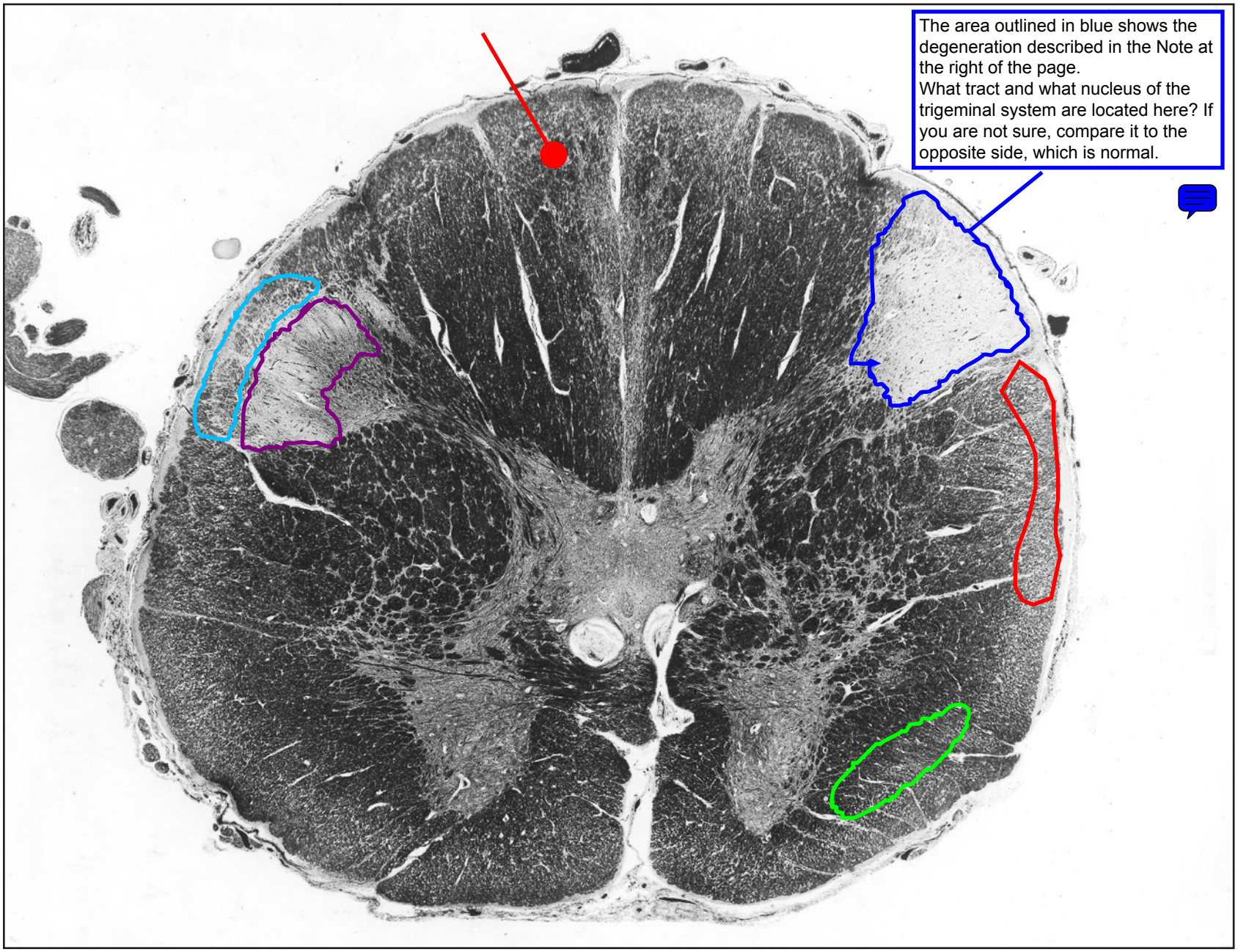
UMass Medical School
Mind Brain Behavior 1

Brainstem B-1

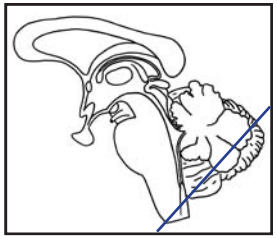
Junction of Cervical Cord and Caudal Medulla



Note: Brainstem B shows marked degeneration of the trigeminal nerve and of trigeminal sensory (and motor) nuclei on one side. In this atlas the degenerated, and therefore unstained, regions "highlight" the location of important but difficult to identify trigeminal structures.

