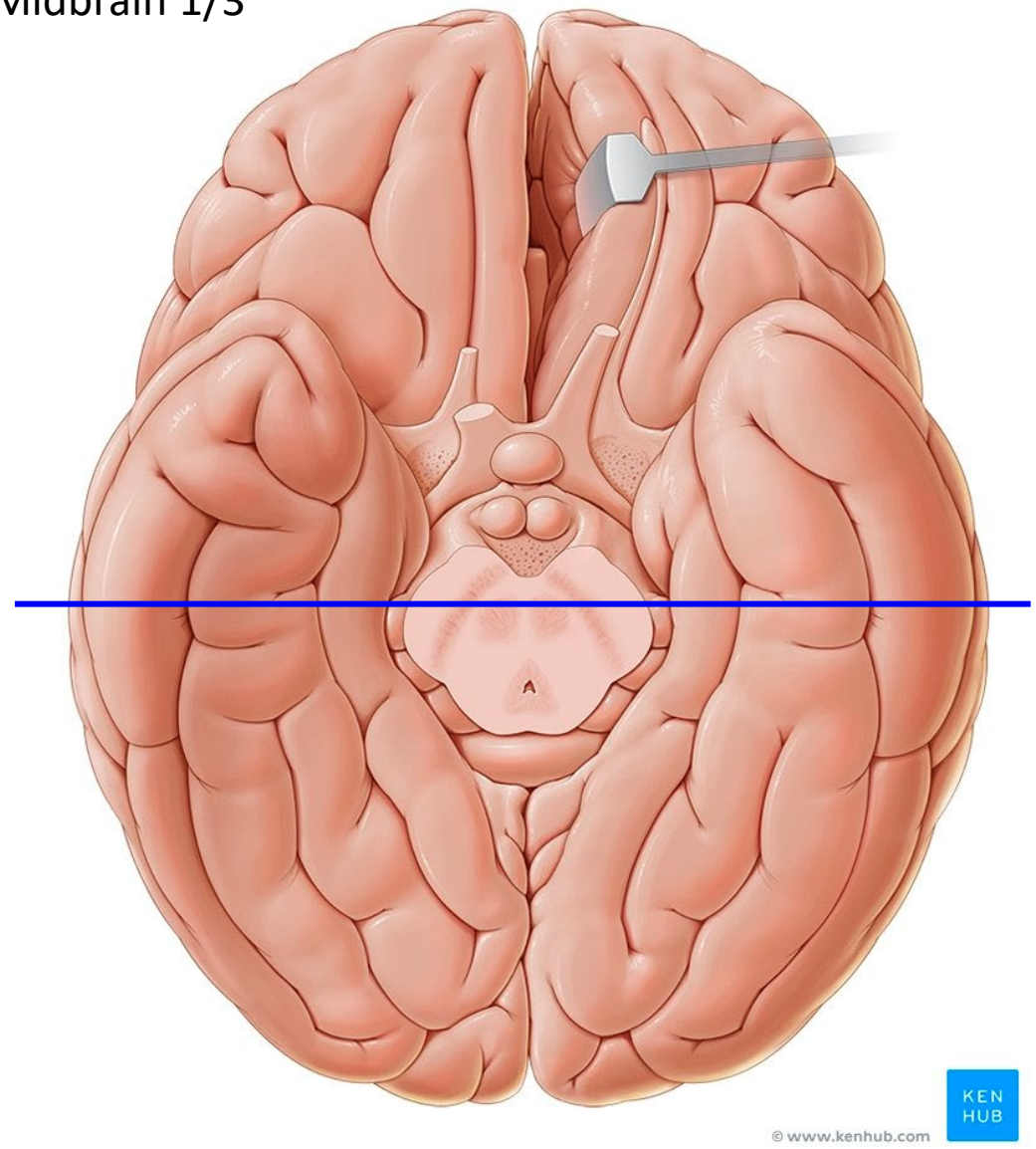
4. At the mammillary bodies

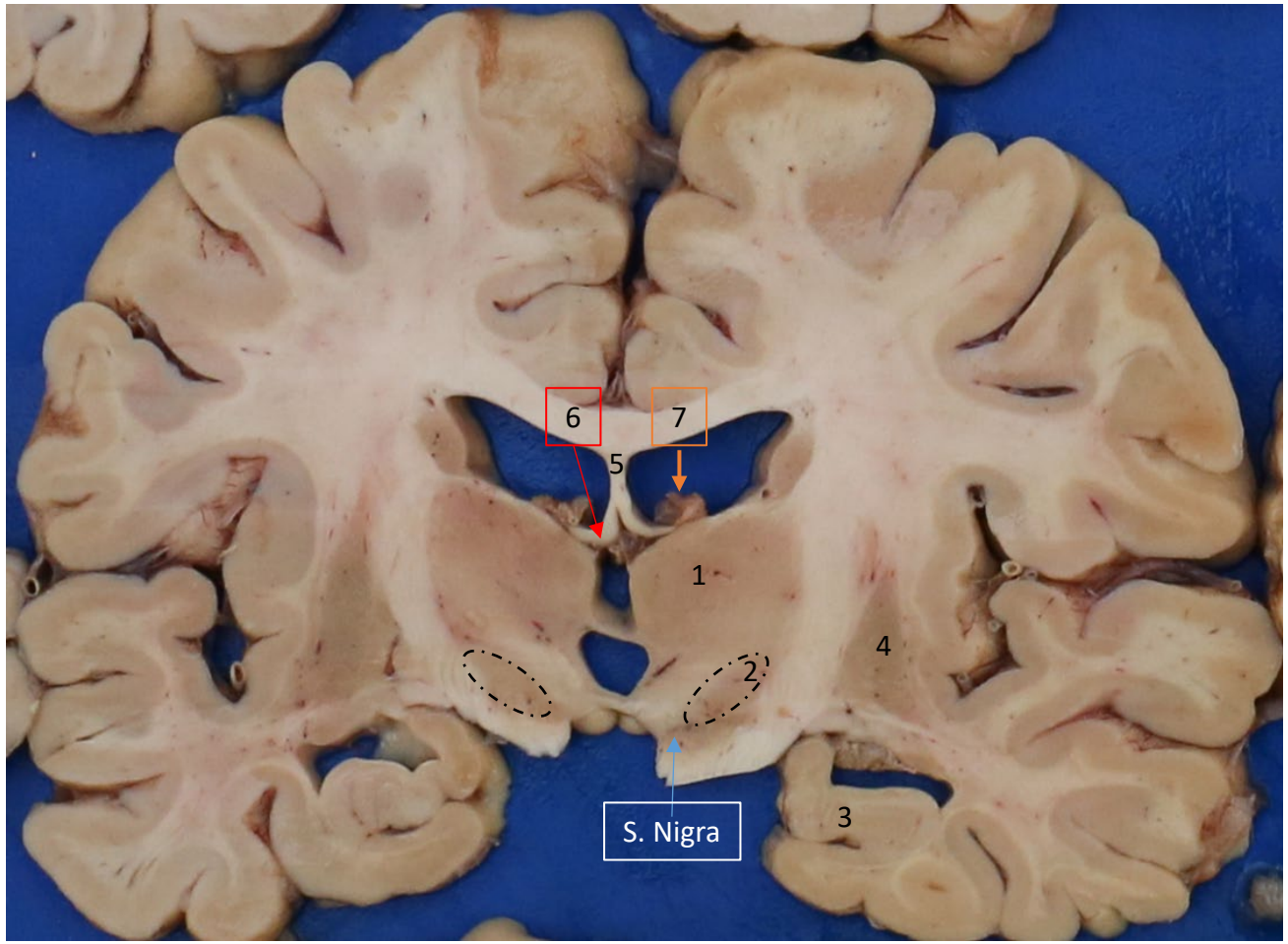


1. Caudate
2. Thalamus
3. Mammillary bodies
4. 3rd Ventricle
5. Putamen
6. Insular cortex
7. Amygdala
8. Anterior hippocampus

Brain Landmarks

5. Midbrain 1/3

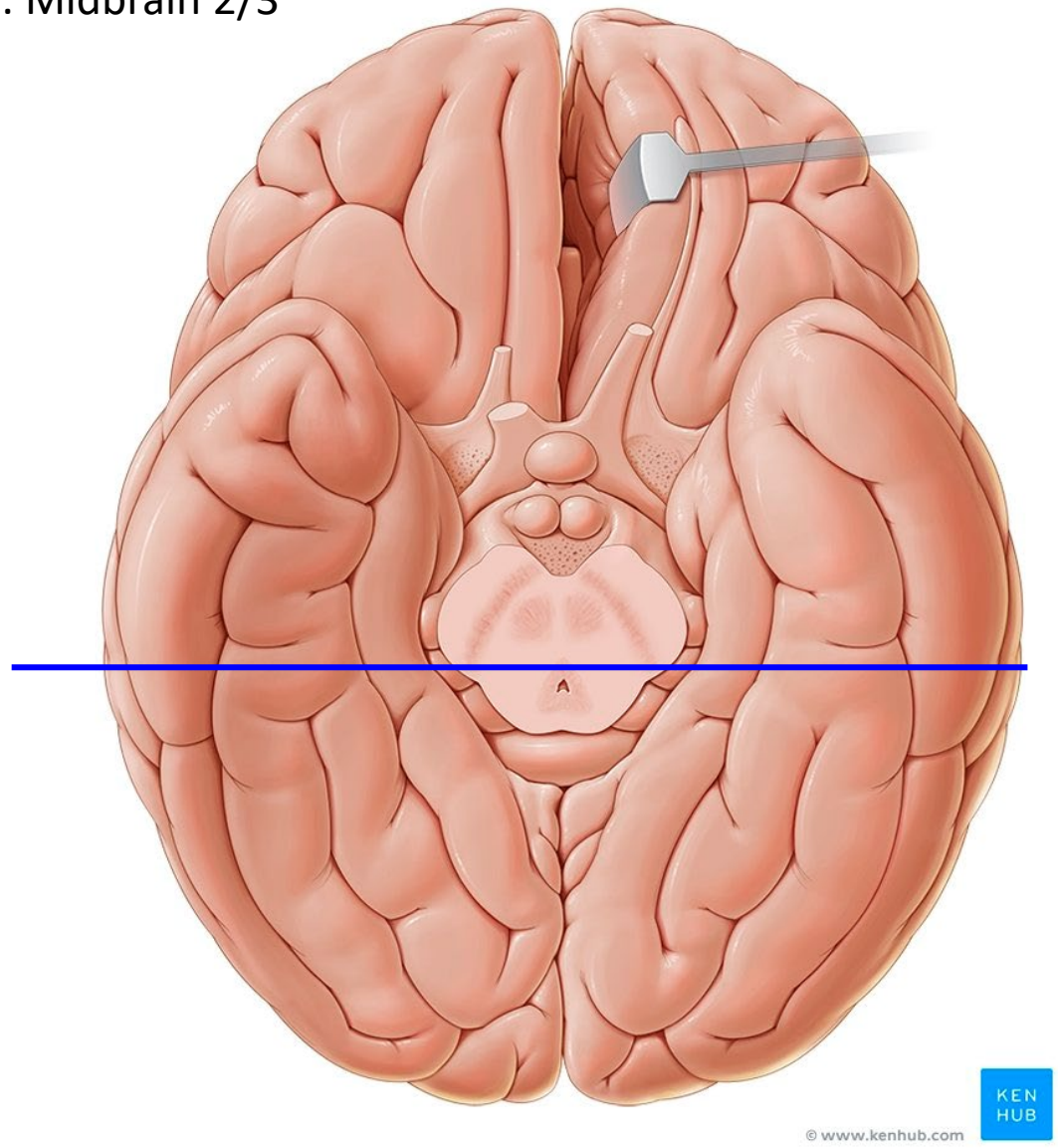


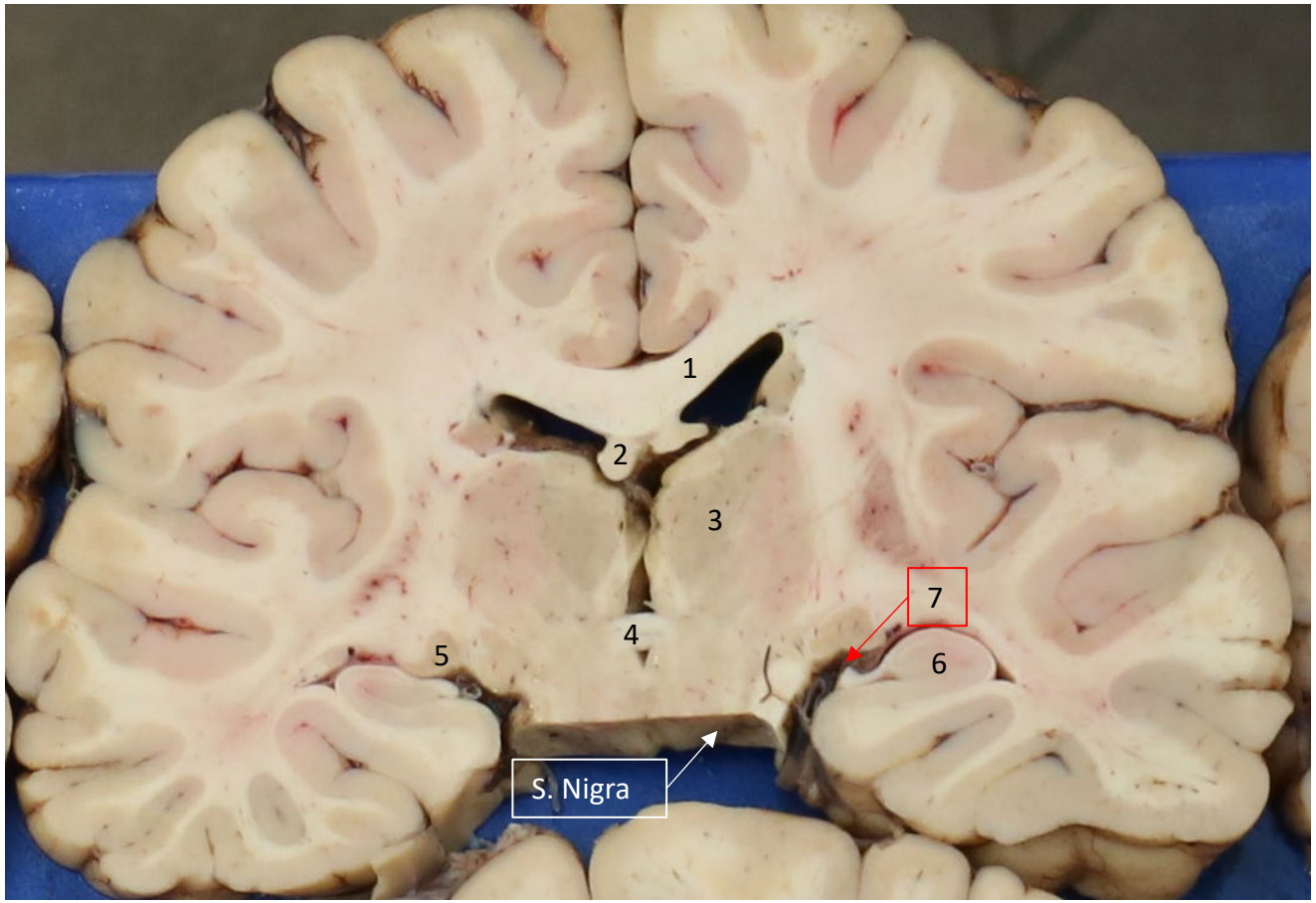


1. Thalamus
2. Subthalamic nucleus
3. Anterior hippocampus
4. Putamen
5. Septum pellucidum
6. Fornix
7. Choroid plexus

Brain Landmarks

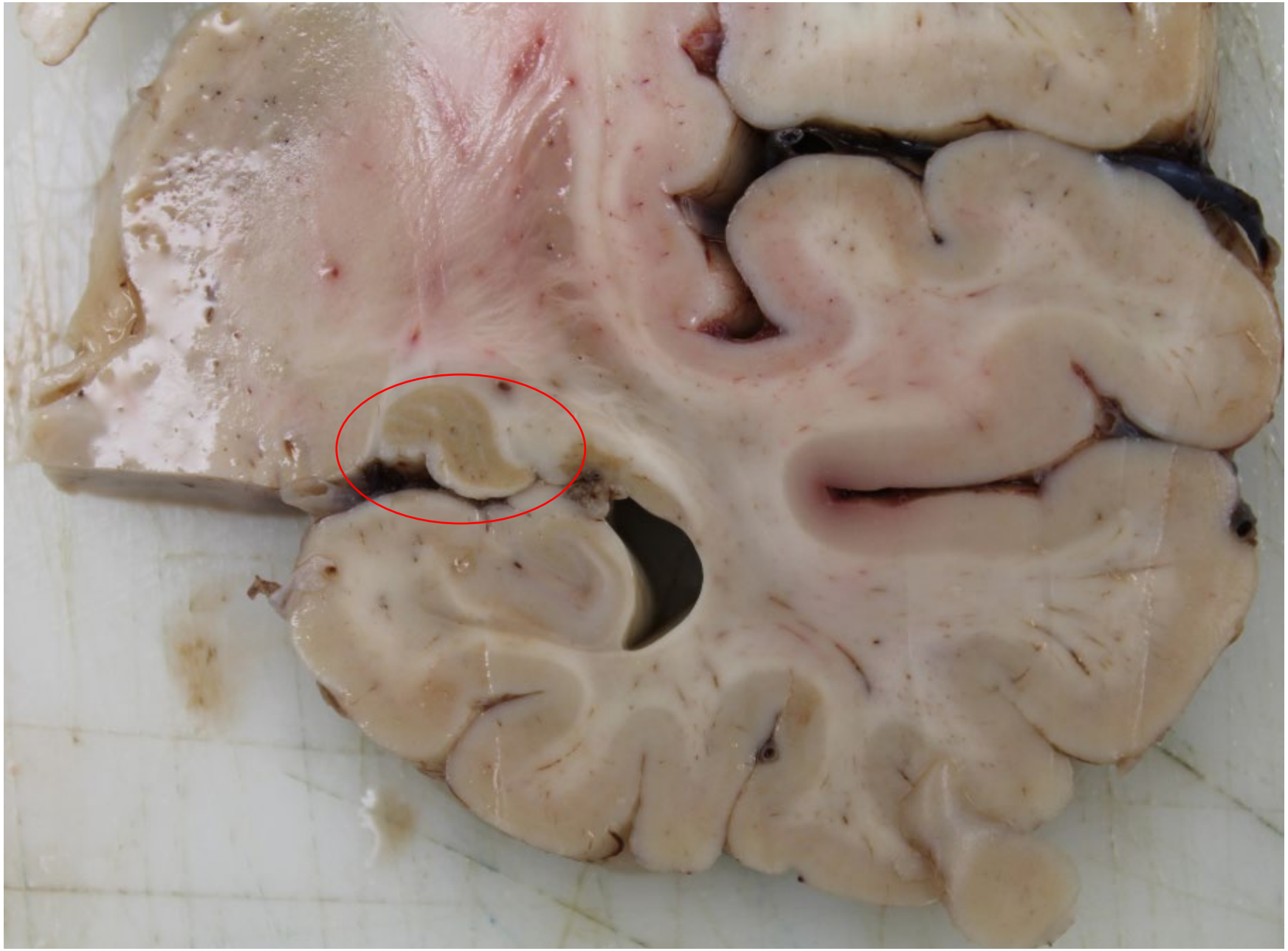
5. Midbrain 2/3





1. Corpus callosum
2. Fornix
3. Thalamus
4. Massa Intermedia
5. Lateral geniculate
6. Hippocampus
7. Fimbria

Napoleon’s Hat: LGN



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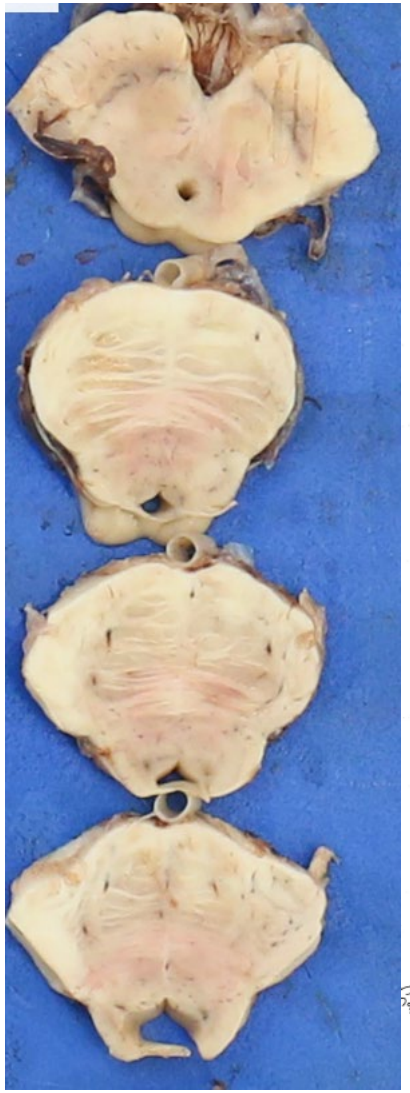

