Lab 6. Limbic System & Ventricles

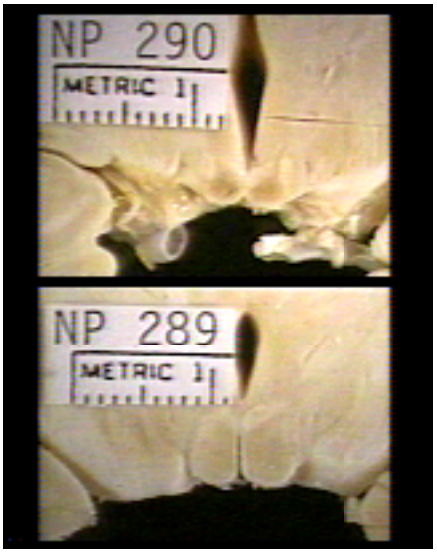
Lesion Lessons

Lesion 7.1. Moe Bedder

i) Location:

ii) Signs/symptoms:

iii) Cause:



(From M.Z. Jones, Michigan St. Univ; Slice of Brain © 1993 Univs. of Utah and Washington)

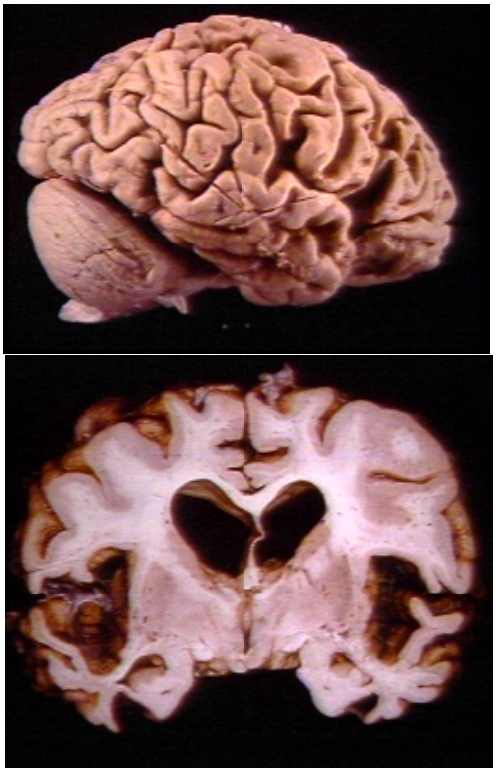
Hint | Web note 1 | Web note 2

Lesion 7.2. Happy Teecher

i) Location:

ii) Signs/symptoms:

iii) Cause:



(From E. Ross, Loyola University; Slice of Brain © 1993 Univs. of Utah and Washington)

Hint
Web note 1
Web note 2

Rhinencephalon and Ring of Limbic Cortex

- The various parts of the rhinencephalon (the "nose brain") are studied using both the whole and half brain specimens.

Locate and note and label the following in Figure 1.

- *frontal lobe* – locate the orbital surface.
- *olfactory bulb* – located on the inferior surface of the *frontal lobe*.
- *olfactory tract* – projects caudally from the *olfactory bulb* and divides into two stria:
  - *medial stria* - terminates in the *subcallosal gyrus*.
  - *lateral stria* - terminates in the *piriform (olfactory) cortex* and several nuclei of the *amygdala*.
- *anterior perforated substance* – located between the *medial* and *lateral olfactory stria*.
- *piriform (olfactory) cortex* – on the rostral surface of the *uncus*.
- *amygdala* – lie just behind and deep to the *piriform cortex* on the medial surface of the *uncus* (not visible on the gross brain).

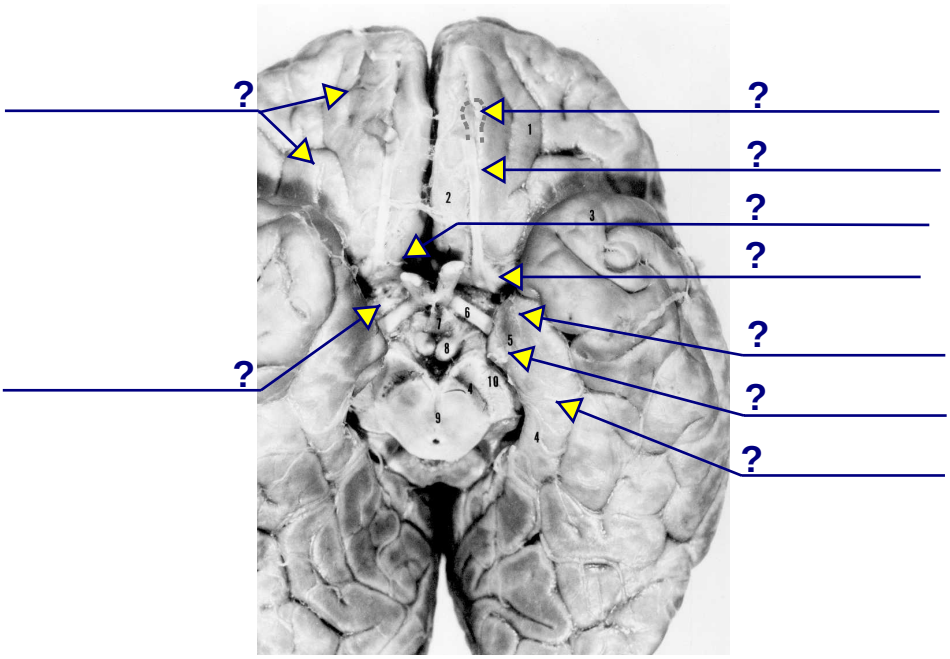


Fig. 1. Ventral view of the gross brain. (From E. Ross, Loyola School of Medicine)