You can use the degenerated side to identify these structures, and then look at the normal side to see their usual appearance in myelin-stained sections.
MORE INFORMATION

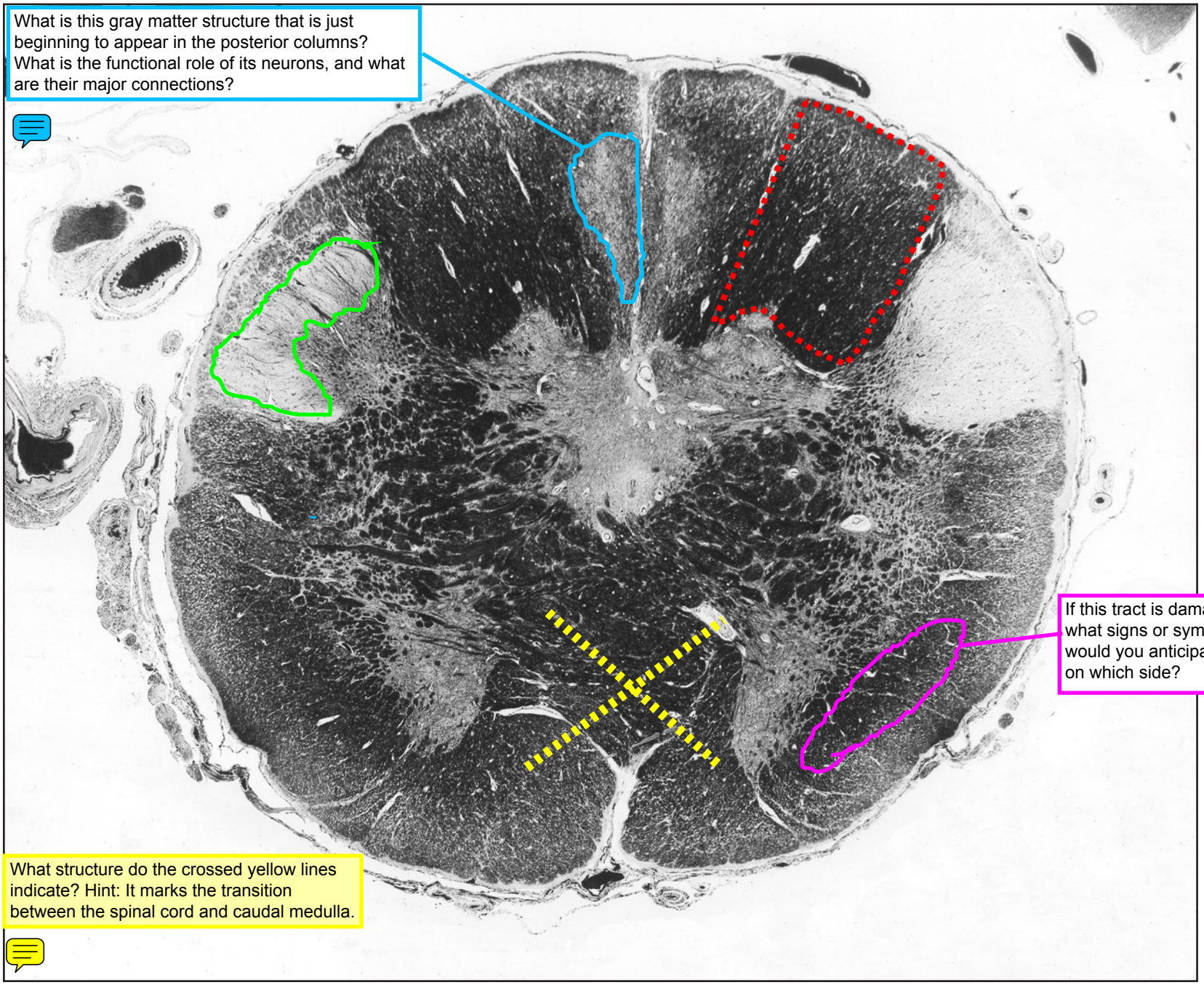
Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

Brainstem B-2

Junction of Cervical Cord and Caudal Medulla

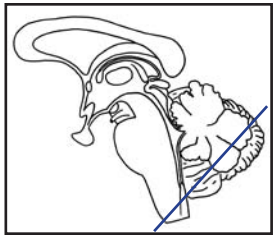


Brainstem Blood Supply:
The Vertebral-Basilar System
OVERVIEW

MEDIAL-LATERAL PATTERN

What arteries provide the major blood supply to this region of the brainstem?