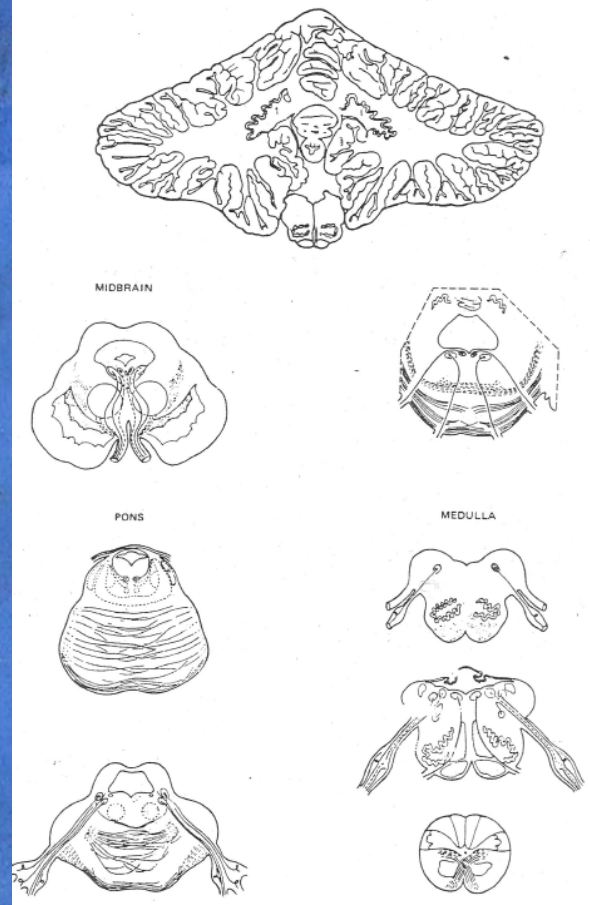

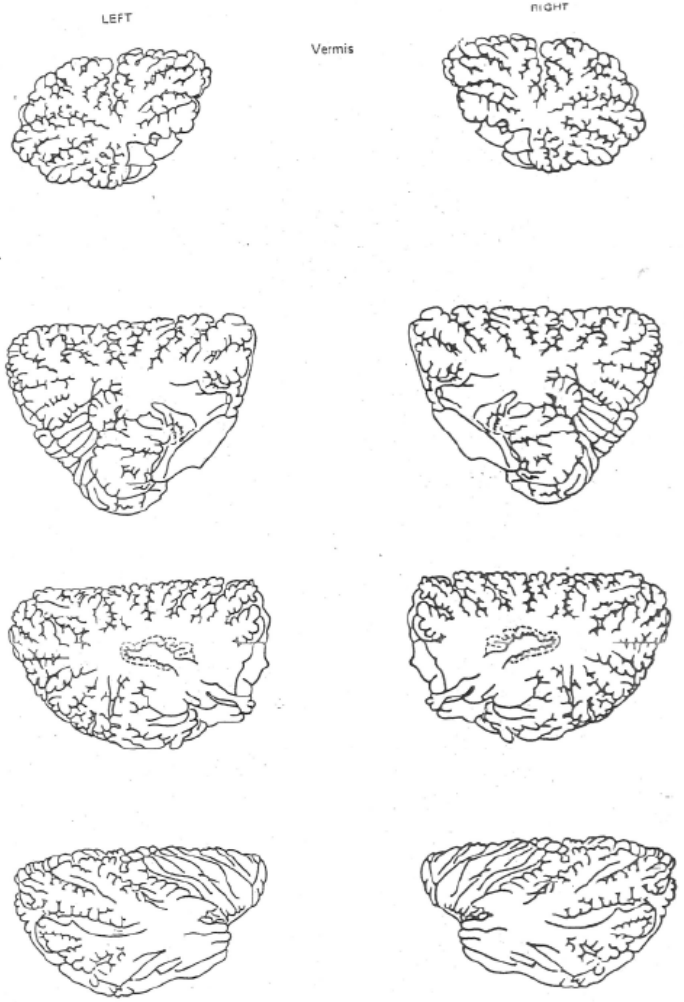

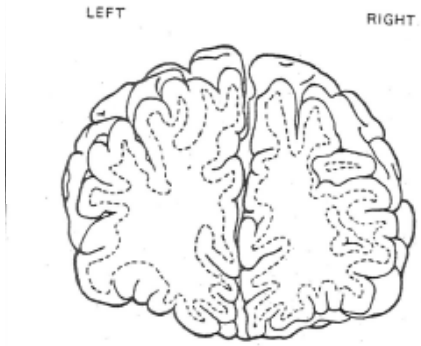
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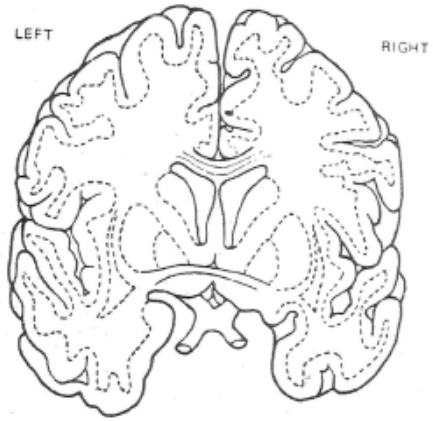
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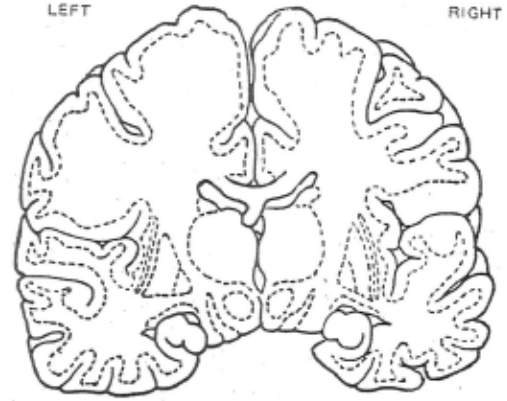
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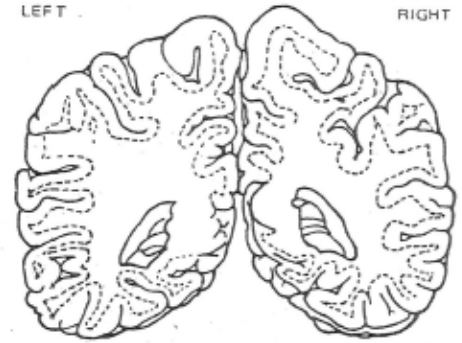
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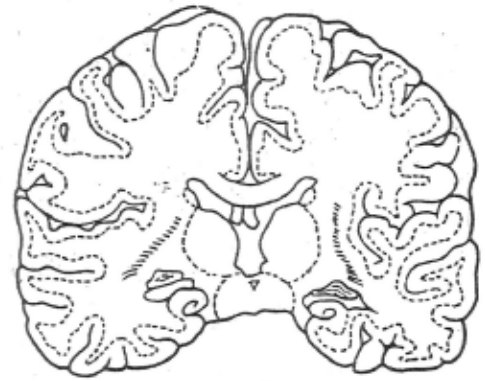

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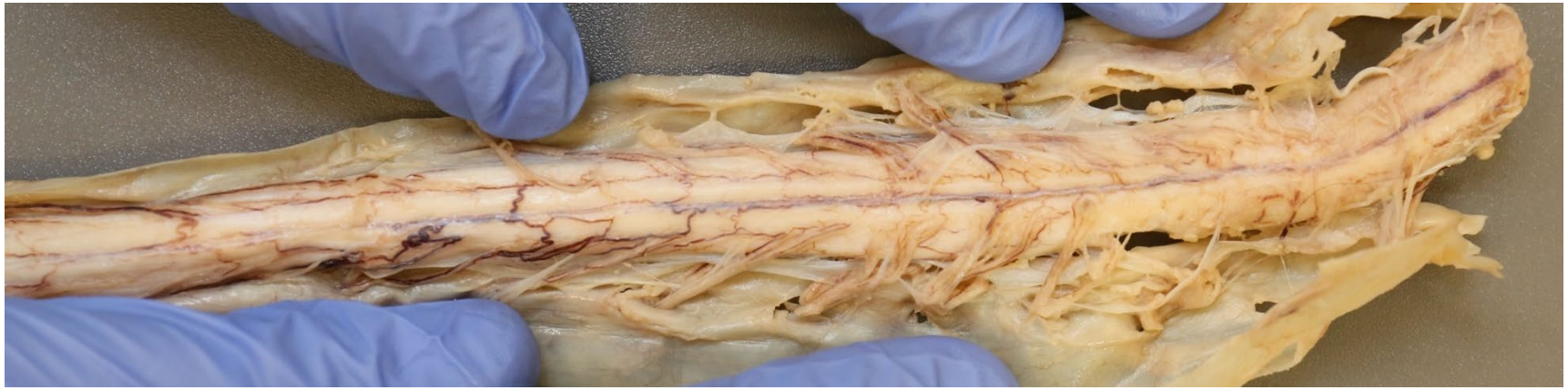
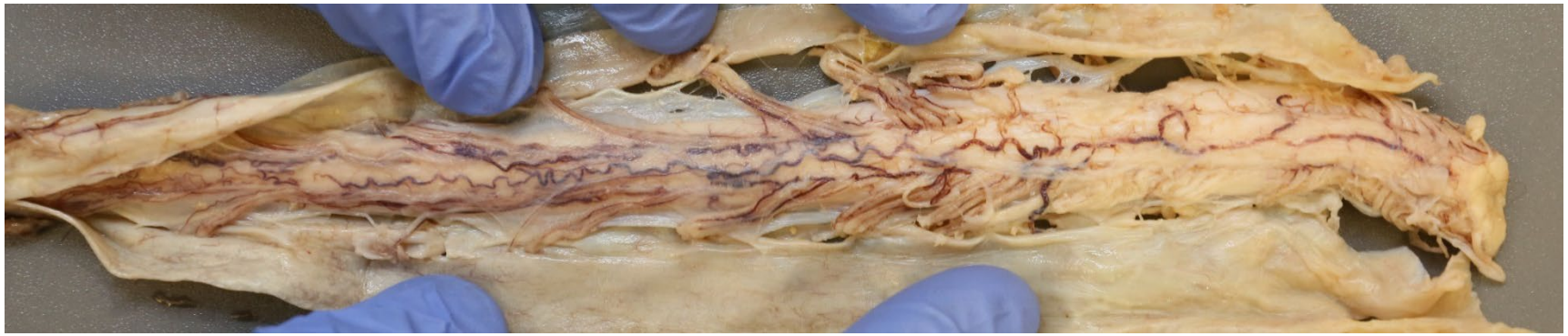
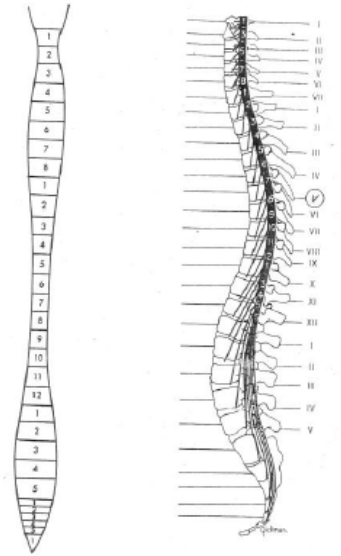
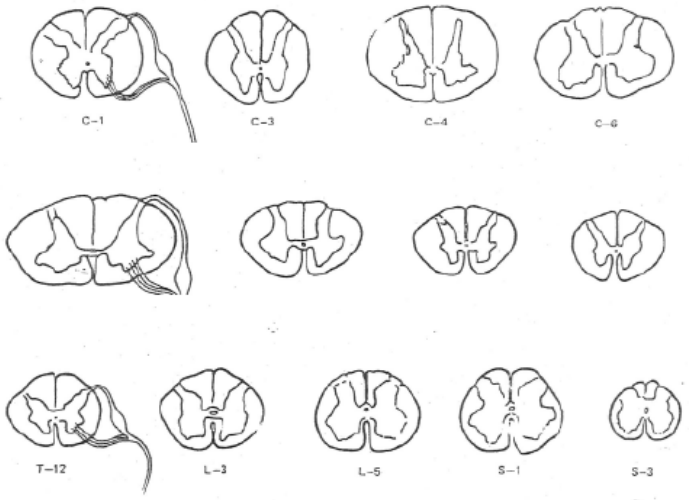




Spinal Cord Levels- External Surface



Cross Sections Spinal Cord



Suggested Sections for brain cutting

1. Include a section of any abnormal brain regions identified at brain cutting.
2. In hypoperfusion/ischemic events, include appropriate watershed areas (2-4 cassettes).
3. If history of alcohol abuse, include a section of superior and inferior cerebellar vermis, mammillary bodies and periaqueductal grey matter.
4. Brains without gross pathology and additional sections for the above-mentioned cases:

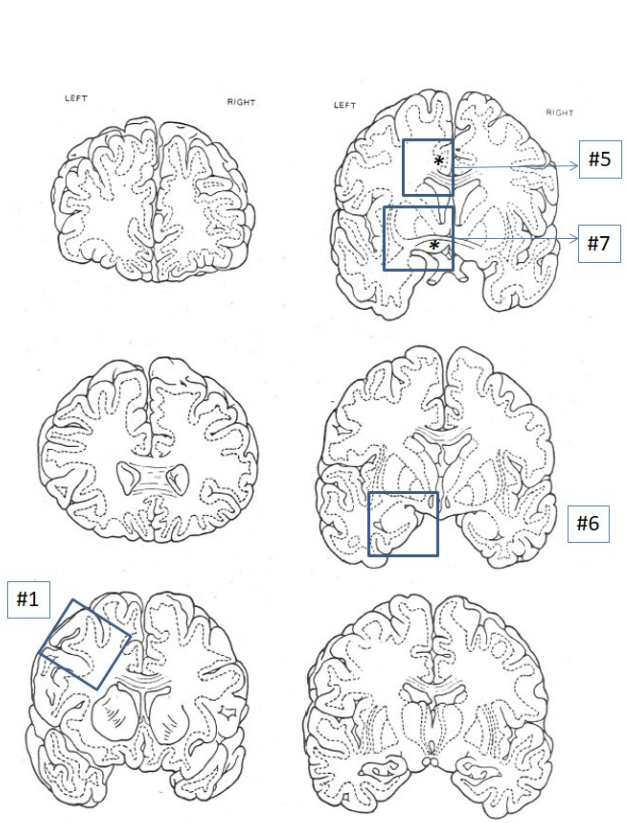
    A. Cerebral cortex (frontal, temporal, parietal OR occipital).

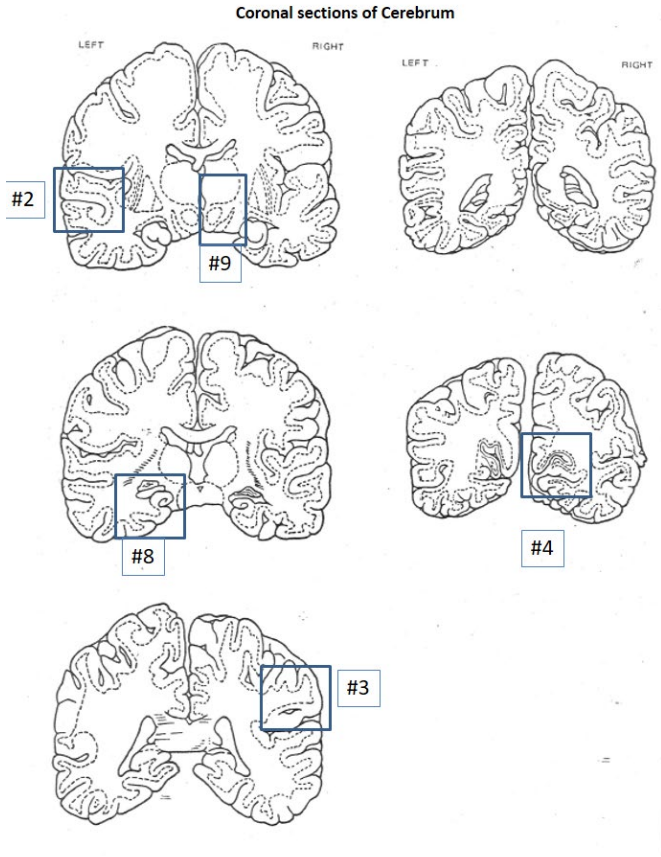
    B. Basal ganglia.