Note and label the following in Figure 2. (also see Fig 1 in Lab 5)

- *limbic cortex* – a continuous ring of cortex on the medial edge or limit of the hemisphere (limbic = limit) that includes the following:
  - *subcallosal gyrus* - just beneath the *rostrum of the corpus callosum*.
  - *cingulate gyrus* –arches over the *genu, body* and *splenium of the corpus callosum*
  - *isthmus* - continuation of the limbic ring around the *splenium* and into the temporal lobe
  - *parahippocampal gyrus* - medial edge of the temporal lobe overlying the *hippocampal formation*.
  - *piriform cortex* - overlying the *uncus*.

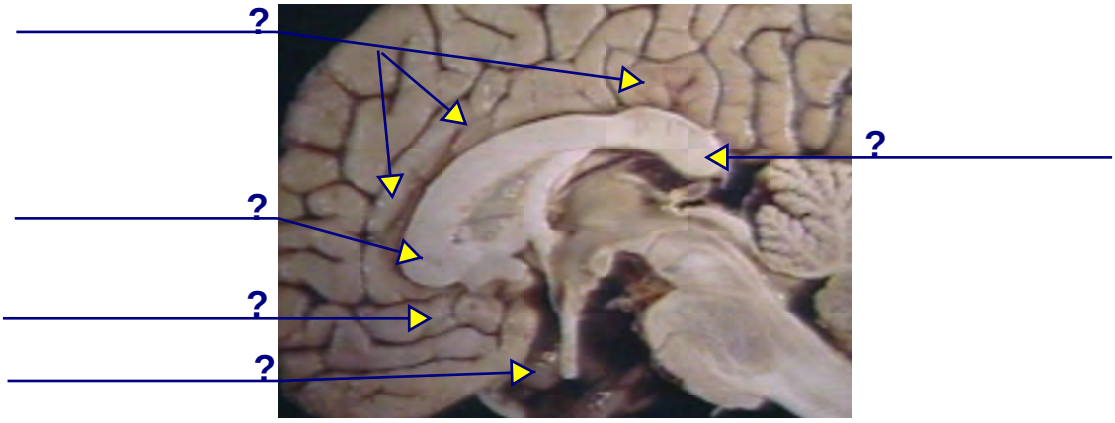


Fig. 2 Mid-sagittal view of the gross brain. (From E. Ross, Loyola School of Medicine)

Coronal (Frontal) Gross Brain Sections

Please follow these directions...

- Using the half-brain at each table, slice the brain in a coronal plane.
- Brains to be sectioned in this manner should be placed on the table with the *ventral surface up*.
- *Beginning approximately 2 cm from the frontal pole* slice through the entire thickness of the brain.
- From this initial cut continue making parallel sections at *approximately 1 cm levels*.
- As each cut is made, place the sections of brain *in sequential order* on your tray.

Gross Brain Sections

Handle and store these sections carefully!

Note the following:

- *Examine the cortical ribbon* and note the width of the cortex in the various lobes, as well as the increased cortical surface achieved by the many infoldings created by the sulci.

Compare the sections with the gross brain sections and coronal MRI images presented on the next several pages.

Label the following structures on Fig 3 and try to locate them on your brain sections:

• internal capsule (ant and post limbs)	• corpus callosum (genu, body, splenium)	• caudate nucleus (head, body, tail)	• basal forebrain area
• superior and inferior colliculi	• cerebellar cortex and nuclei	• lateral ventricle (body and frontal, temporal & occiptal horns	•internal capsule (ant & post limbs)
• putamen	• globus pallidus	• third ventricle	• external capsule
• thalamus	• red nucleus	• septum pellucidum	• extreme capsule
• substantia nigra	• hippocampus	• amygdala	• insula
• Sylvian fissure	• hypothalamus	• optic nerve & tract	• claustrum
• cerebral aqueduct	• fourth ventricle	• pons	

Important note

Identification of structures will often depend on the level of the cuts made.

Accordingly, is is unlikel that you will be able to locate all of the structures indicated.

You should therefore also examine the brain slices of others.