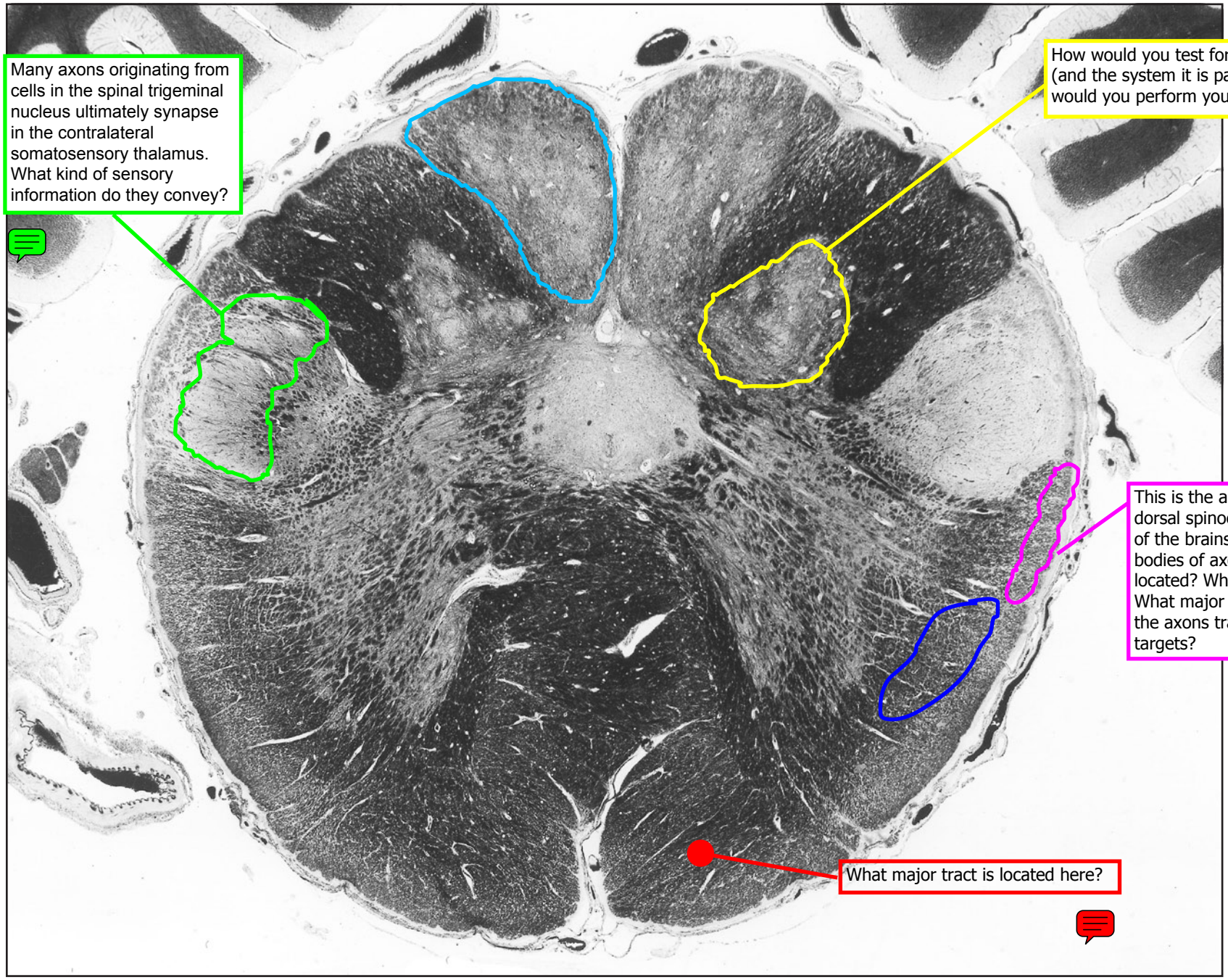
Mid Sagittal



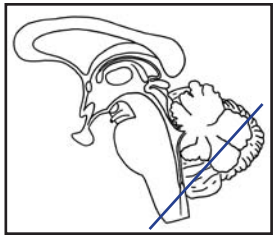
UMass Medical School
Mind Brain Behavior 1