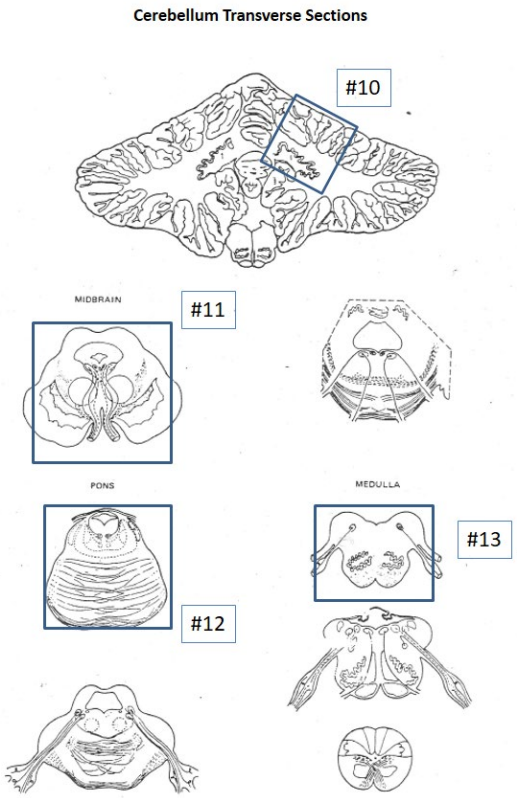
    C. Hippocampus at the level of the lateral geniculate (LGN) a.k.a. Napoleon's hat

    D. A section of brain stem (midbrain, pons and /or medulla)

Blocking Diagram for Neurodegenerative diseases ADRC

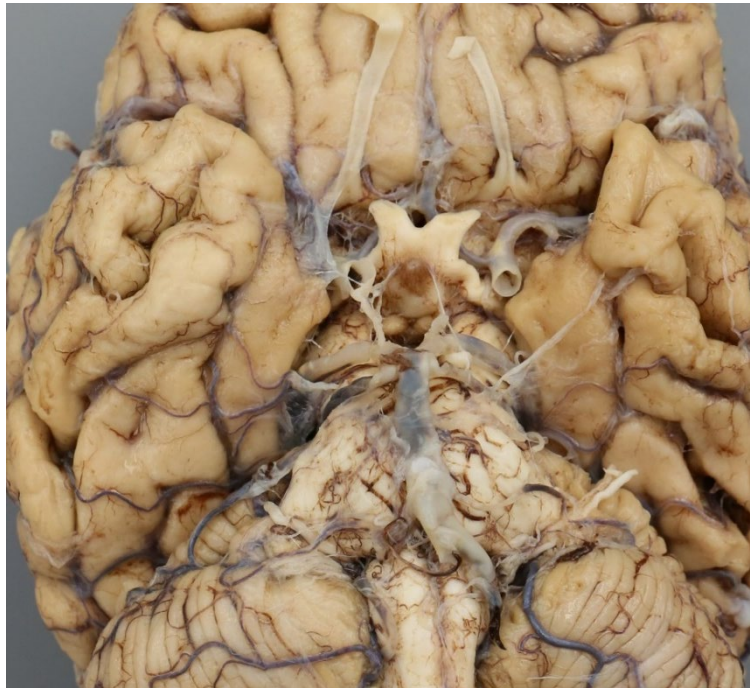


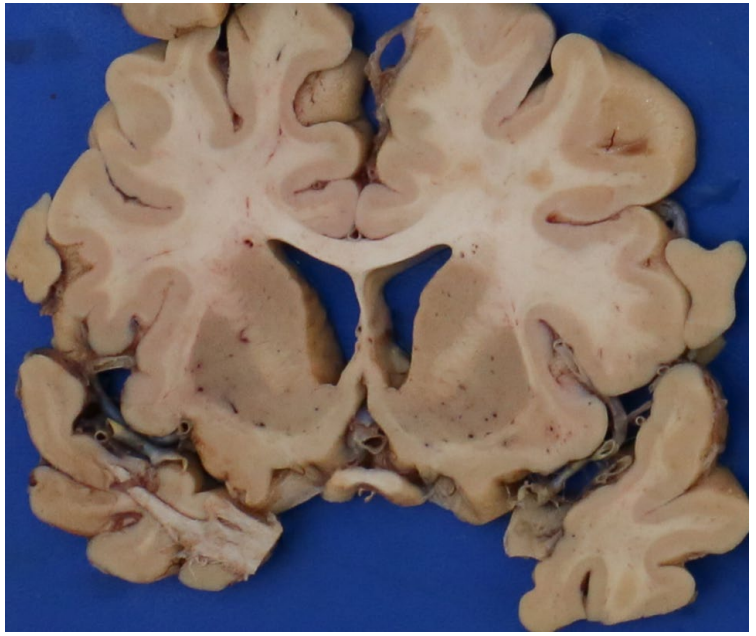




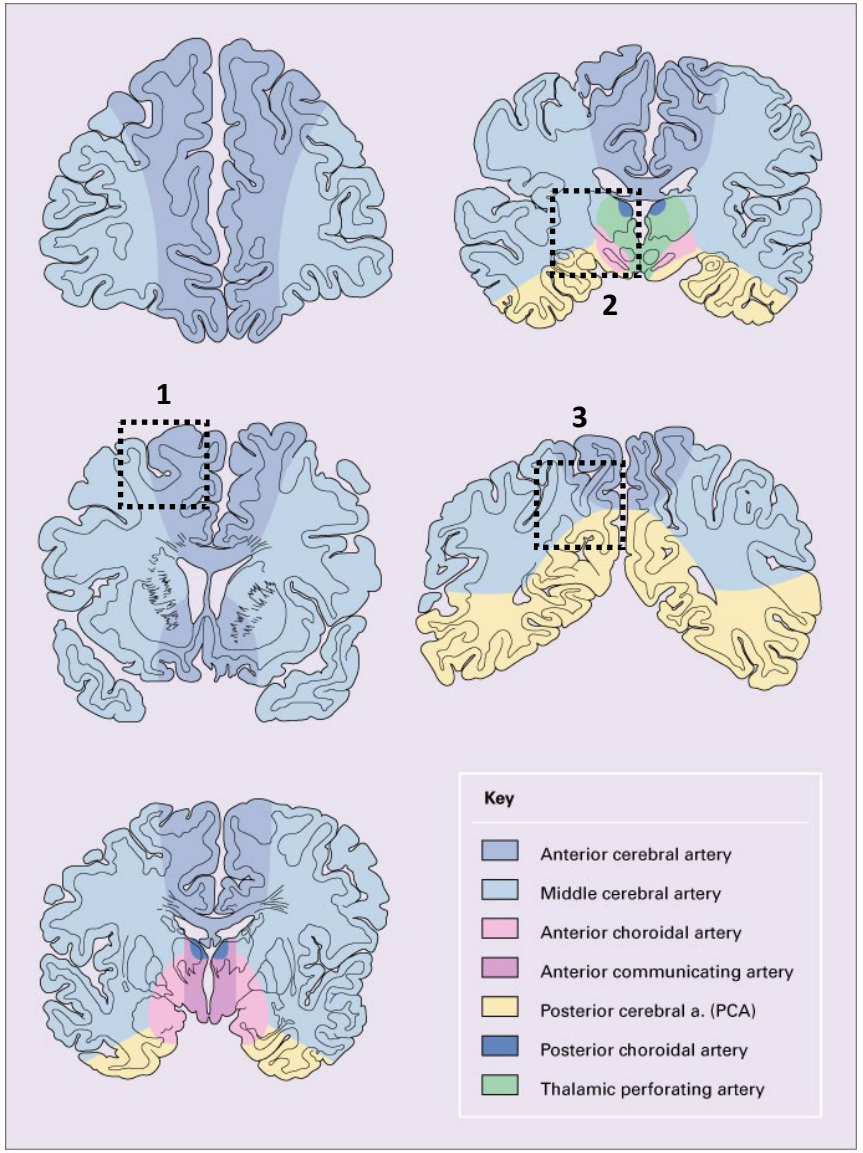
1 Middle Frontal Gyrus
2 Superior and Middle Temporal Gyrus
3 Inferior Parietal Cortex
4 Primary Visual Cortex
5 Anterior cingulate with corpus callosum
6 Amygdala
7 Nucleus basalis at the level of anterior commissure. Include Basal Ganglia GP and Putamen
8 Hippocampus at the level of the lateral geniculate
9 Subthalamic nucleuses and Thalamus
10 Superior cerebellum with full dentate nuclei
11 Midbrain at the level of the red nucleus
12 Pons one section with basis pontis and 1 or 2 additional levels of locus ceruleus
13 Medulla at the level of inferior olivary nucleus

Vessels





CNS WATERSHED AREAS (SCP sections)



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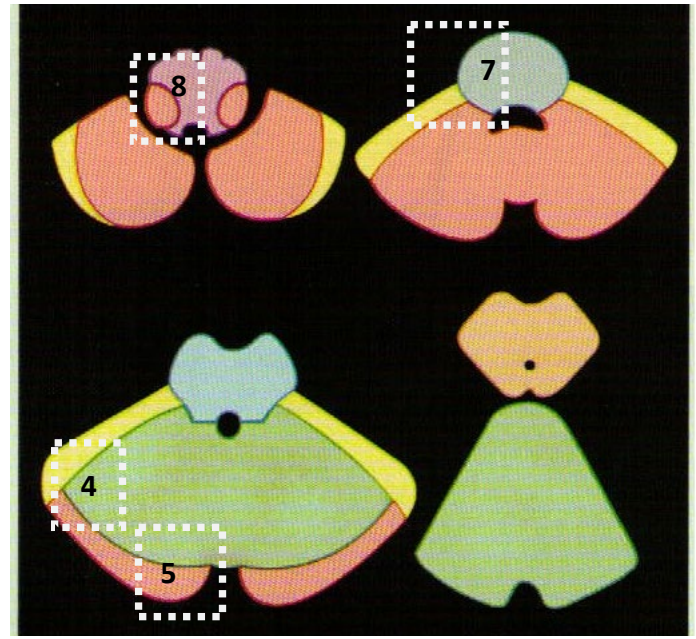
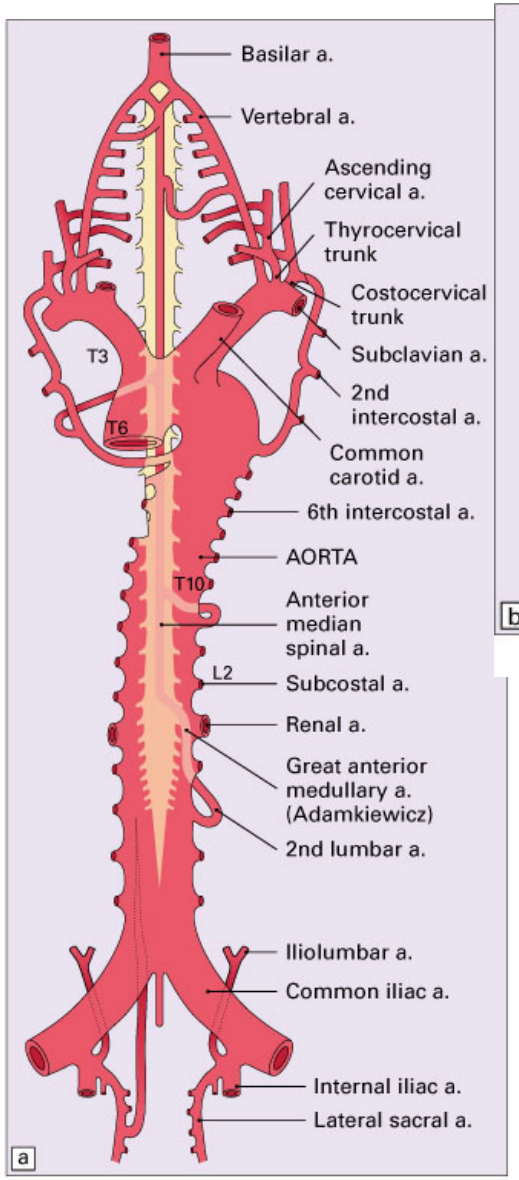


- Pontine perforating arteries
- Sup Cerebellar Art
- Antero Inferior Cerebellar artery
- Postero Inferior Cerebellar artery
- Medullary Perforating arteries

1. Superior and Middle Frontal gyrus at the level of CAP
2. Thalamus, Red nucleus, SN and LGN
3. Medial Parieto-Occipital cortex
4. Cerebellar hemispheres
5. Cerebellar vermis
6. Pons
7. Medulla



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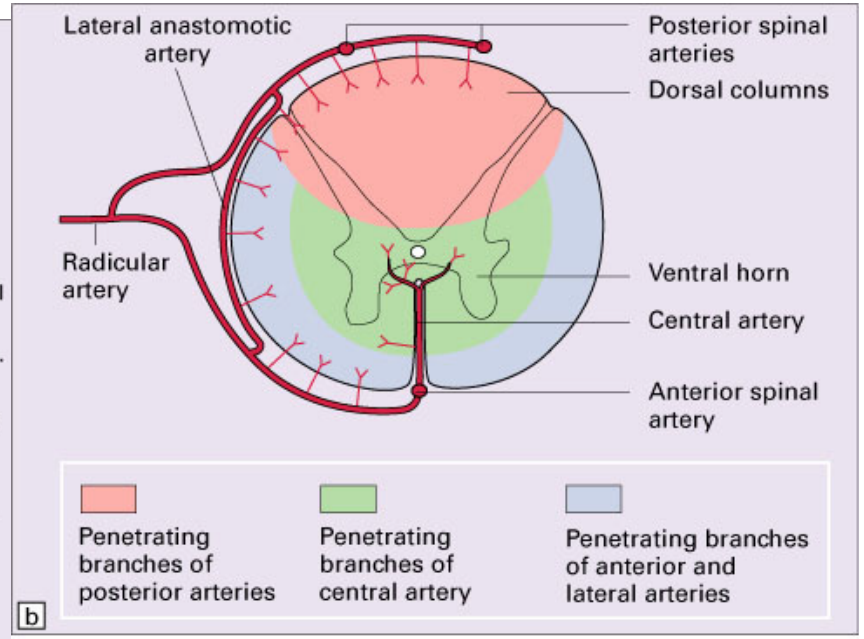

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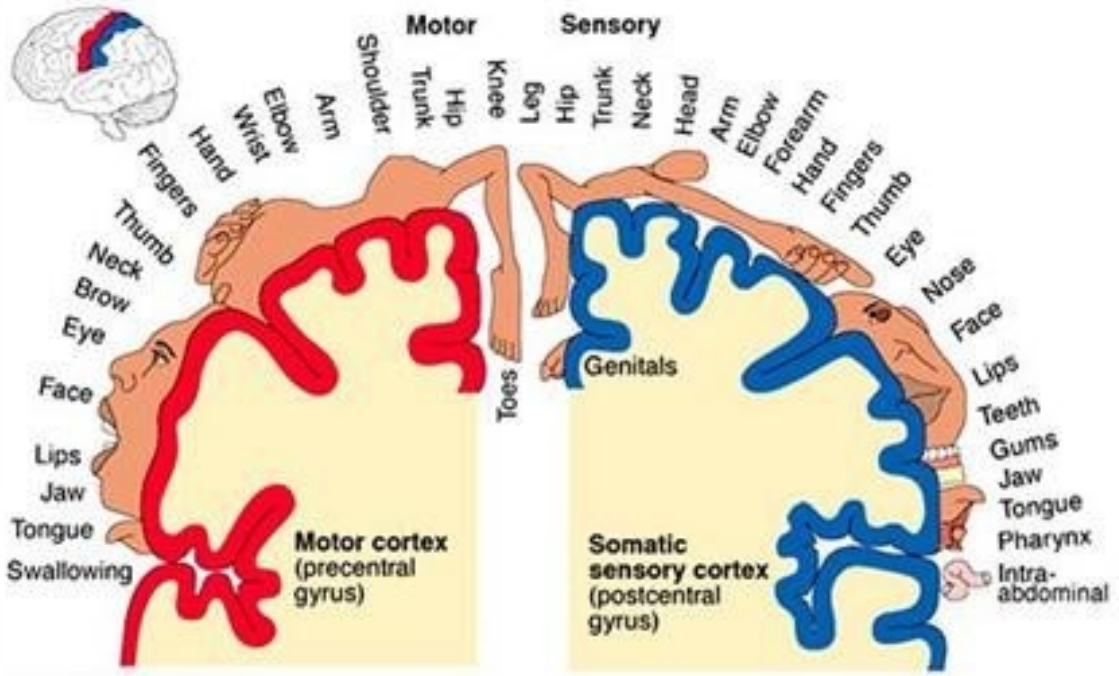
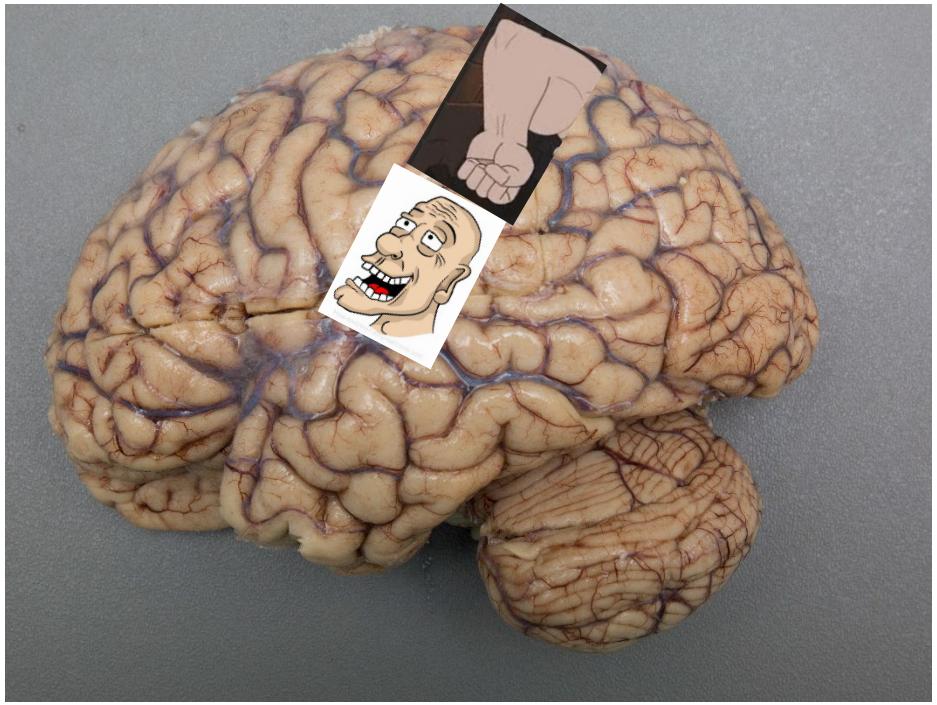
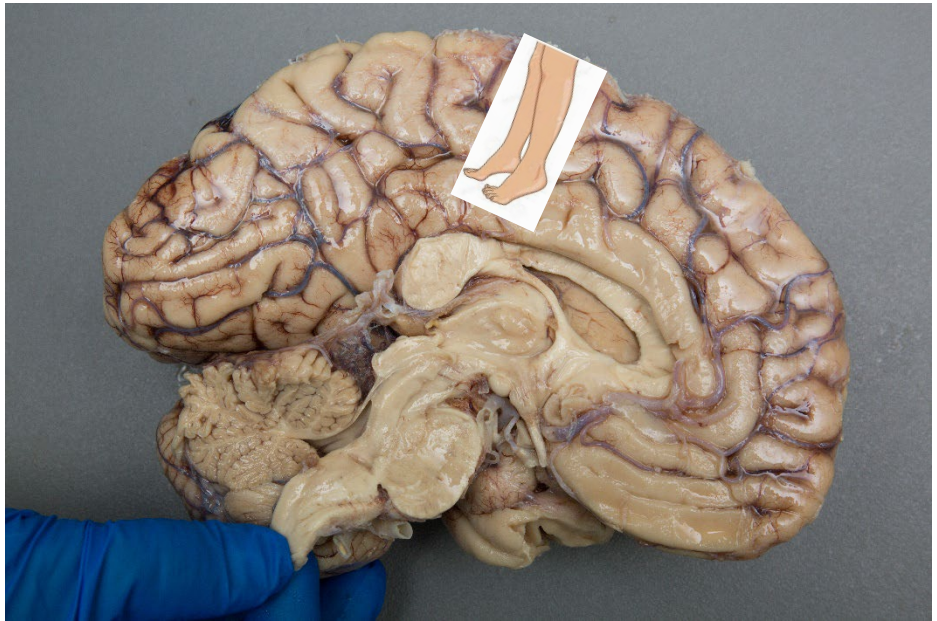
Infarction in the distribution of Anterior Spinal Art:

- Anterior grey matter
- Anterior tracts
- T4 is the most vulnerable watershed area