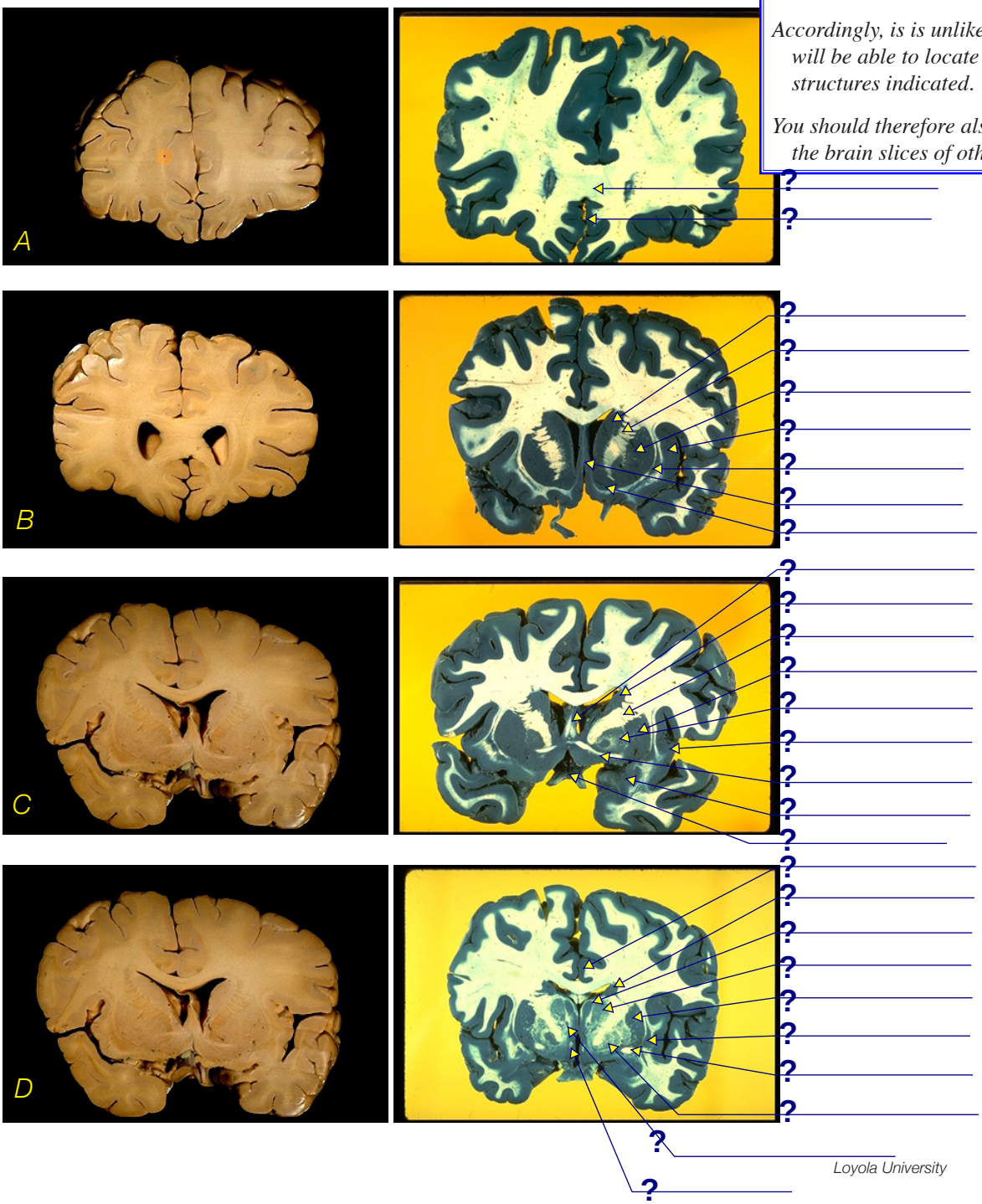


Fig. 3. Unstained and Mulligan-stained coronal sections of the gross brain. (From A.J. Castro, LSU and Loyola Univ. Schools of Medicine)