Brainstem B-3

Caudal Medulla



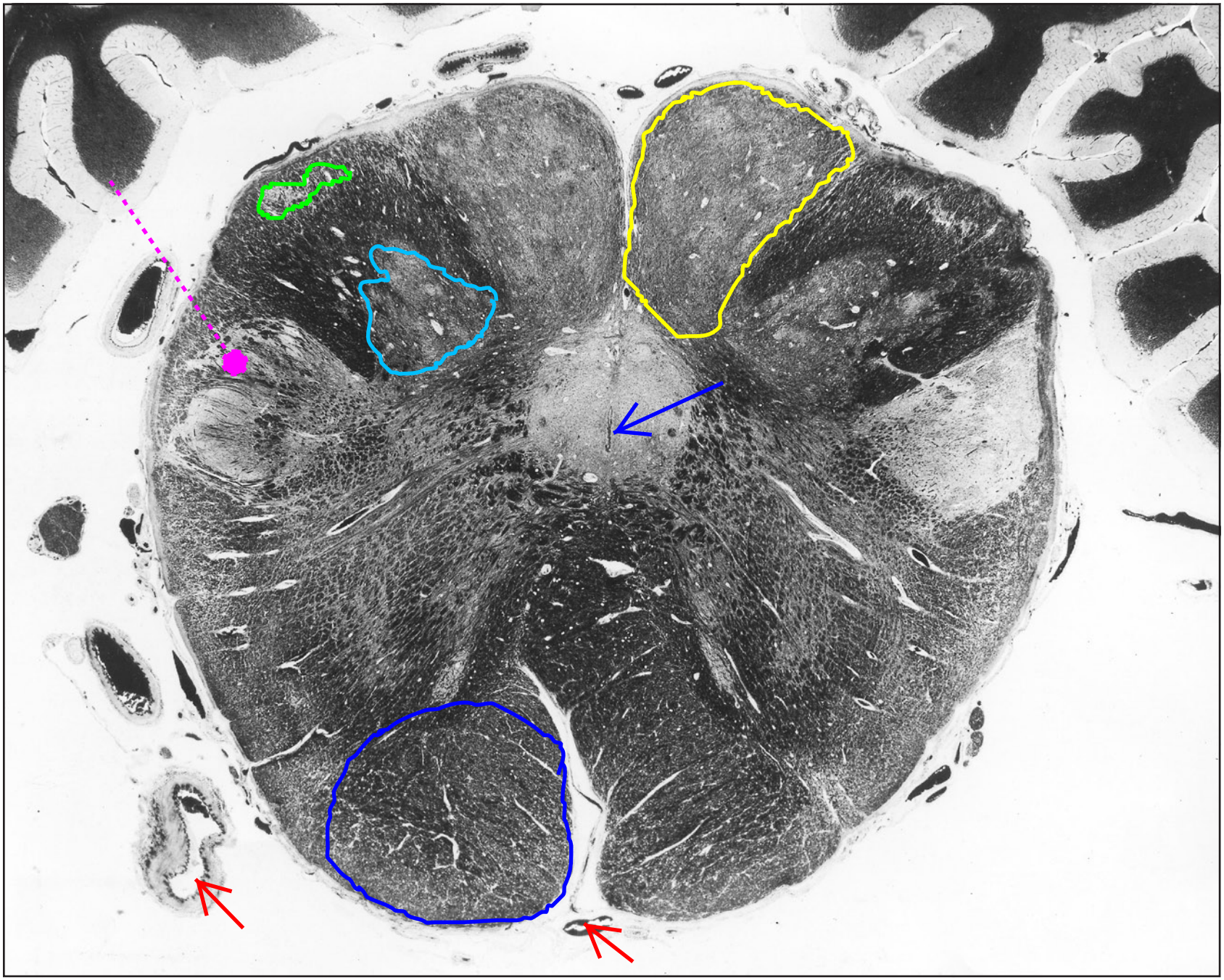
Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

Brainstem B-4

Caudal Medulla

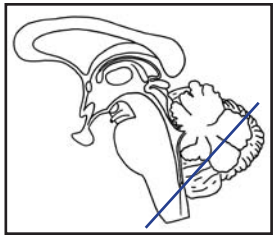


List several features by which you can distinguish the Caudal Medulla (shown here) from the Rostral Medulla (shown in B-6 to B-10).