HOMUNCULUS


Motor
Sensory
Shoulder
Arm
Elbow
Wrist
Hand
Fingers
Thumb
Neck
Brow
Eye
Face
Lips
Jaw
Tongue
Swallowing
Trunk
Hip
Knee
Leg
Toes
Head
Neck
Trunk
Hip
Arm
Elbow
Forearm
Hand
Fingers
Thumb
Eye
Nose
Face
Lips
Teeth
Gums
Jaw
Tongue
Pharynx
Intra-abdominal
Genitals
Motor cortex (precentral gyrus)
Somatic sensory cortex (postcentral gyrus)





Brain Gross Description Template

In Soft Ctrl+M: AUB

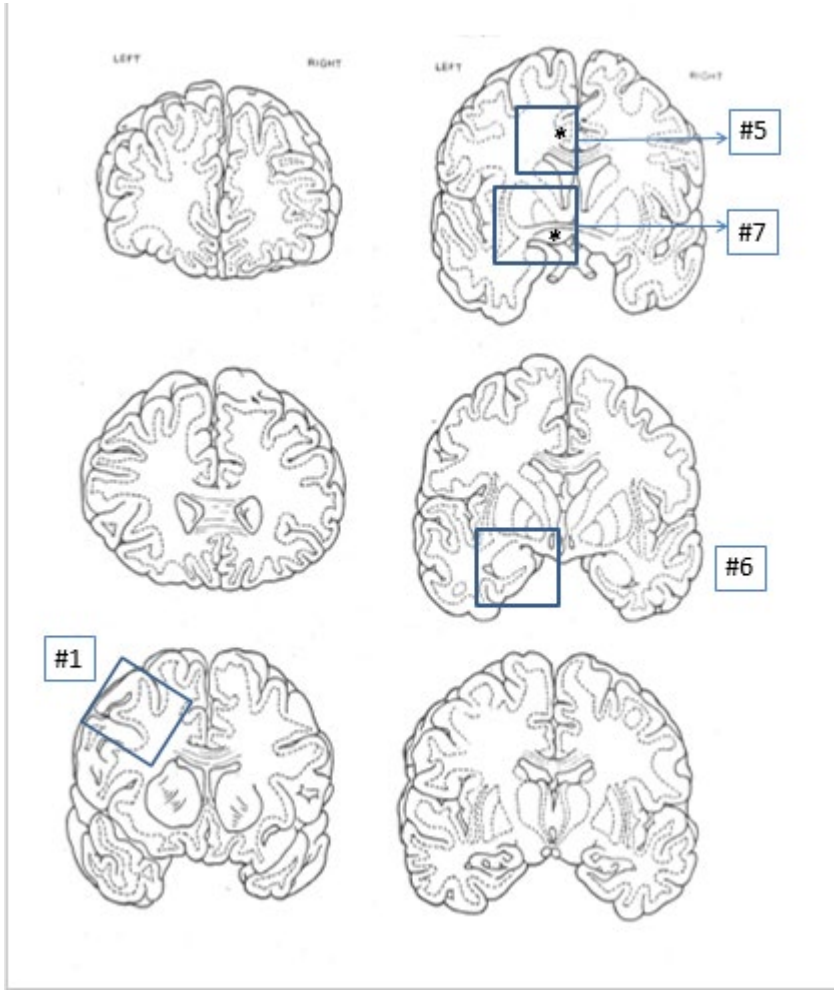
The brain weighs <New Edit Field> g Fix/Fresh (normal range: 1200 - 1400 g). Both the external and internal surfaces of the dural leaflets are smooth and free from nodules. The superior sagittal sinus is patent. There is /is no evidence of cingulate, uncal, or cerebellar tonsilar herniation. The leptomeninges are (thin, translucent, and free from exudates or cloudy). Examination of the arteries of the circle of Willis and their major branches reveals they are patent with mild/moderate/severe atherosclerosis. Aneurysms are/are not seen. The superficial veins of the brain and cranial nerves are unremarkable. There is/is no atrophy primarily affecting the <New Edit Field> lobes. After coronal sectioning, the cerebral hemisphere reveals a cortex of <New Edit Field> mm at the level of the genu of the corpus callosum. The lateral ventricle is/ is not dilated. The septum pellucidum is unremarkable. The centrum semi-ovale is (free from hemorrhage and tumor mass)/or has XXX lesions. The central nuclei of the brain, including caudate, globus pallidus, putamen, thalami, lateral geniculate bodies and subthalamic nuclei all are unremarkable. The hippocampus and amygdala are Select One. The substantia nigra and locus ceruleus are Select One. The remainder of the midbrain, pons, medulla, cerebellar hemispheres, vermis and cerebellar nuclei are <New Edit Field>. The spinal cord is <New Edit Field> OR not available for examination.

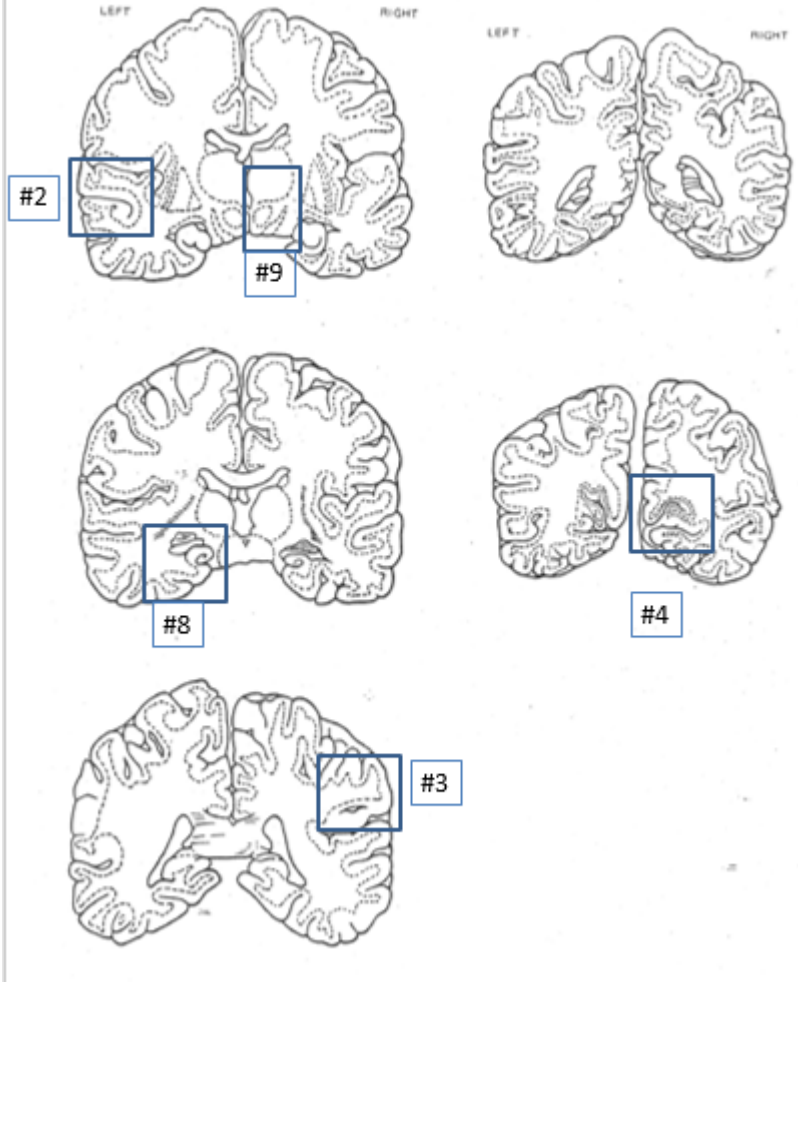
Sections for Neurodegenerative Cases

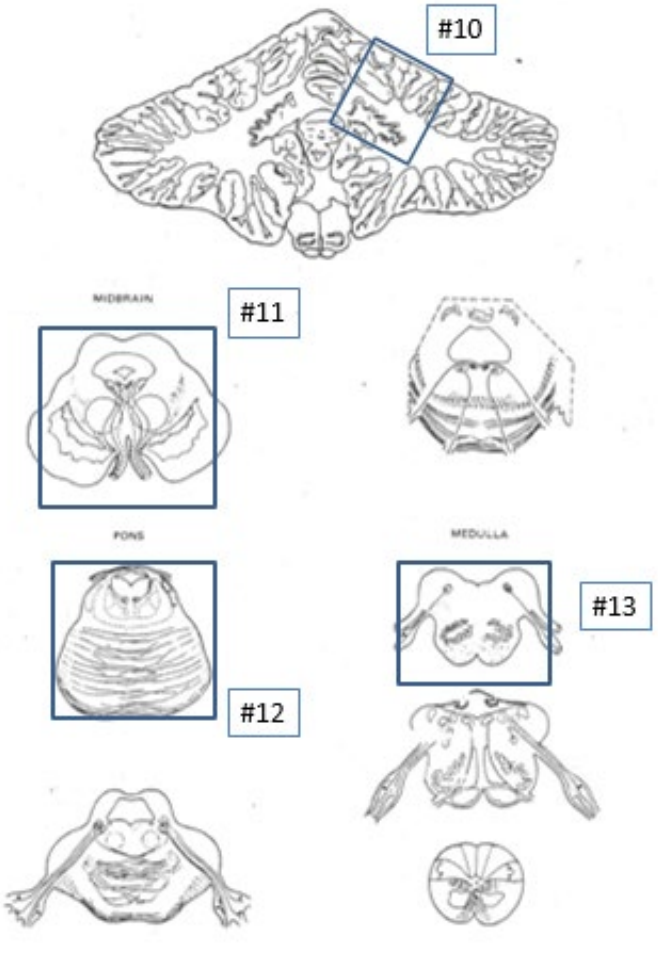
1 Middle Frontal Gyrus
2 Superior and Middle Temporal Gyrus
3 Inferior Parietal Cortex
4 Occipital, Primary Visual Cortex
5 Anterior cingulate with corpus callosum
6 Amygdala
7 Nucleus basalis at the level of anterior commissure. Include Basal Ganglia GP and Putamen

8 Hippocampus at the level of the lateral geniculate
9 Subthalamic nucleuses and Thalamus
10 Superior cerebellum with full dentate nuclei
11 Midbrain at the level of the red nucleus
12 Pons one section with basis pontis and 1 or 2 additional levels of locus ceruleus
13 Medulla at the level of inferior olivary nucleus

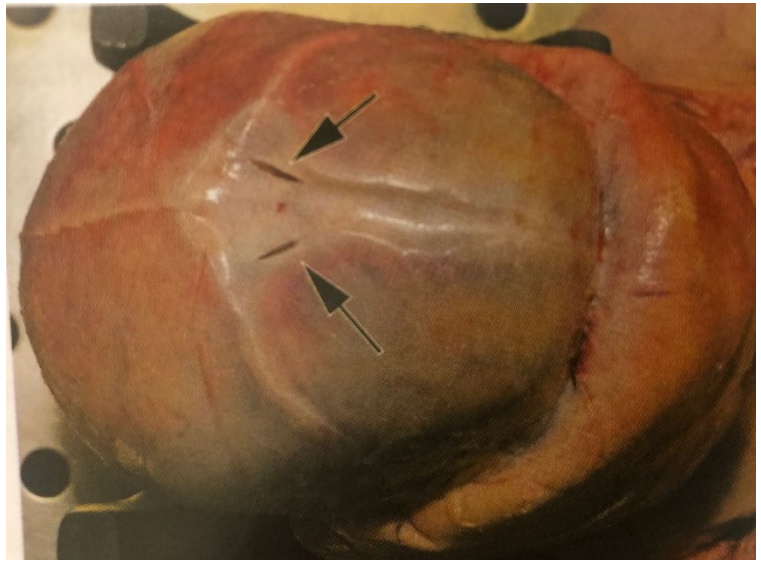
Sections for Neurodegenerative Cases

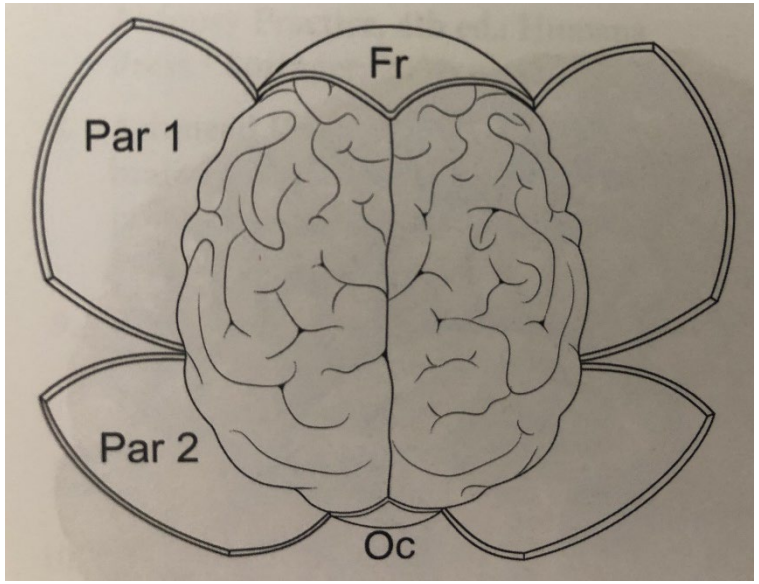


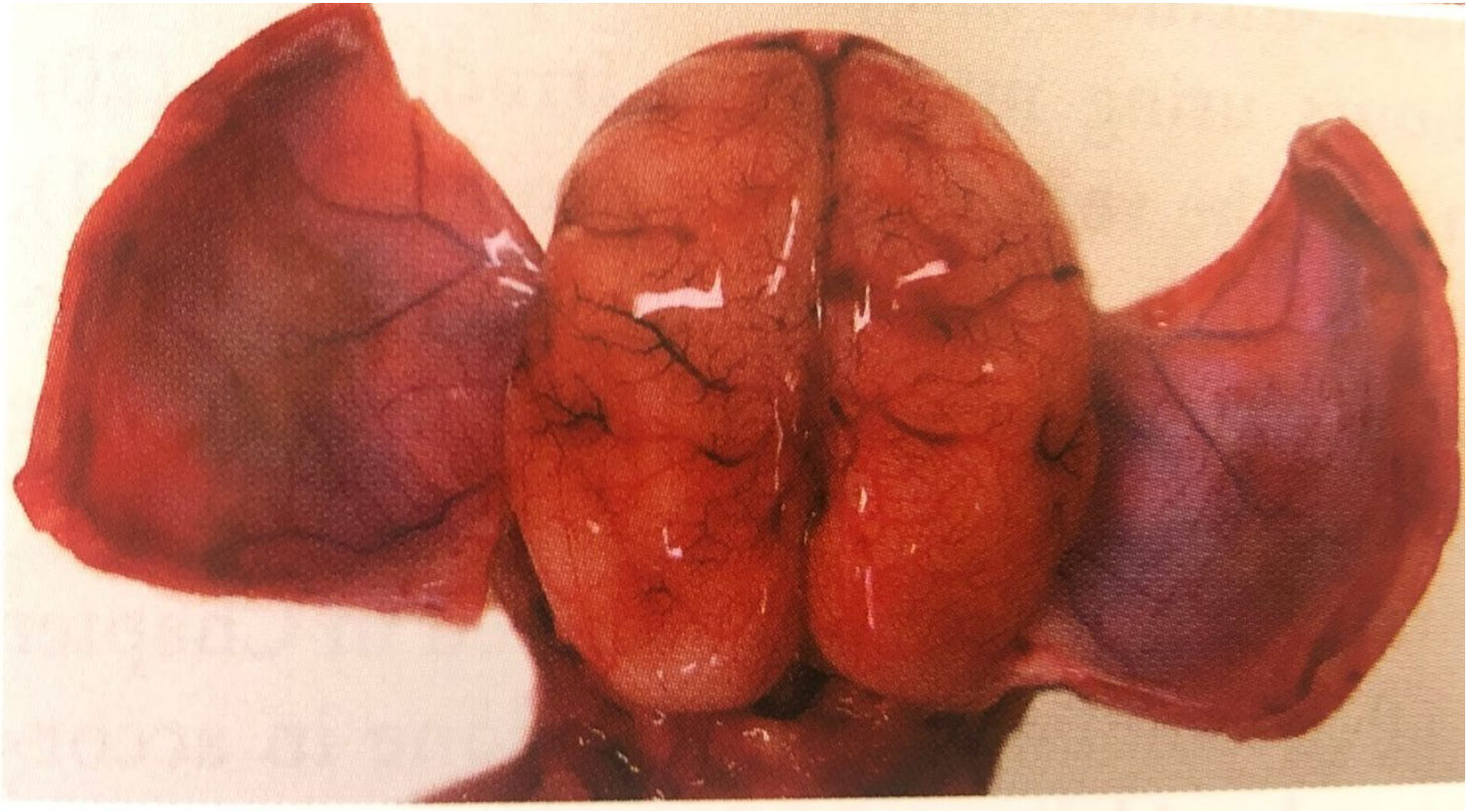




Brain Removal Perinatal







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Perinatal/ Infant Brains

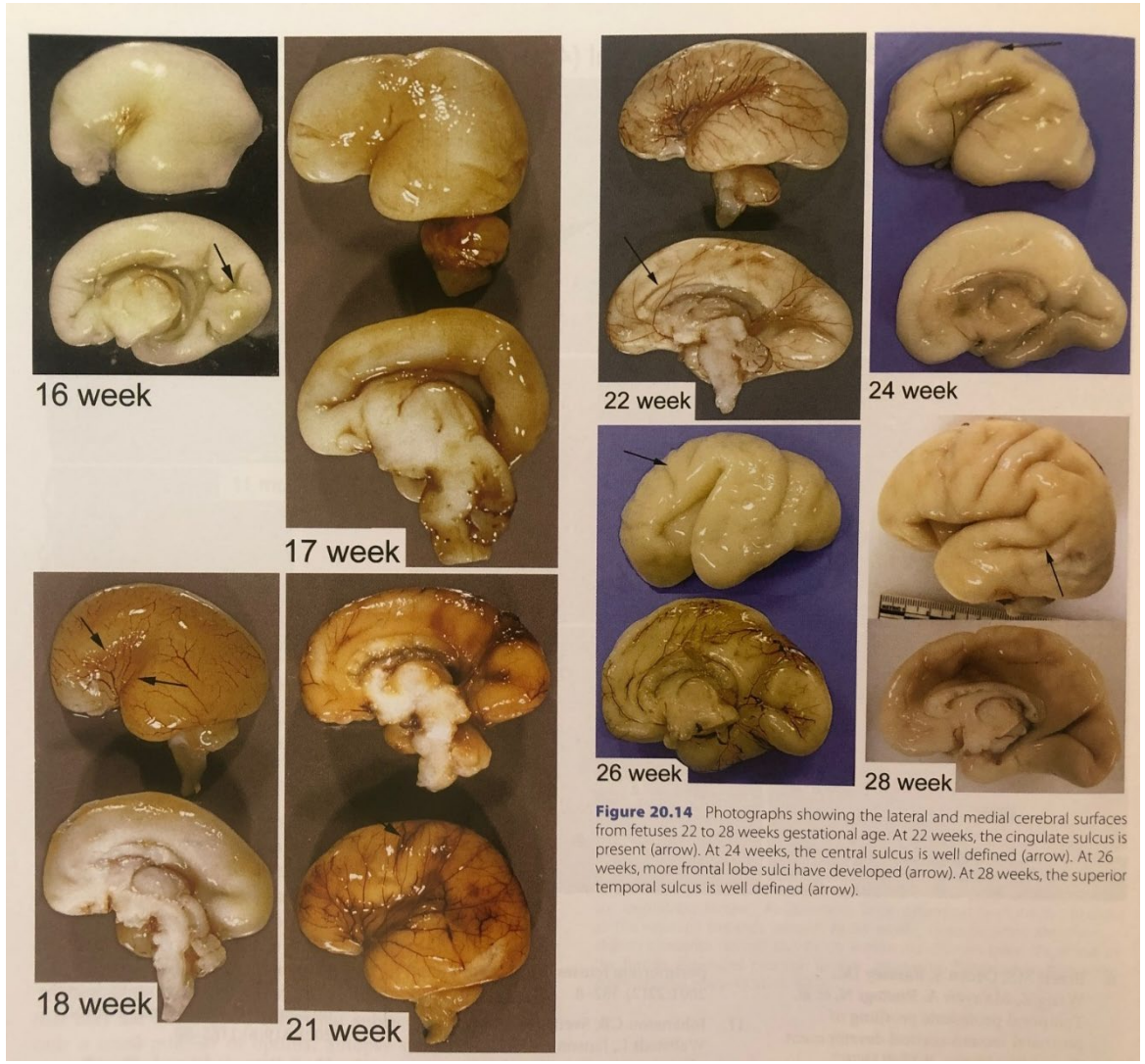

Figure 20.14 Photographs showing the lateral and medial cerebral surfaces from fetuses 22 to 28 weeks gestational age. At 22 weeks, the cingulate sulcus is present (arrow). At 24 weeks, the central sulcus is well defined (arrow). At 26 weeks, more frontal lobe sulci have developed (arrow). At 28 weeks, the superior temporal sulcus is well defined (arrow).