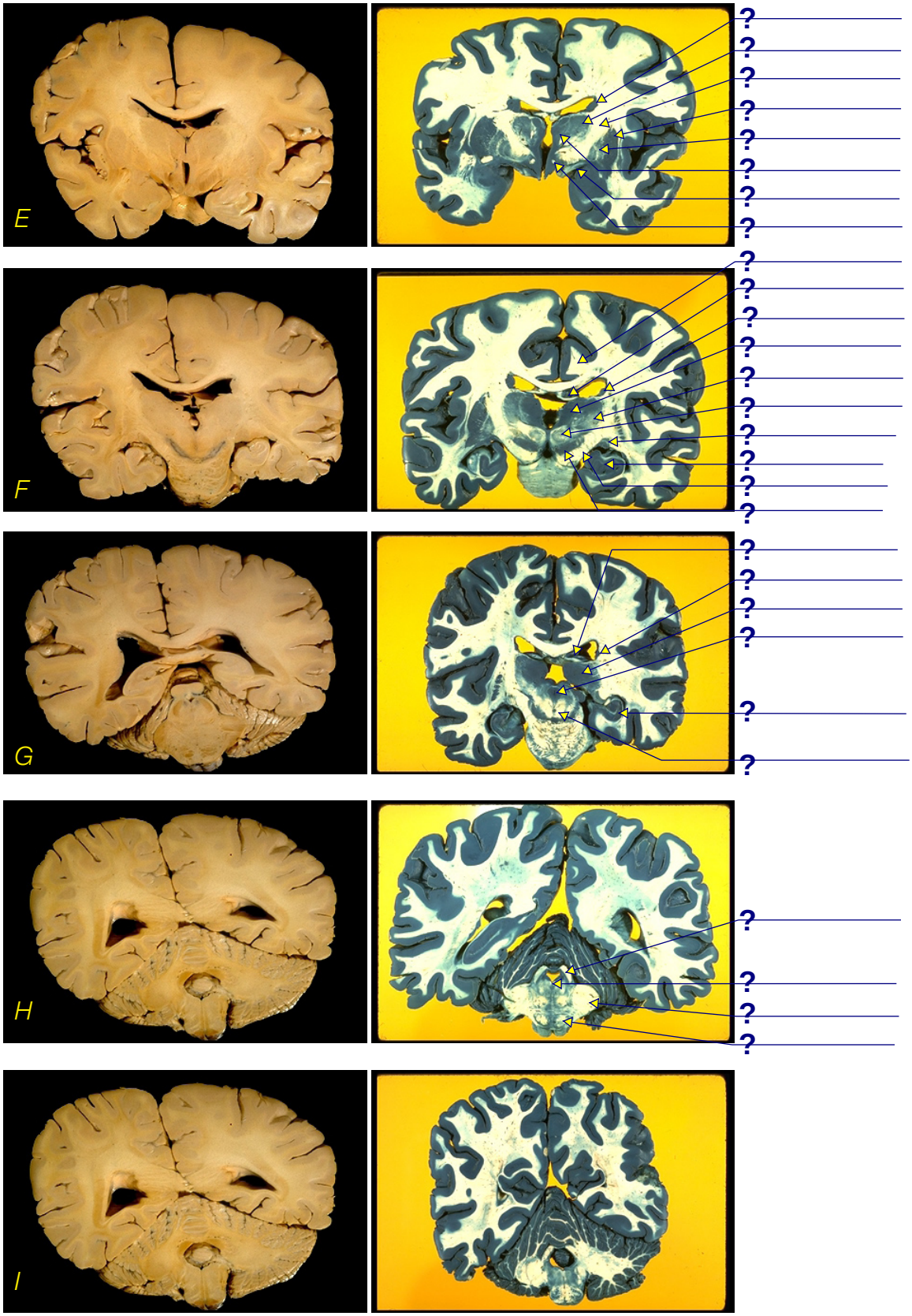


Fig. 3. Cont'd.

Coronal MRI (T2) Series

- ***Refer to your gross brain sections and the "Rand Atlas" to identify major structures in Fig 4.***
  - particularly locate the *basal ganglia, thalamus, ventricles, major blood vessels, etc.*
  - the individual figure number designations refer to the slice numbers in the *T2 Coronal MRI Rand Atlas.*

Lab MRI's

In studying the images in the Lab Manual, you should make use of the MRI's on the light boxes in the lab.

Identify the following blood vessels on Figure 4

• *middle cerebral art.*	• *anterior cerebral art.*	• *basilar art.*
• *vertebral art.*	• *posterior cerebral art.*	• *sup. sagittal sinus*
• *great cerebral vein (of Galen)*		

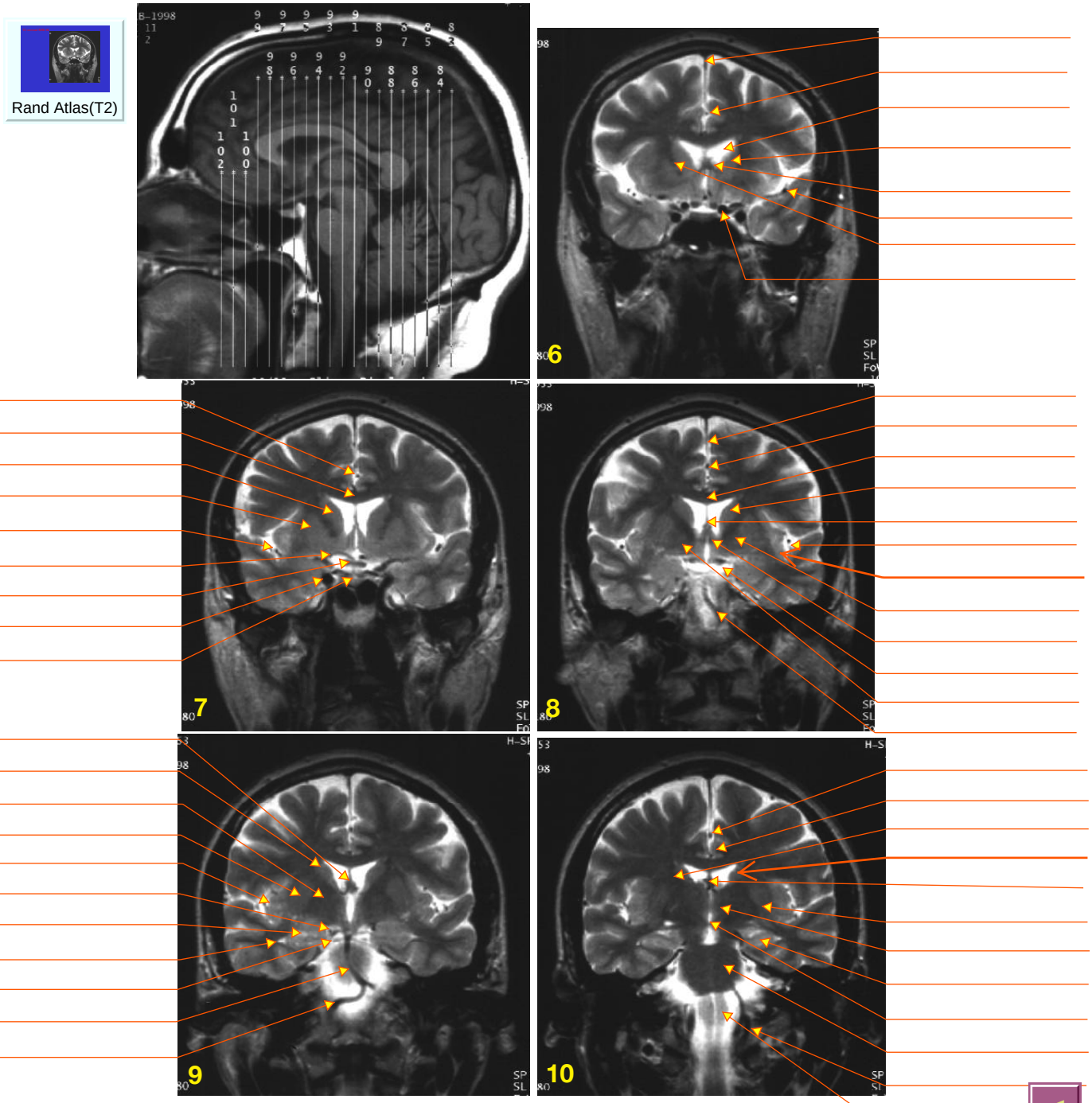
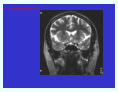


Fig. 4. Coronal T2 MRI images. Figure numbers are in reference to the Rand Atlas. (From Rand Swenson, Dartmouth Medical School)

Label the following structures on Figure 4:

• *internal capsule (ant and post limbs)*	• *corpus callosum (genu, body, splenium)*	• *caudate nucleus (head, body, tail)*	• *basal forebrain area*
• *superior and inferior colliculi*	• *cerebellar cortex and nuclei*	• *lateral ventricle (body and frontal, temporal & occiptal horns*	•*internal capsule (ant & post limbs)*
• *putamen*	• *globus pallidus*	• *third ventricle*	• *external capsule*
• *thalamus*	• *red nucleus*	• *septum pellucidum*	• *extreme capsule*
• *substantia nigra*	• *hippocampus*	• *amygdala*	• *insula*
• *Sylvian fissure*	• *hypothalamus*	• *optic nerve & tract*	• *claustrum*
• *cerebral aqueduct*	• *fourth ventricle*	• *pons*	• *falx cerebri*



Rand Atlas(T2)

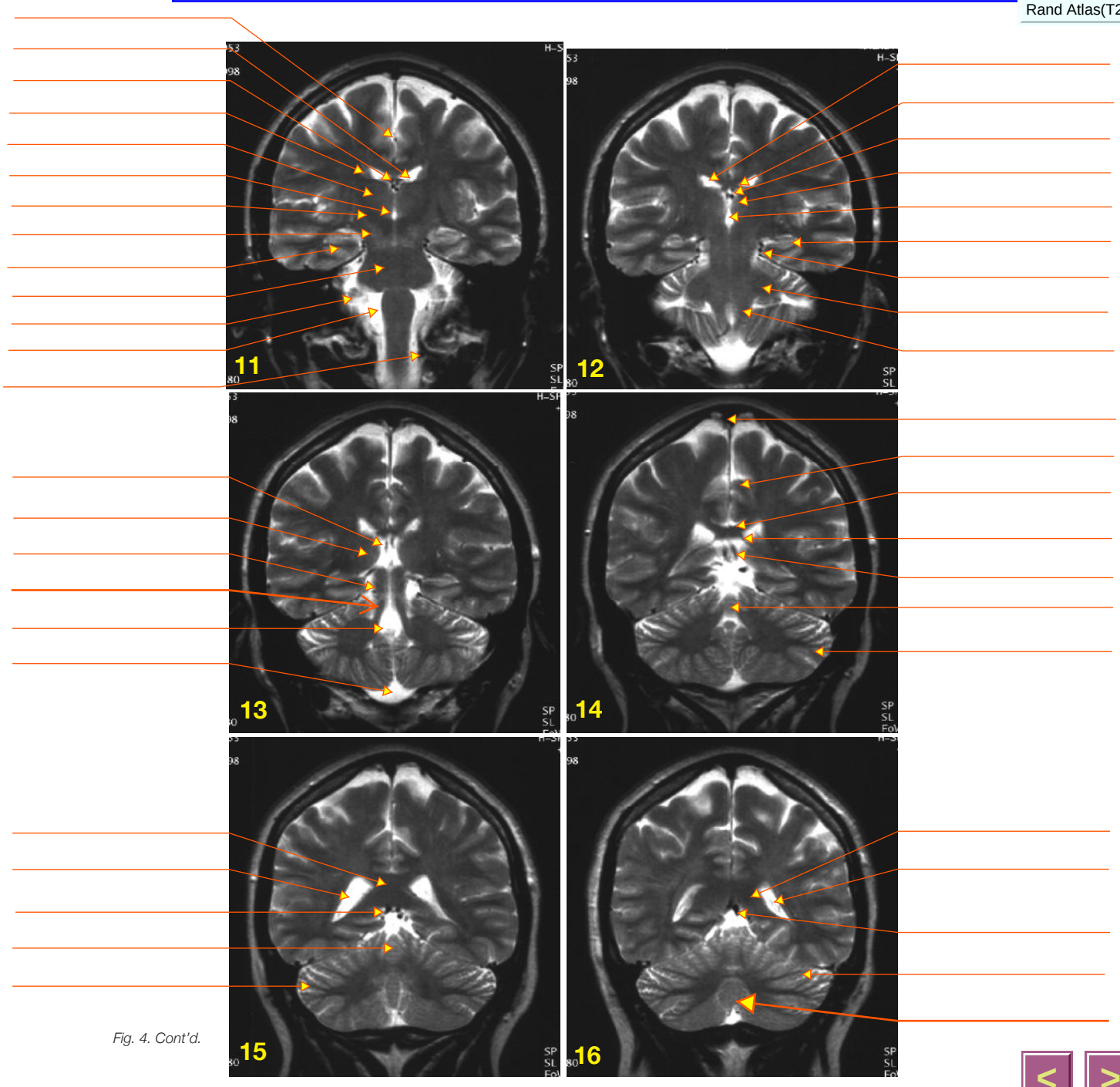


Fig. 4. Cont'd.

Horizontal (Axial) Sections

Please follow these directions...

- Examine one whole brain per table in horizontal section.
- Place the brain the ventral surface down on the tray.
- Look into the interhemispheric or sagittal fissure and observe the approximate level of the *corpus callosum*.