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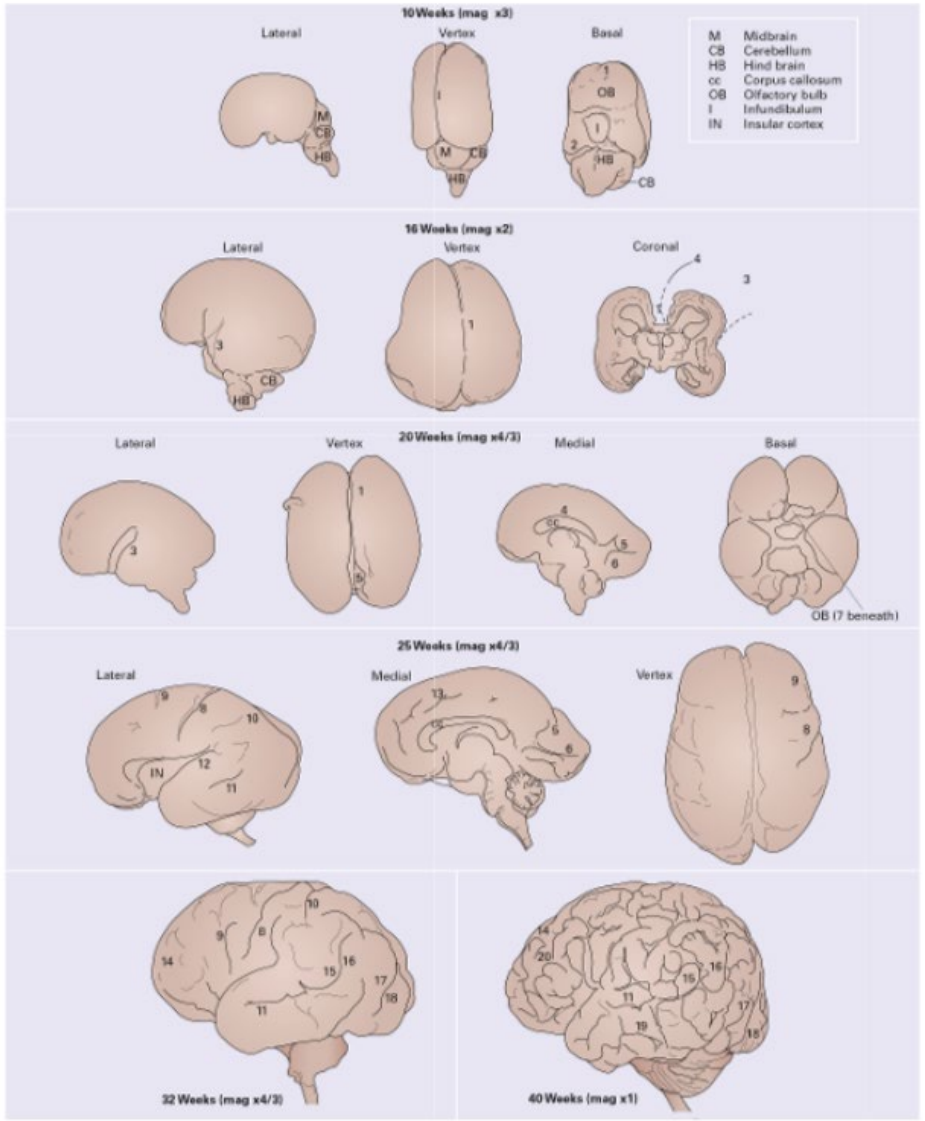

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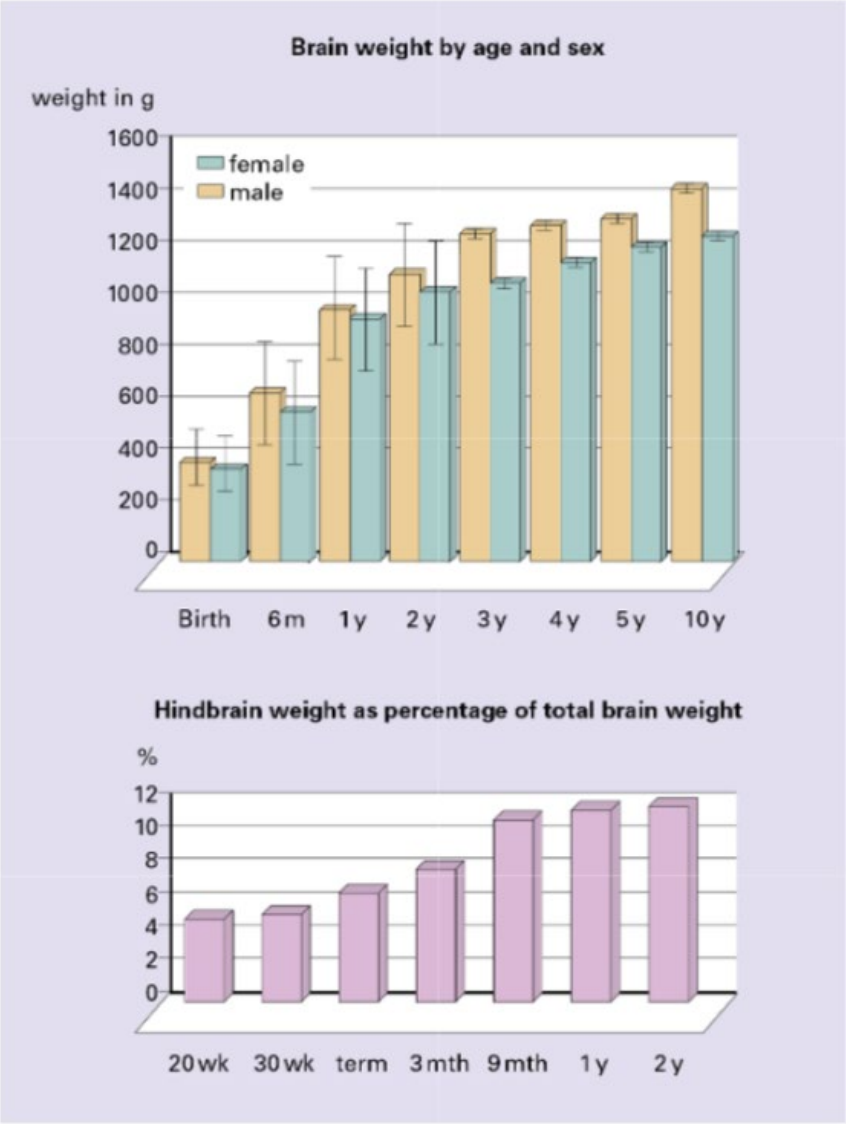
Perinatal/ Infant Brains



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If child abuse is suspected remove the cervical spinal cord on block with the spine

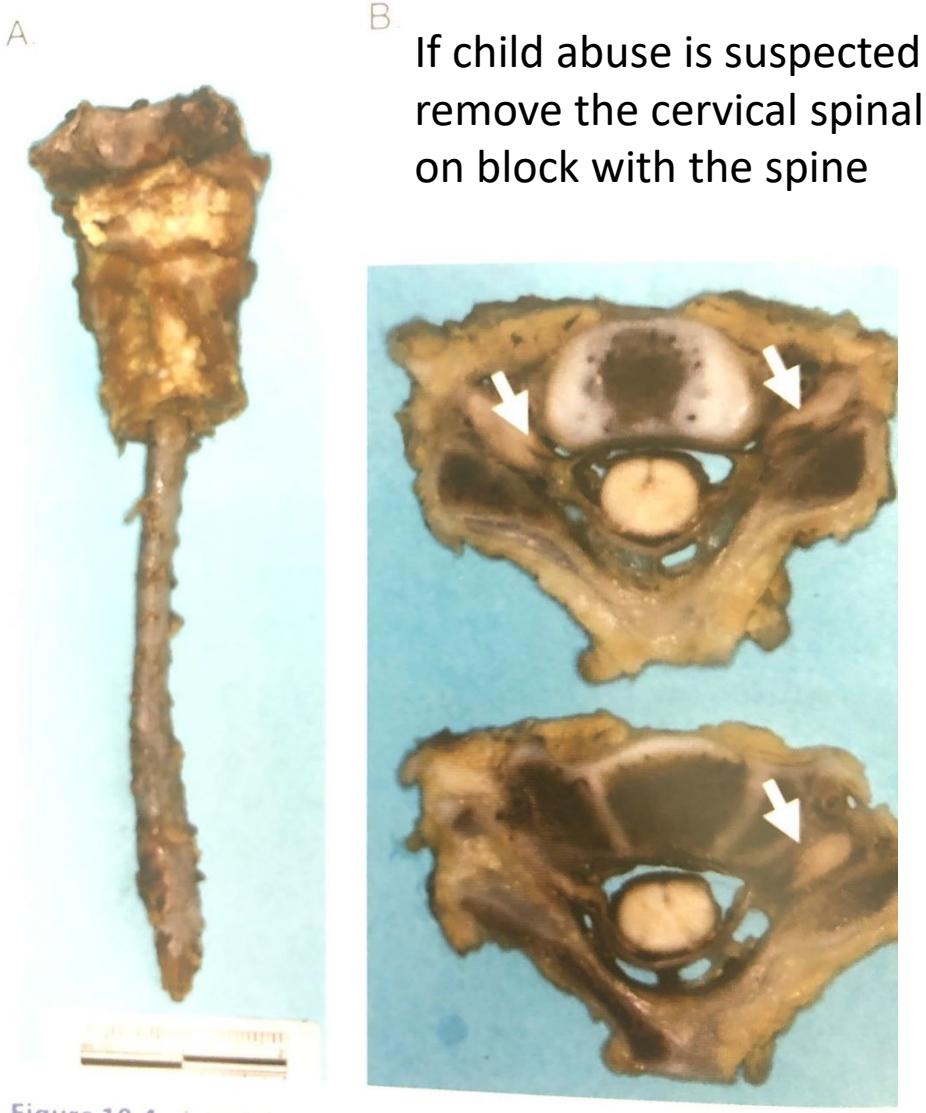

Figure 10.4 A Vertebral en bloc specimen, dorsal aspect, here including

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PEDIATRIC NEUROPATHOLOGY: PERINATAL WORKSHEET

Autopsy #	Attending/House Staff	Date of Brain Cutting:	Slides Received:
Gestational age:	IUFD x days	Live birth (lived m/h/d/w)	Neuro sign out:
Placenta findings:		Clinical History:	

Brain Weight: _____ (Fresh/Fixed)	Posterior fossa contents Weight: _____ (Fresh/Fixed)	Dura: Y / N Spinal Cord: Y / N Pituitary: Y / N

Gestational Age (weeks)	Fresh Brain weight (g)	Fixed Brain weight (g)	Posterior fossa contents weight (g)	% Posterior fossa contents
14 - 15	15.4 +/- 1.2	14.4 +/- 3.3	0.76 +/- 0.14	5.91 +/- 0.62
16 - 17	21.2 +/- 1.0	21.5 +/- 5.3	1.21 +/- 0.19	5.37 +/- 0.78
18 - 19	37.3 +/- 8.1	38.7 +/- 9.5	2.19 +/- 0.7	4.88 +/- 0.5
20 - 21	52.2 +/- 7.2	55.3 +/-10.1	2.81 +/- 0.42	4.98 +/- 0.49
22 - 23	75.0 +/-17.7	78.1 +/-14.3	3.7 +/- 0.74	4.54 +/- 4.41
24 - 25	101.5 +/-18.7	111.9 +/- 17.3	5.23 +/- 0.7	4.61 +/- 0.29
26 - 27	130.6 +/- 17.3	146.2 +/- 21.6	6.95 +/- 1.41	4.52 +/- 0.32
28 - 29	169.2 +/- 19.1	184.6 +/- 26.4	7.63 +/- 0.79	4.76 +/- 0.46
30 - 31	203 +/- 25.9	229.5 +/- 29.8	12.2 +/- 2.02	5.24 +/- 0.35
32 - 33	234.9 +/- 28.2	266.0 +/- 32.7	14	5.18
34 - 35	280.3 +/- 28.1	309.3 +/-47.04	15.7 +/- 3.18	5.58 +/- 0.41
36 - 37	325.8 +/- 40.7	366.0 +/- 50.2	21.43 +/- 3.36	6.07 +/- 0.66
38 - 39	391.7 +/- 41.4	433.3 +/- 56.9	26.9 +/- 4.7	6.27 +/- 0.56
40 - 41	409.6 +/- 37.5	455.2 +/- 53.6	29.05 +/- 4.04	6.68 +/- 0.65

External Appearance:

Dura:

Meninges:

Vessels:

Nerves:

Development (Fissures and sulci)

Internal Appearance:

Cassette Summary:

	Midfrontal watershed		Thalamus		
	ACC, caudate, CC, lateral ventricle		Hippocampus		
	Occipital watershed with ventricle		Cerebellum with dentate and or vermis		
	Basal ganglia and insular cortex		Midbrain		
	Orbitofrontal		Pons/Medulla		

PEDIATRIC NEUROPATHOLOGY: INFANT WORKSHEET

Autopsy #	Attending/House Staff	Date of Brain Cutting:	Slides Received:
SEX:	Age at death:	Gestational age at birth:	Neuro sign out:
Placenta findings:		Clinical History:	

Brain Weight: _____ (Fresh/Fixed)	Posterior fossa contents Weight: _____ (Fresh/Fixed)	Dura: Y / N Spinal Cord: Y / N Pituitary: Y / N

BRAIN WEIGHT TABLE

Age	Ht (cm) F-M	FEMALE BW	MALE BW
Term (40 wks)	50-50	409.6 +/- 37.5	409.6 +/- 37.5
1 mo	54-54	516	523
2 mo	56-58	560	609
4-8 mo	57-59	580 +/- 120	640 +/-160
9-18 mo	72-76	940 +/-120	970 +/-160
19-30 mo	84-85	1040 +/-130	1120 +/-200
31-43 mo	94-94	1090 +/-230	1270 +/-210

Term: body weight between 2.1 and 3.3Kg

Hindbrain Wt as % Total Wt	
Term (40wks)	6-7%
3 mo	8%
9 mo	11%
1 yr	11-12%
2 yr	12%

External Appearance:

Dura:

Meninges:

Vessels:

Nerves:

Development (Fissures and sulci)

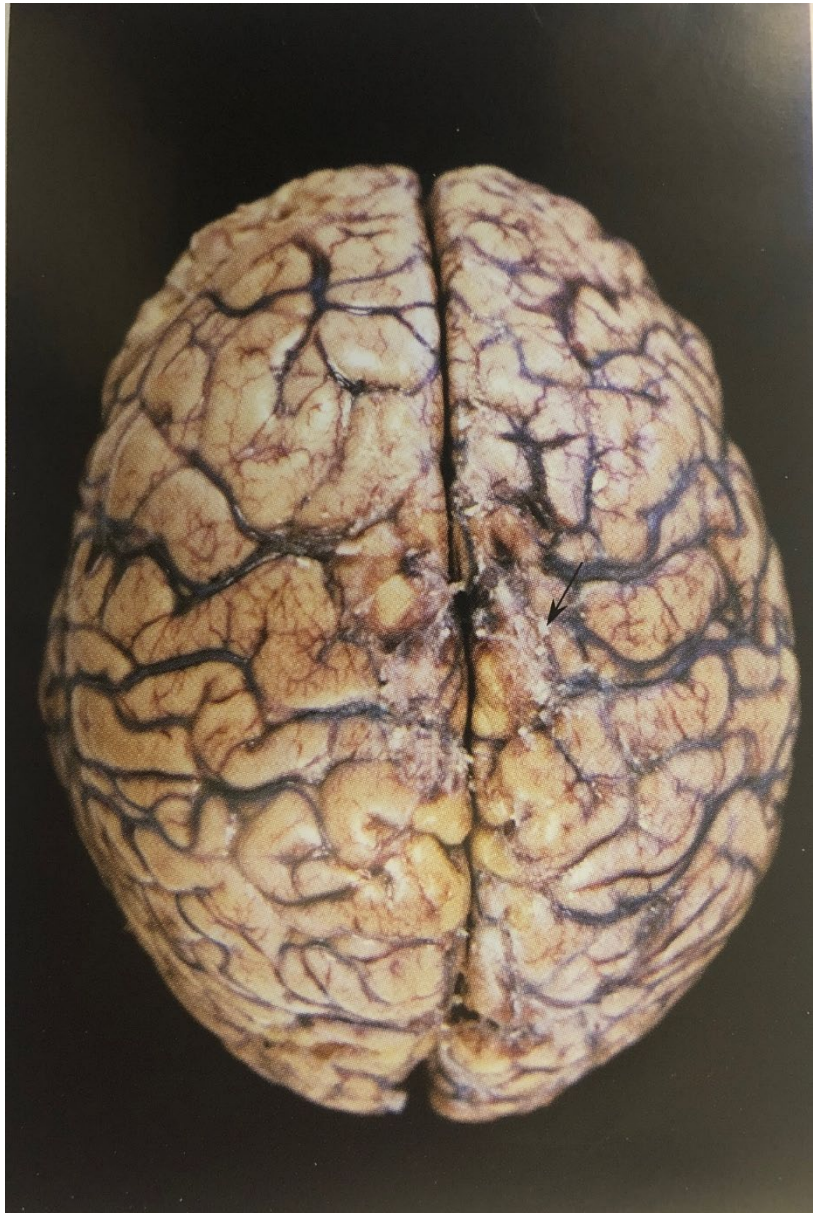
Internal Appearance:

Cassette Summary:

	Midfrontal watershed		Cerebellum		
	Caudate with corner lateral ventricle		Midbrain		
	Occipital watershed with ventricle		Pons		
	Basal ganglia and insular cortex		Medulla		
	Thalamus				
	Hippocampus				