- Make a horizontal section through the *cerebral hemisphere* at the level of the *cingulate gyrus* to expose the *corpus callosum*. Examine the *cortex* and *centrum ovale* of the "top" portion removed. You will note that no nuclear structures are present at this level.
- Continue making horizontal sections at one centimeter intervals throughout the rest of the brain and arrange them in order on your trays.

Cortical thickness varies...

...in different areas, with an average of approximately 3 mm.

- *thickest in the region of the precentral gyrus, measuring approx. 4.5 mm*
- *thinnest in the region of the calcarine fissure and anterior portion of the postcentral gyrus, where it measures as little as 1.3 mm.*

Label the following structures on Fig 5 and try to locate them on your brain sections:			
• *thalamus*	• *claustrum*	• *putamen*	• *globus pallidus*
• *caudate*	• *internal capsule - ant limb*	• *internal capsule - genu*	• *internal capsule - post limb*
• *external capsule*	• *extreme capsule*	• *insular cortex*	• *substantia nigra*
• *optic radiations*	• *corpus callosum (genu and splenium)*	• *cerebellar cortex and nuclei*	• *ventricles (lateral, third, fourth, aqueduct)*
• *pons*			

Compare thes picures with the series of axial (horizontal) MRI sections on the next few pages.

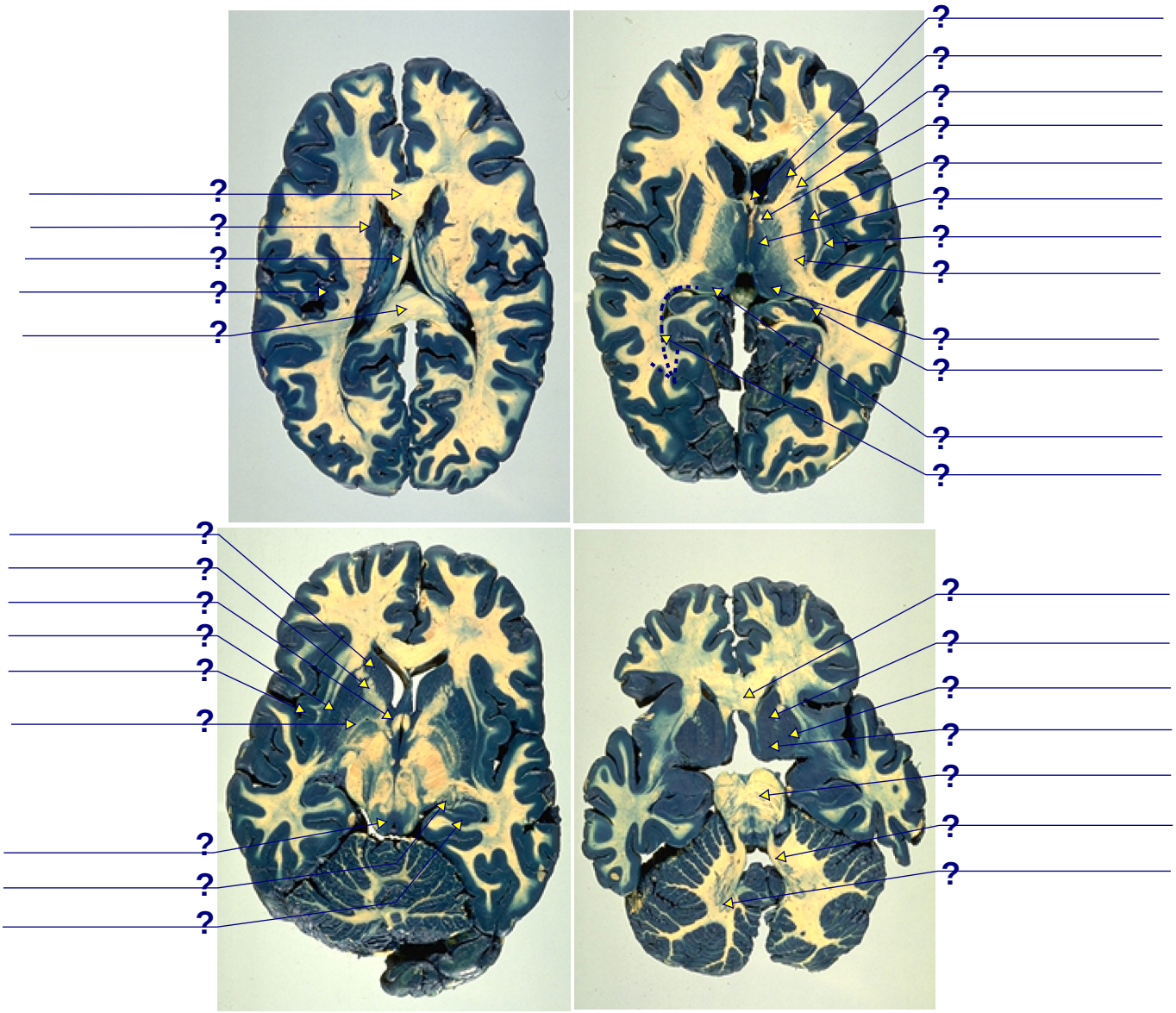
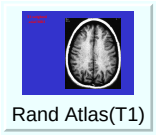