Few Gross Autopsy Examples

Diffuse cerebral edema



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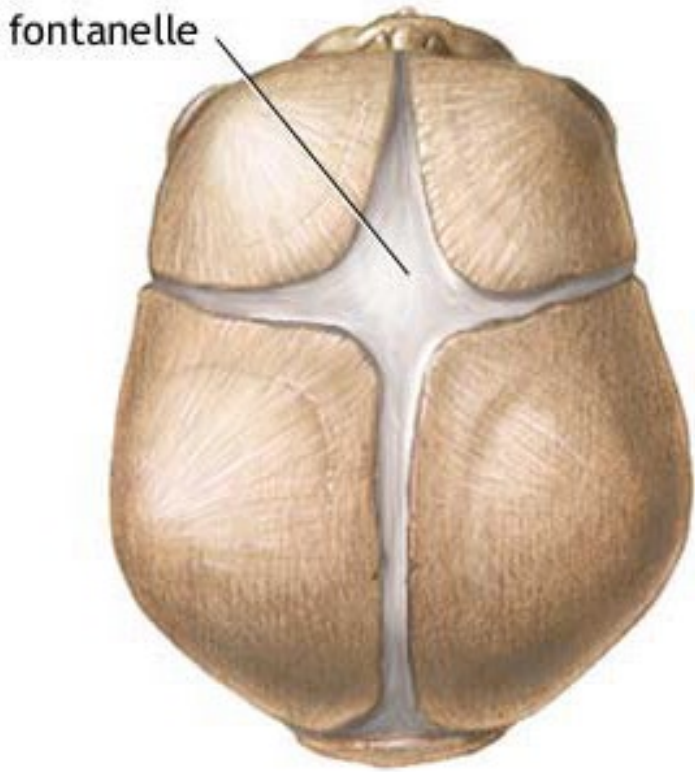
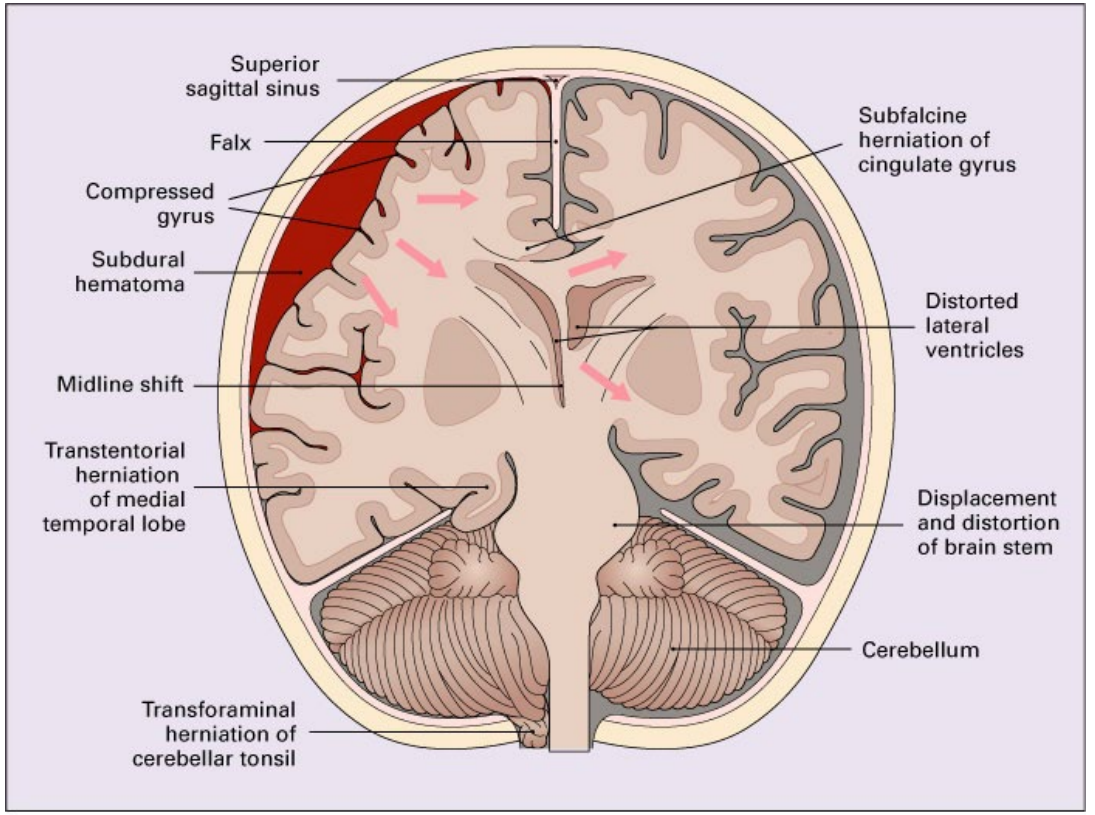
Infants



Older Children and Adults

Herniations



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Subdural Hematoma

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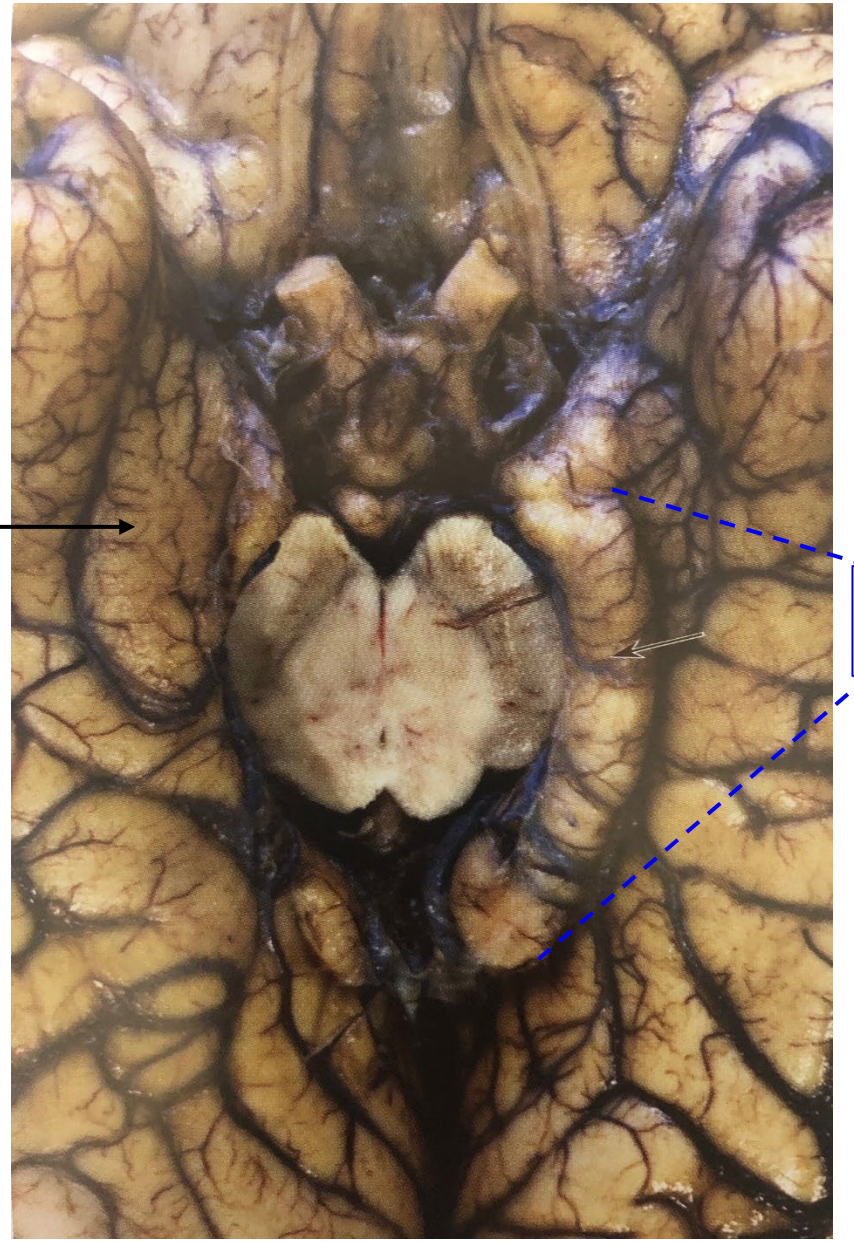
Herniations



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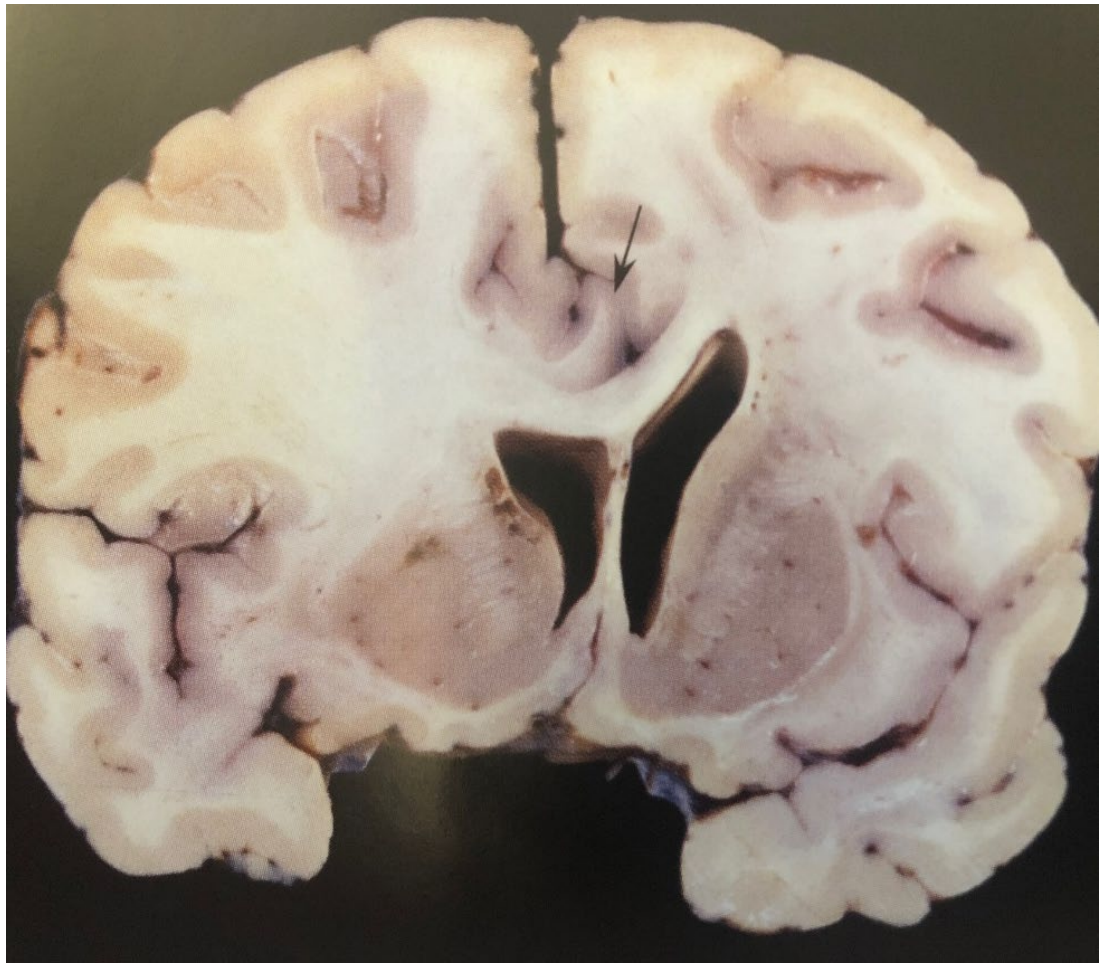
Subfalcine Herniation



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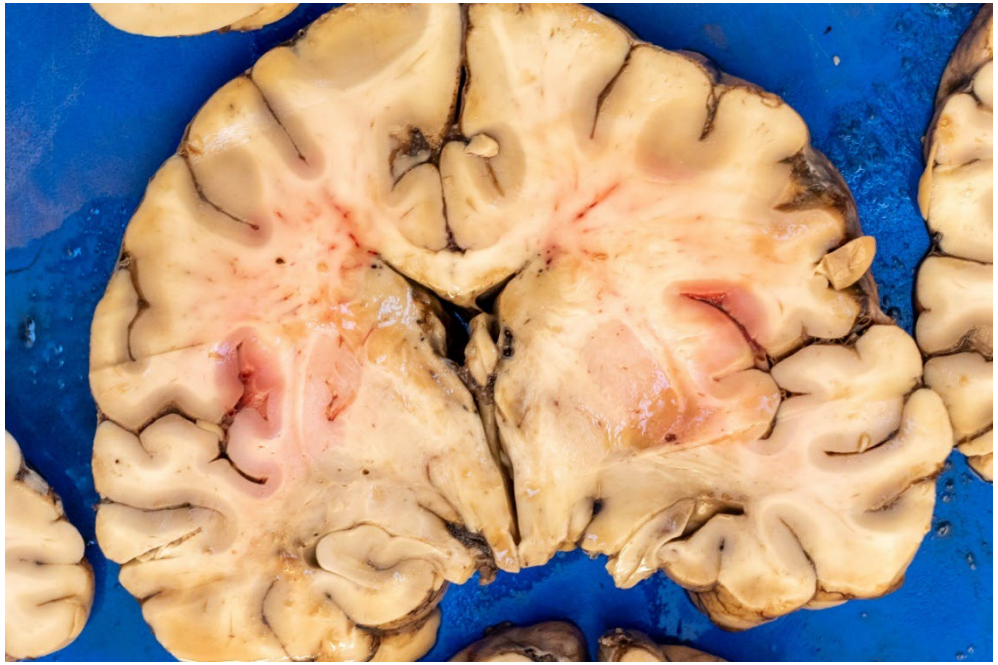
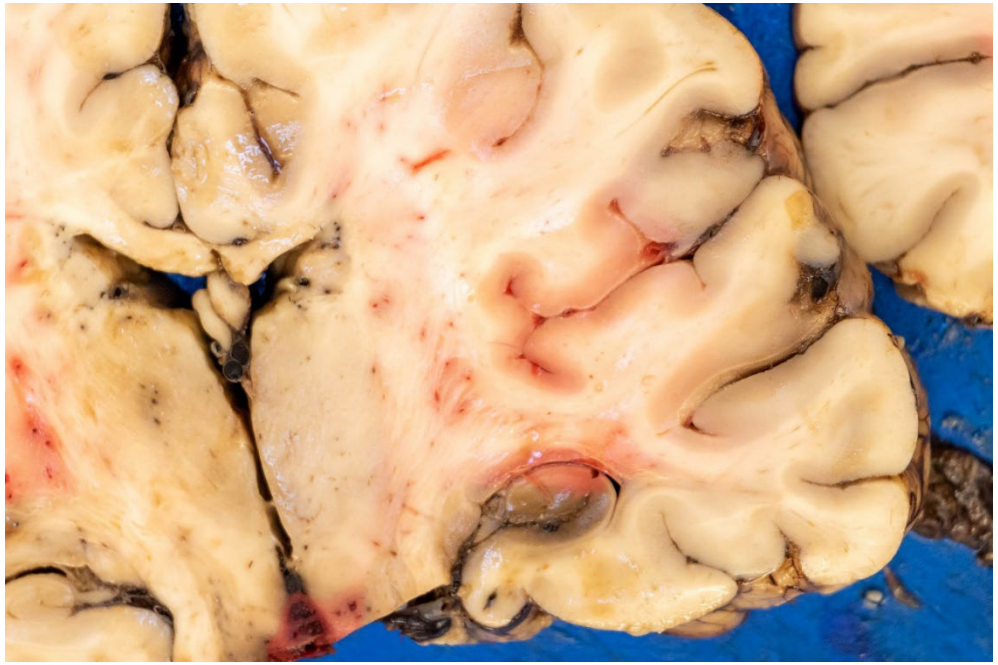
Bilateral Tonsillar Herniation