Fig. 5. Mulligan-stained horizontal sections of the gross brain.
(From A.J. Castro, LSU and Loyola Univ. Schools of Medicine)

Horizontal (Axial) MRI Series (T1)

- ***Refer to your gross brain sections and the "Rand Atlas" to identify major structures in Fig 6.***
  - particularly locate the basal ganglia, thalamus, ventricles, major blood vessels, etc.
  - the individual figure number designations refer to the slice numbers in the *T1 Axial MRI Rand Atlas*.



Label the following structures on Figure 6 and try to locate them on your brain sections:

• *thalamus*	• *claustrum*	• *putamen*
• *globus pallidus*	• *caudate*	*substantial nigra*
• *optic radiations*	• *insular cortex*	• *external capsule*
• *corpus callosum (genu and splenium)*	• *ventricles (lateral, third, fourth, aqueduct)*	• *internal capsule (genu, ant & post limbs)*
• *extreme capsule*	• *cerebellar cortex and nuclei*	• *pons*

Fig. 6 Axial T2 MRI images. Figure numbers are in reference to the Rand Atlas. (From Rand Swenson, Dartmouth Medical School)

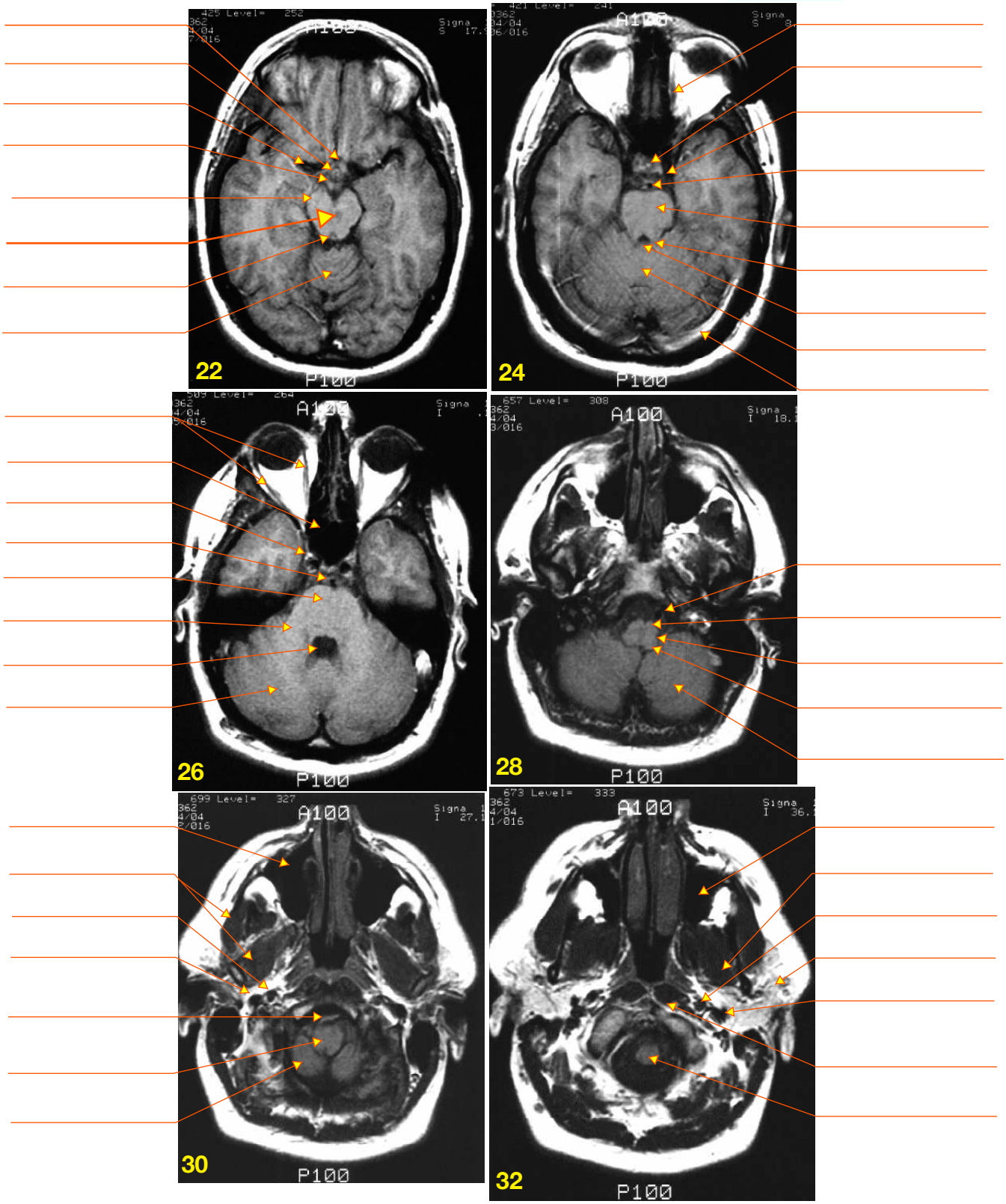


Fig. 6 Cont'd.

Ventricles

Refer to available models to study the *ventricular system*.

Note and label the following in Figure 7b.

Lateral ventricles

– rostrally, the lateral wall is formed by the *caudate nucleus*.

– medially, it is limited by the *septum pellucidum*. No *choroid plexus* is seen in the anterior portion.

• *body of the lateral ventricle* – which contains *choroid plexus*.

– its roof is formed by the *corpus callosum*.

• *anterior horn of the lateral ventricle*

– connects with the third ventricle via the *interventricular foramen* (*foramen of Monro*) located between the anterior end of the *thalamus* and the *columns of the fornix*.

• *posterior (occipital) horn of the lateral ventricle*.

– is approximately 2 to 2.5 cm from the *occipital pole*.

• *inferior (temporal) horn*

– is limited by the *tail of the caudate nucleus* and by the *stria terminalis*.

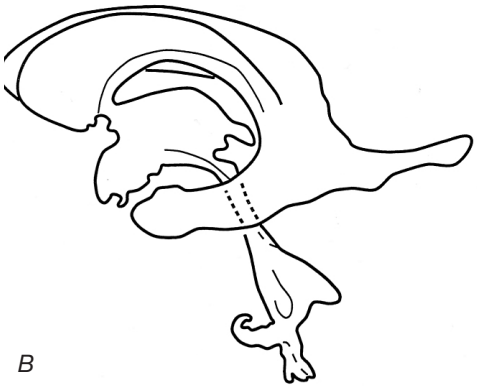
Question classics

What is the function of the choroid plexus?

How does cerebrospinal fluid pass from the ventricular system to the subarachnoid space?

Question classic

What is the outcome of a mass occupying pathology that blocks CSF flow through the cerebral aqueduct?



B

Ventricles Movie

Fig. 7a and b Ventricular system. (AJ Castro, Loyola School of