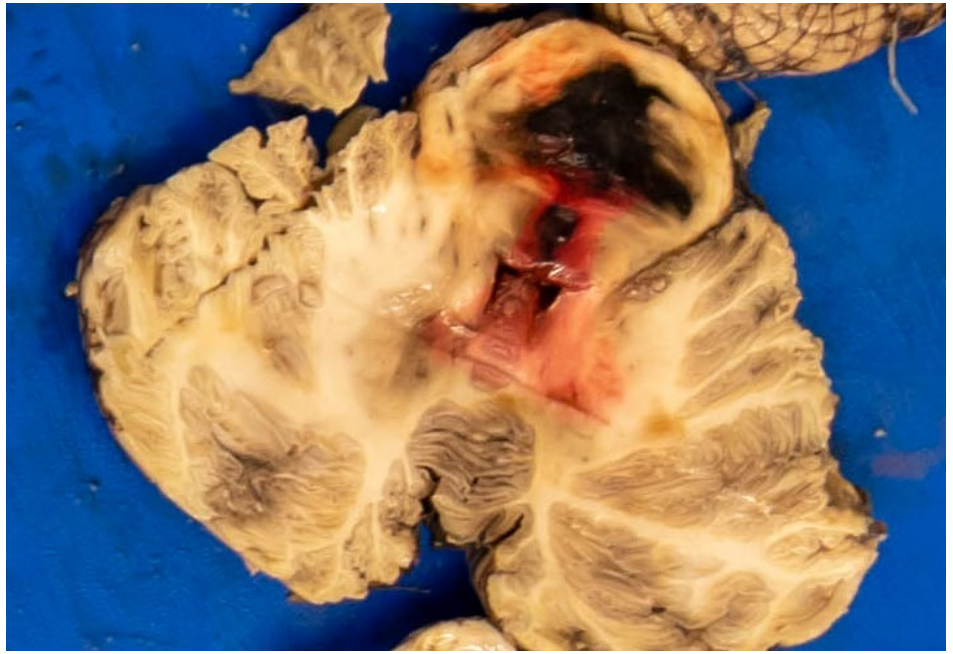
Neuropathology-web.org

Ischemic lesions

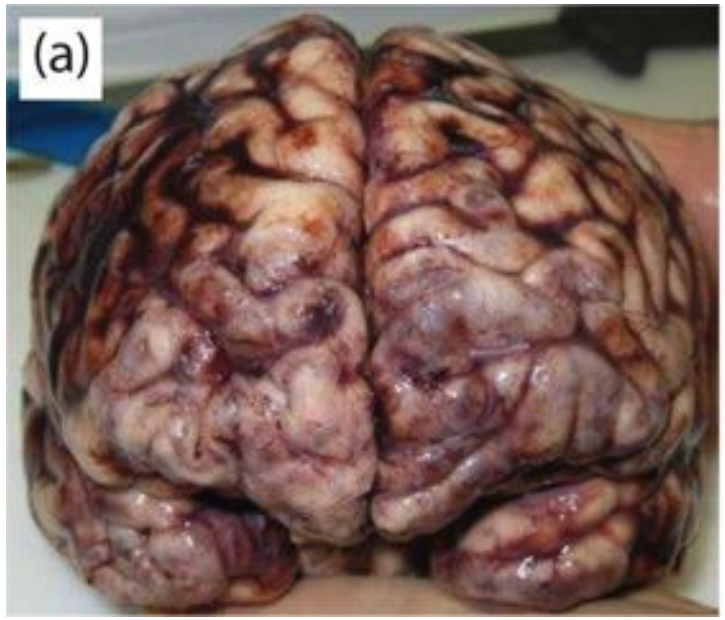


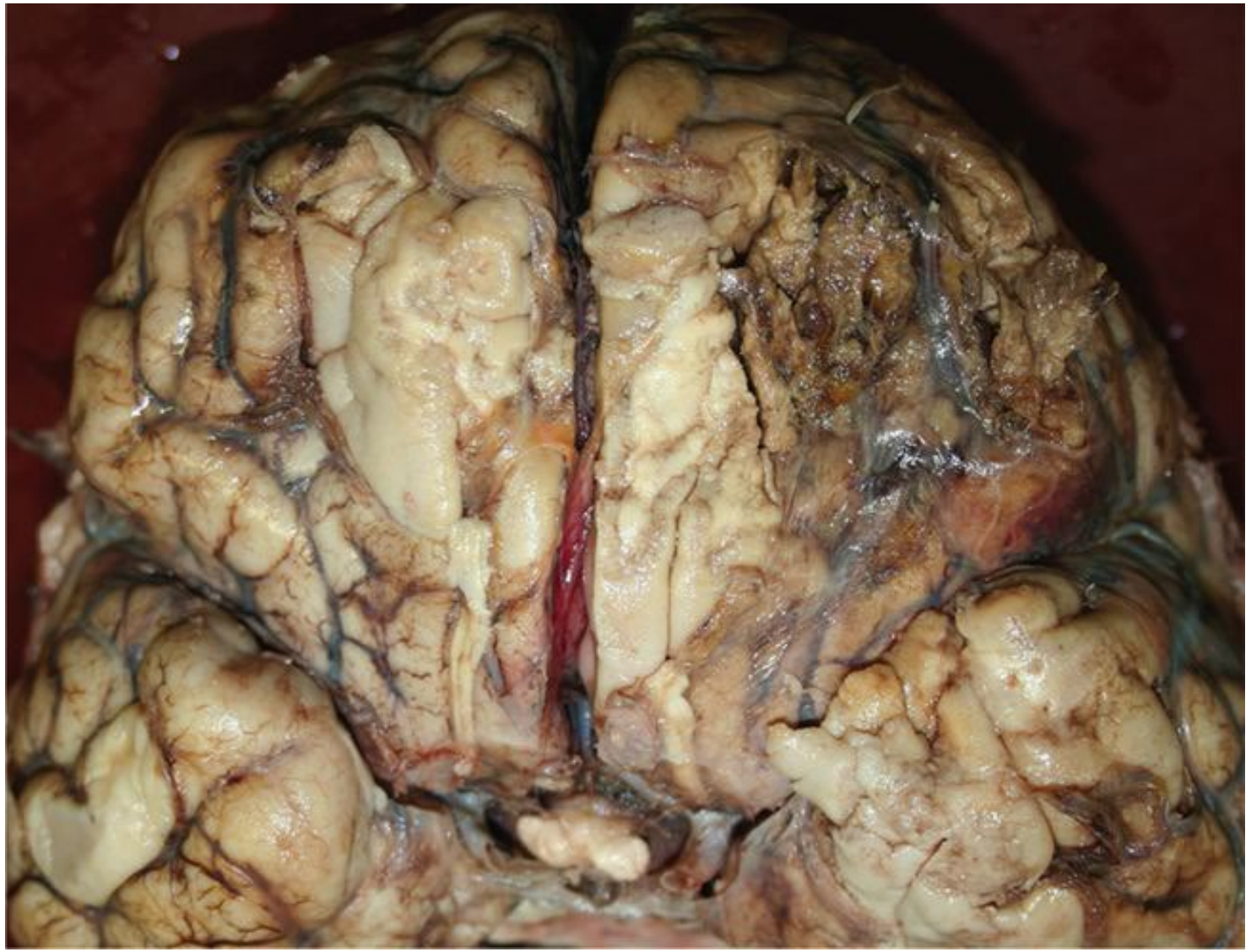


Duret's Hemorrhage



Contusions: Acute and Chronic





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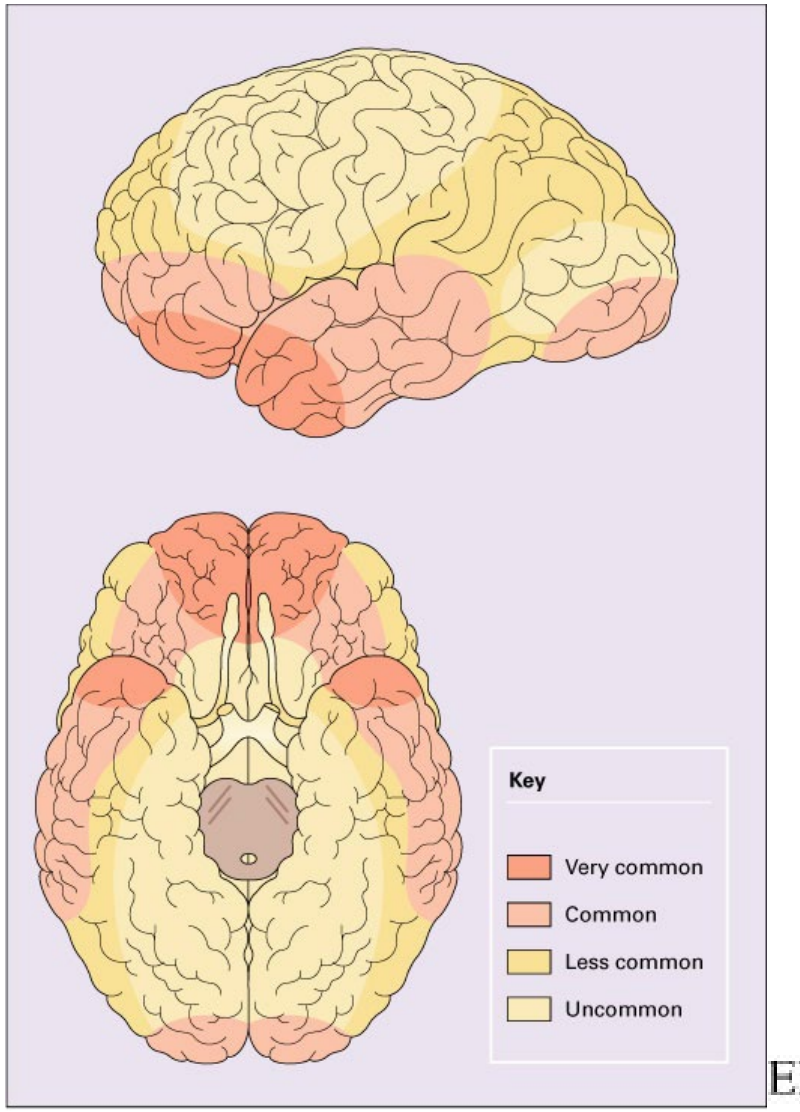
Contusions



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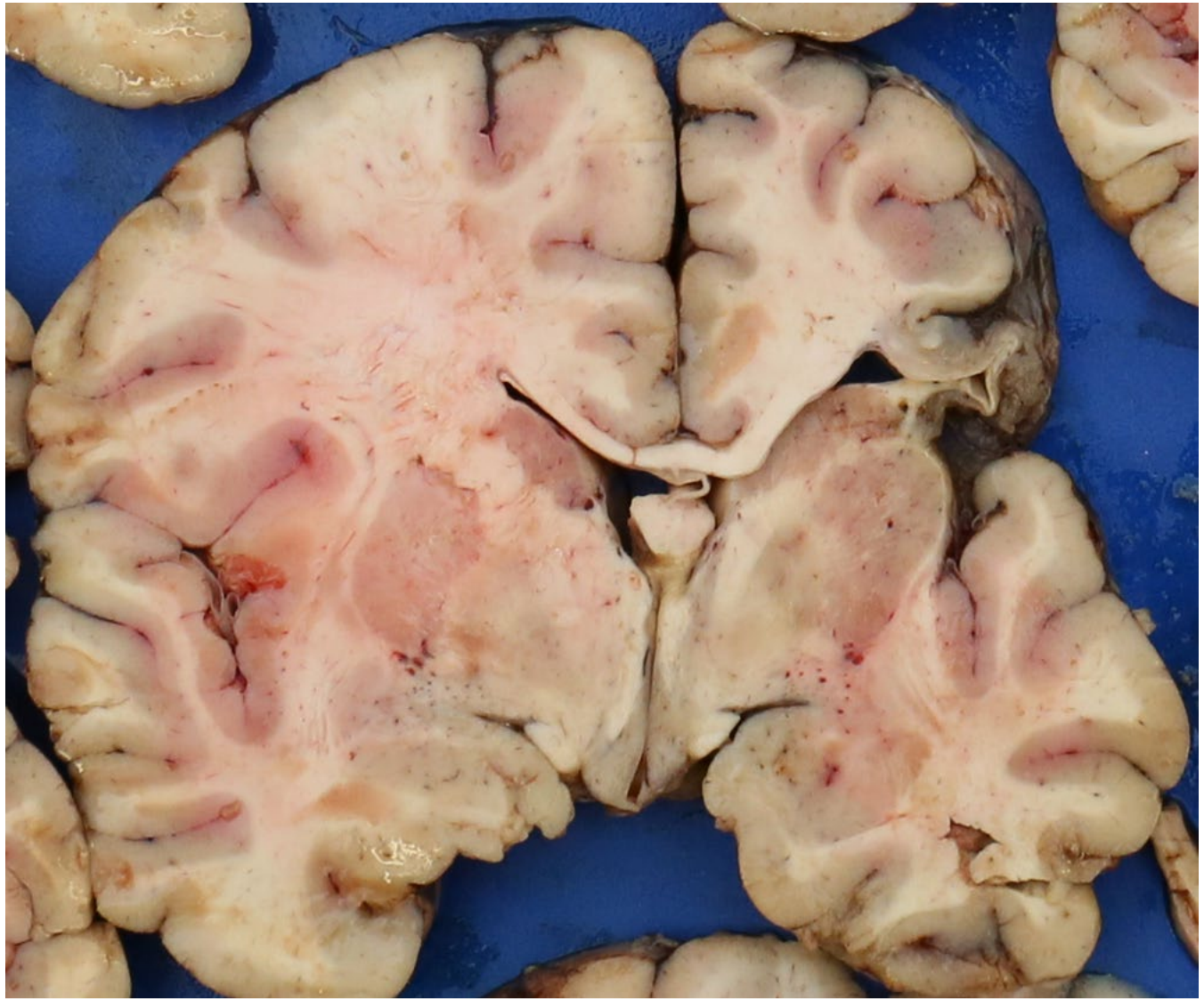

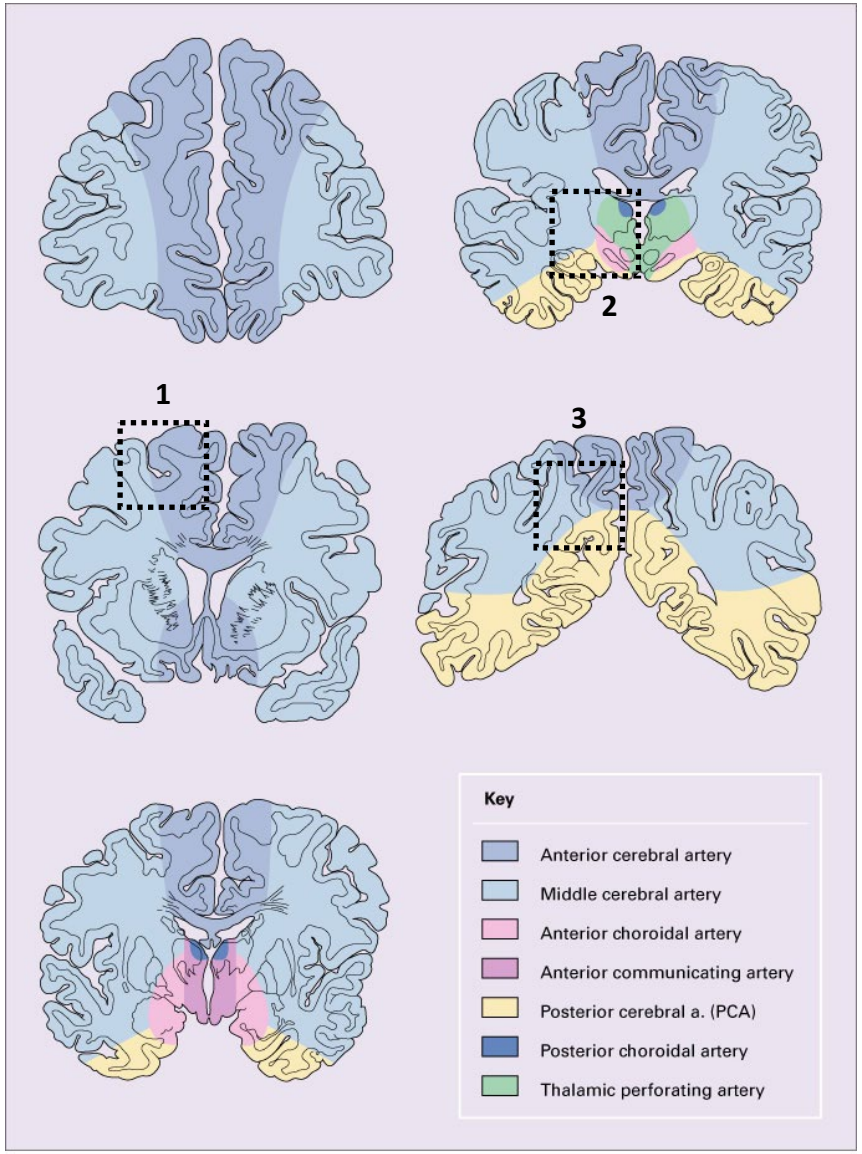

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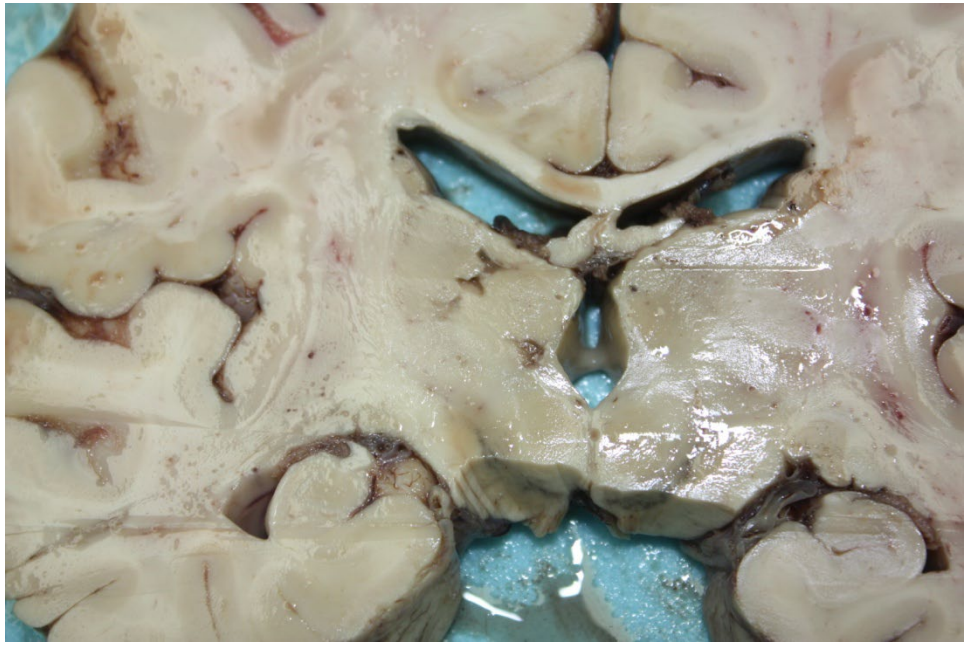
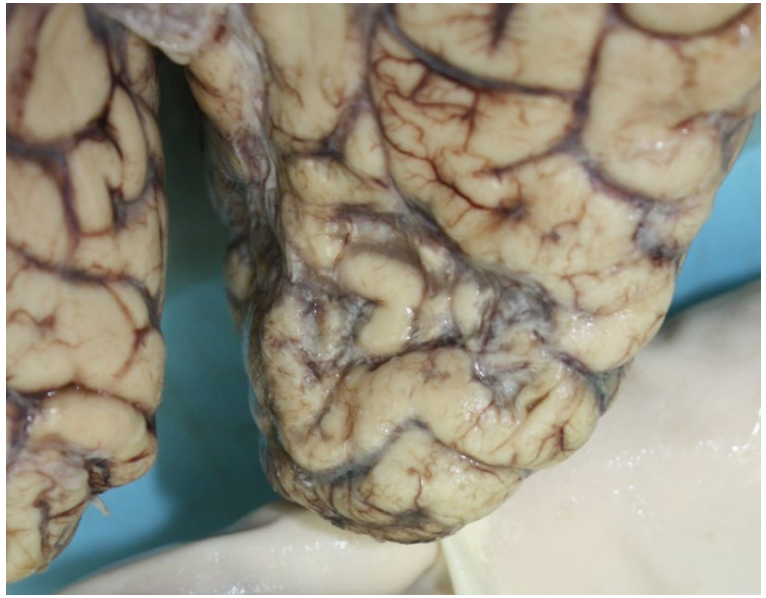
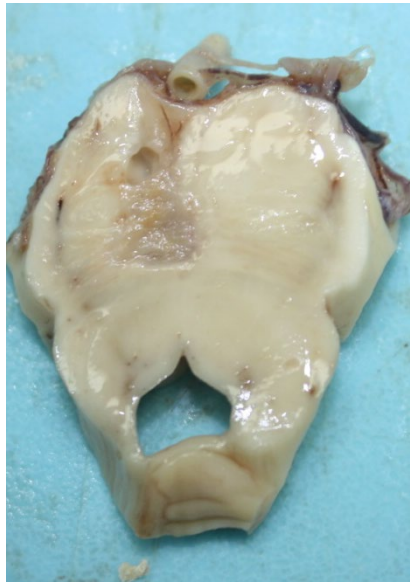
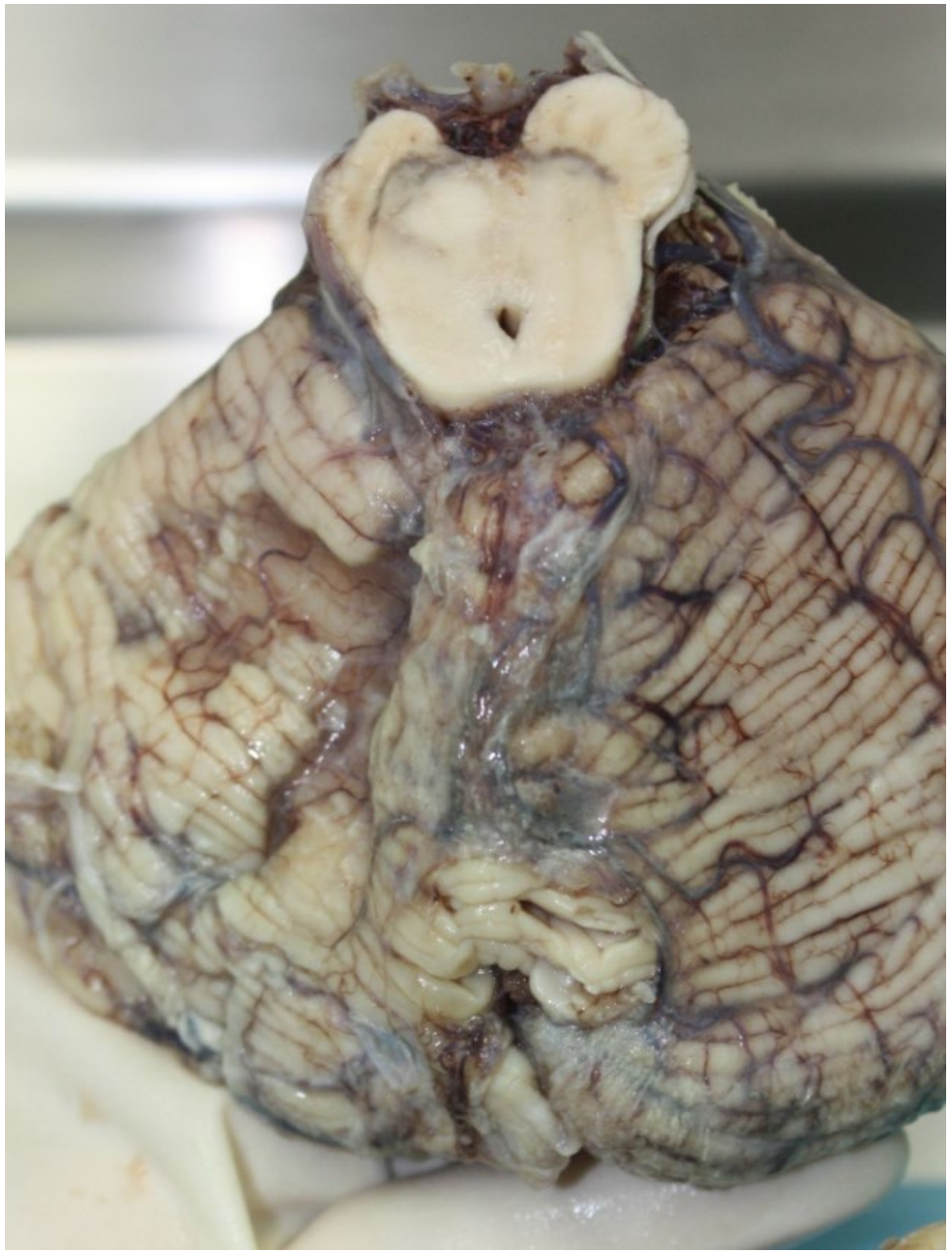


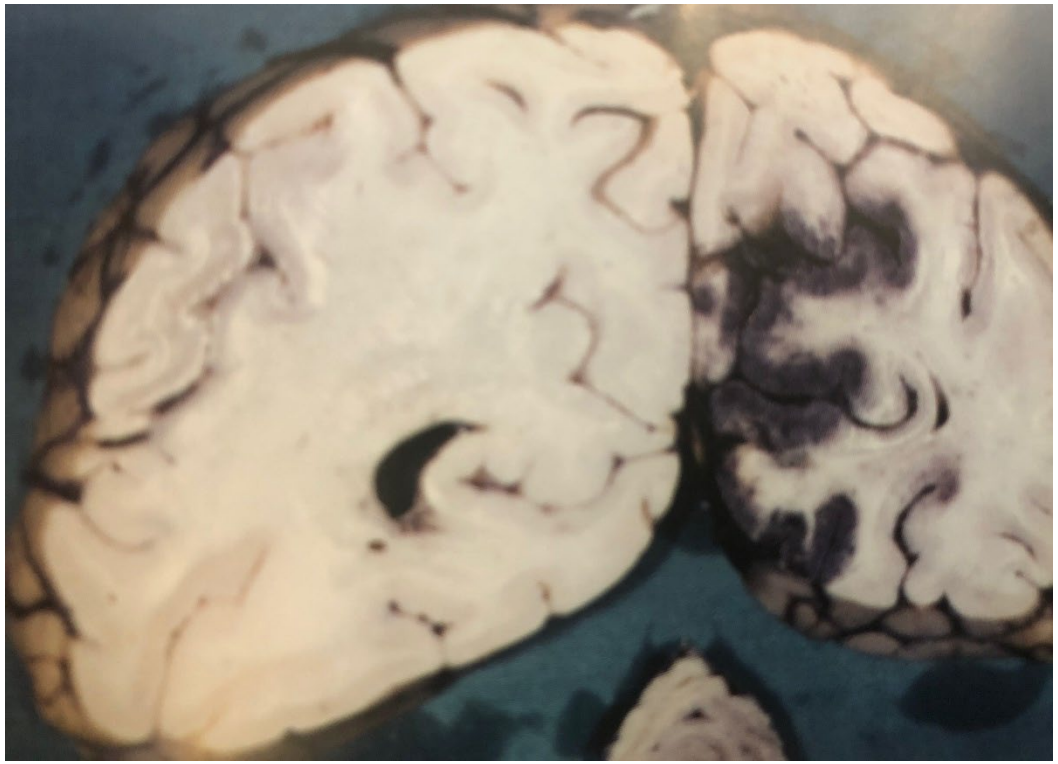






Infarcts

PCA infarct



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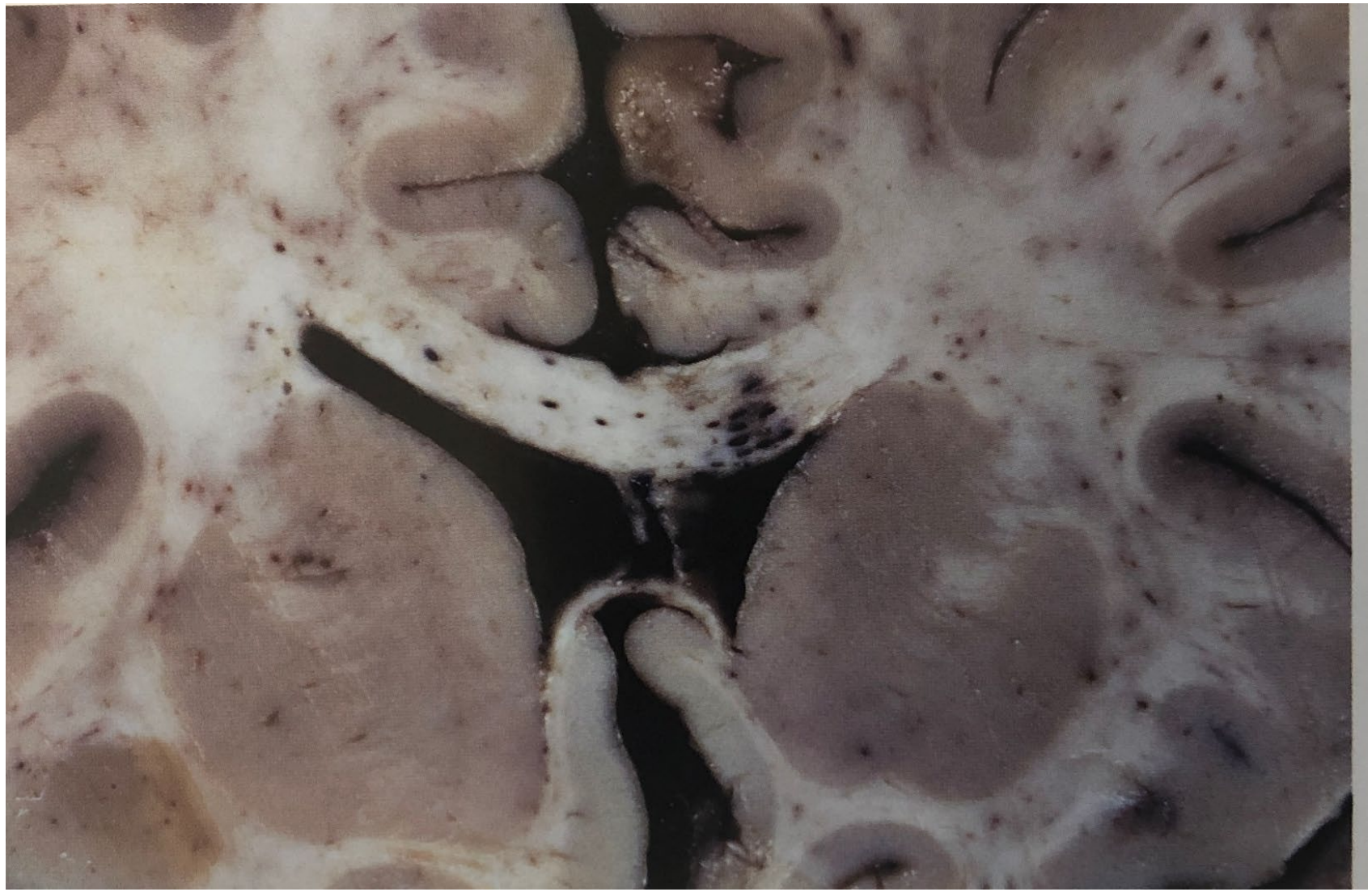
Diffuse traumatic axonal injury



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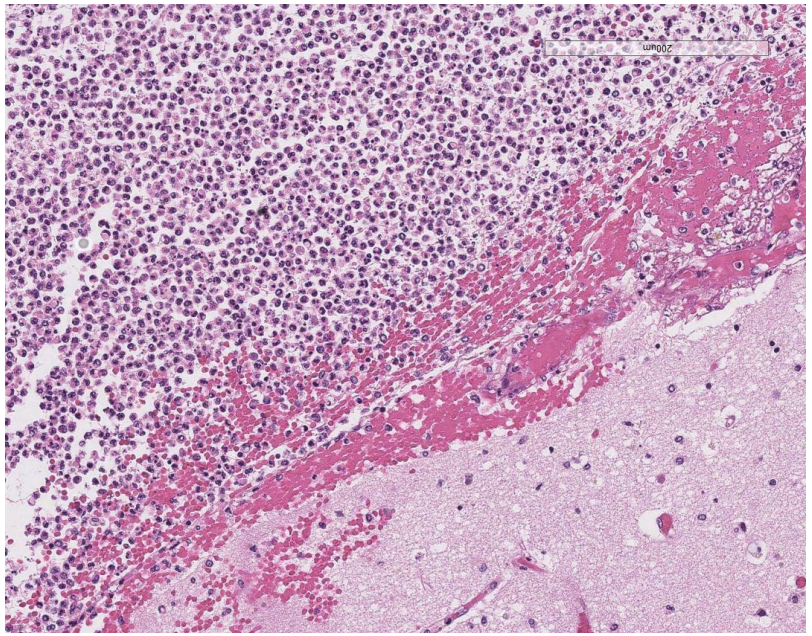
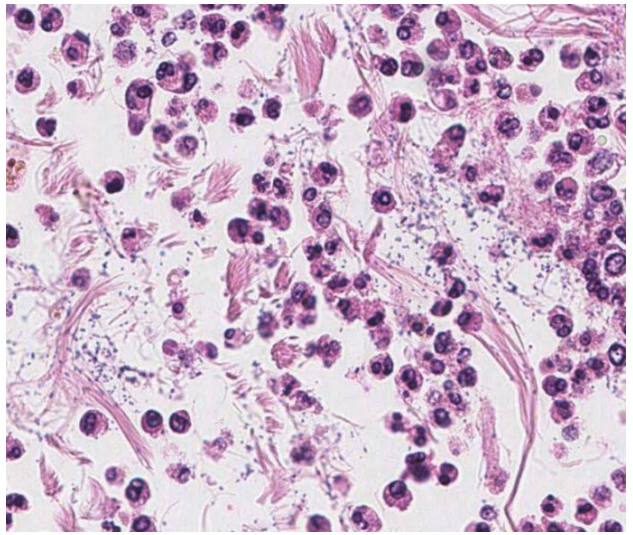
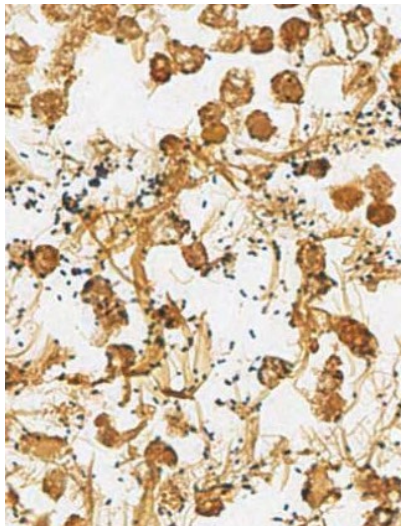
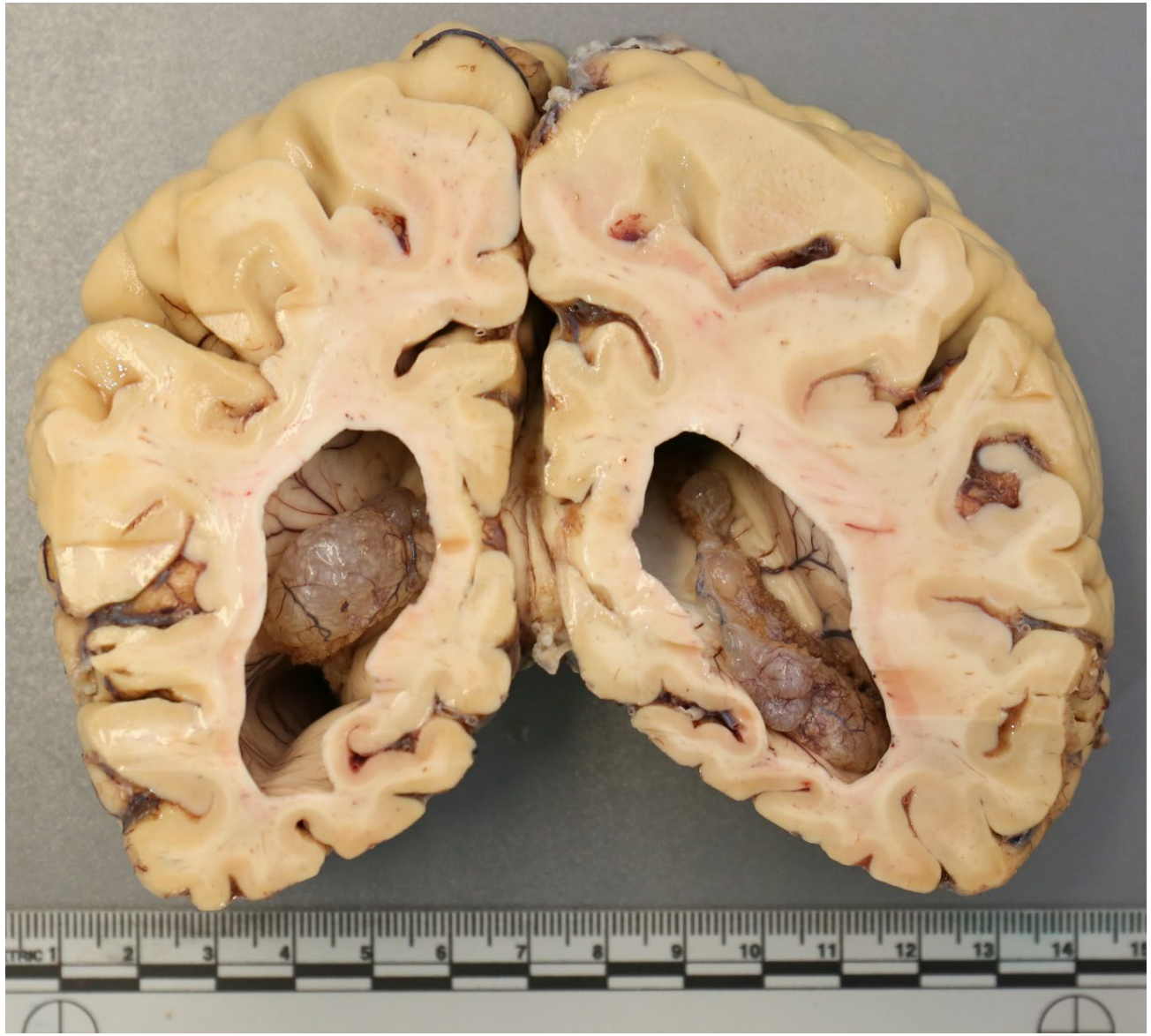
Meningitis





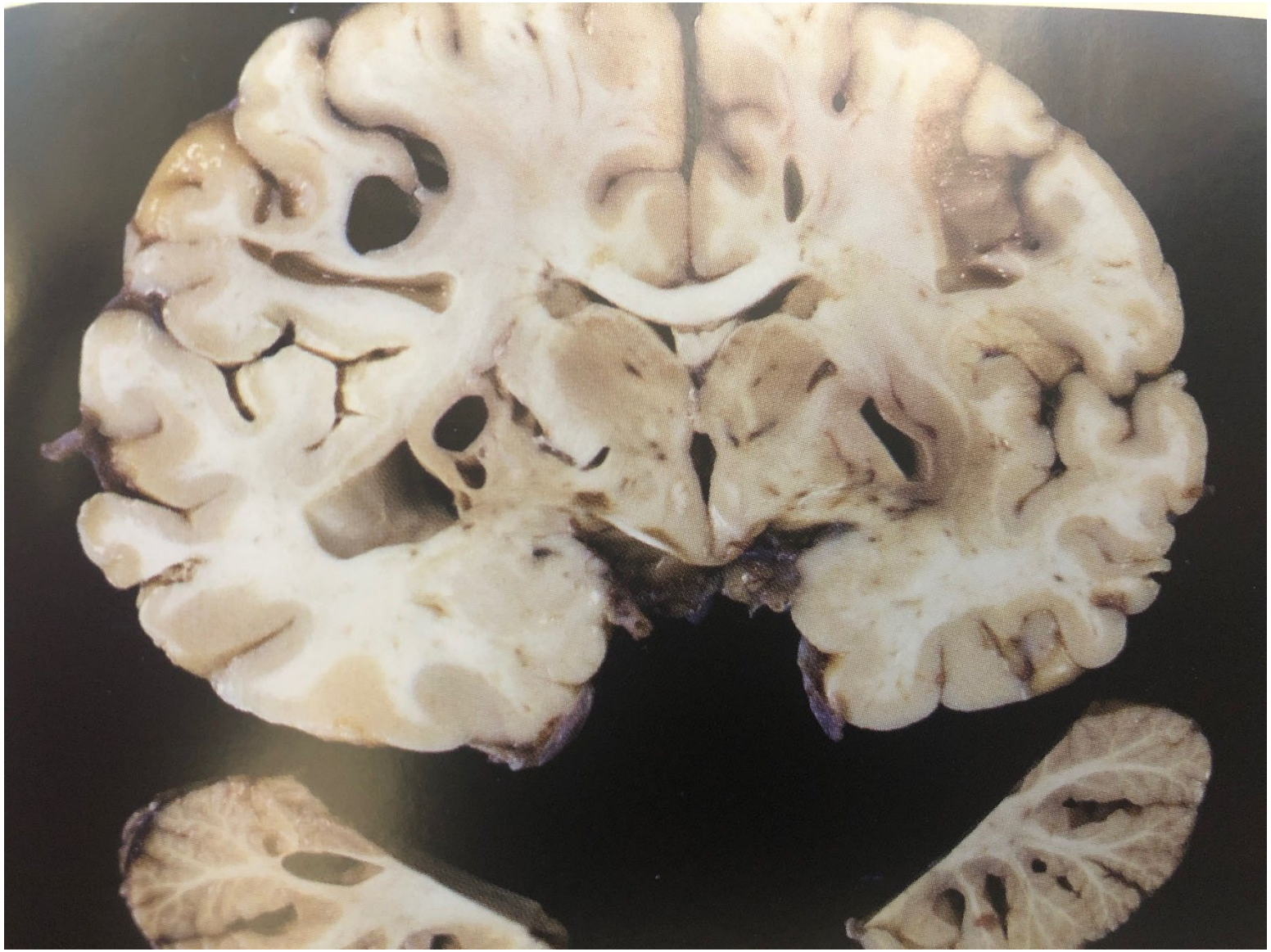


Cerebral atrophy, Hydrocephalus, Cystic Choroid Plexus



Cerebral Lipoma

Swiss Cheese artifact



Brain Cutting Basics

Sandra Camelo-Piragua, MD

sandraca@umich.edu

- Questions, Comments
- Feedback and Suggestions