– medially, the *hippocampus, the choroid plexus,* and the *hippocampal fimbria* can be seen.

– contains *choroid plexus*.

Third and fourth ventricles

• *CSF* – flows from the *third* to the *fourth ventricle* the *cerebral aqueduct*.

• *massa intermedia* – passes through the *third ventricle*.

Figure 8 (fig. 2 cropped).

CSF flow

Indicate the flow of CSF on the figure.

Review Questions

1. What is Papez circuit?

2. What visual field deficit is associated with the interruption of optic radiations that pass around the temporal horn of the lateral ventricles?

3. What pathways pass through the anterior limb of the internal capsule?

...the posterior limb?

4. What is an obstructive hydrocephalus?

5. What is the mammillothalamic tract?

8. What creates the perforations in the anterior perforated substance?

9. How are the lateral ventricles connected to the third ventricle?

10. Trace the flow of CSF from the cerebral ventricles to the subarachnoid space.

11. Where is CSF produced? ...resorbed? What is its normal volume? What is rate of production (ml/day)?

Patient Puzzle

Patient 7.1. Case of a real pain in the neck

Patient: Mr. Ray Gunn Age: 62 Occupation: Riverman

Signs and Symptoms:

- Mr. Gunn complained of a painful, stiff neck and reports increasing difficulties walking over the past few months.
- He reports no particular traumatic events associated with this symptoms although he does tell you that he was treated for whiplash in a car accident 8 or 9 years ago.
- Upon examination, you find that neck flexion causes a sharp pain to radiate to the shoulders and upper arms. You also notice hyperreflexia in both legs.
- In addition to the weakness, you also find a right-sided hyperreflexia.

Play Movie

(Patient movie from Dr. Wendy Kartje.)

Diagnosis:

1. What do you think happened to Ray? Do you think his previous car accident is relevant?

2. What sign is demonstrated in the movie? What does it indicate and what does it tell you about the level of the problem?

3. What is seen on his MRI?

Related questions:

1. What are some of the causes for hyperreflexia?

2. Distinguish upper from lower motor neuron signs?

3. Can you sketch and identify the components of a cervical vertebra?

(From C. Andrews, Univ. of Utah; Slice of Brain © 1993 Univs. of Utah and Washington)

Web note

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