FOLLOW-UP QUESTION
At this level of the Caudal Medulla be sure you can identify:
- Nucleus gracilis
- Nucleus cuneatus
- Lateral cuneate nucleus
- Spinal trigeminal nucleus

Describe a major OUTPUT of each of these nuclei. Do those axons cross the midline on the way to their synaptic targets?

Mid Sagittal



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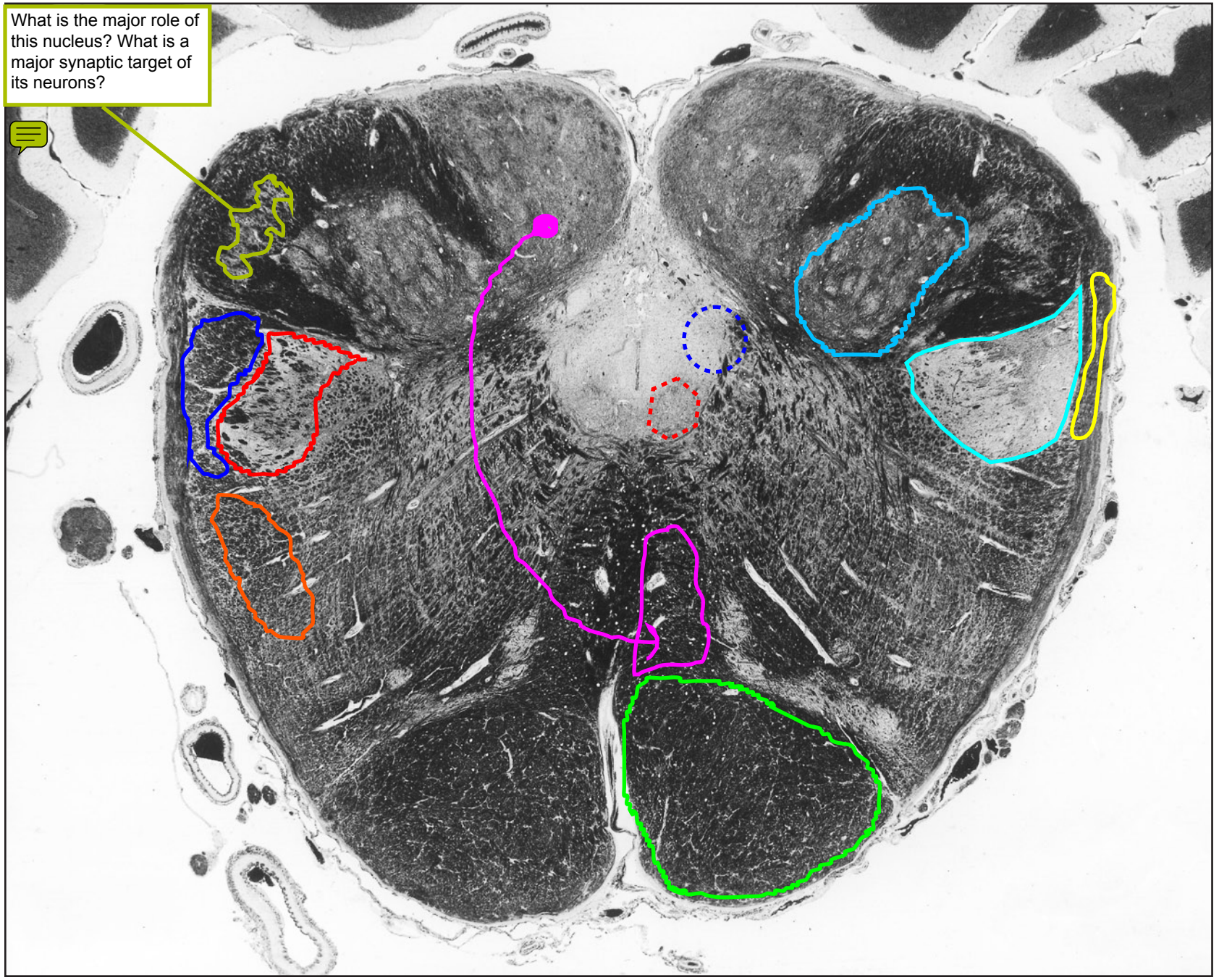
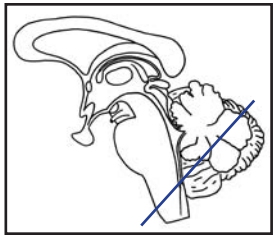
Mind Brain Behavior 1

Brainstem B-5

Caudal Medulla

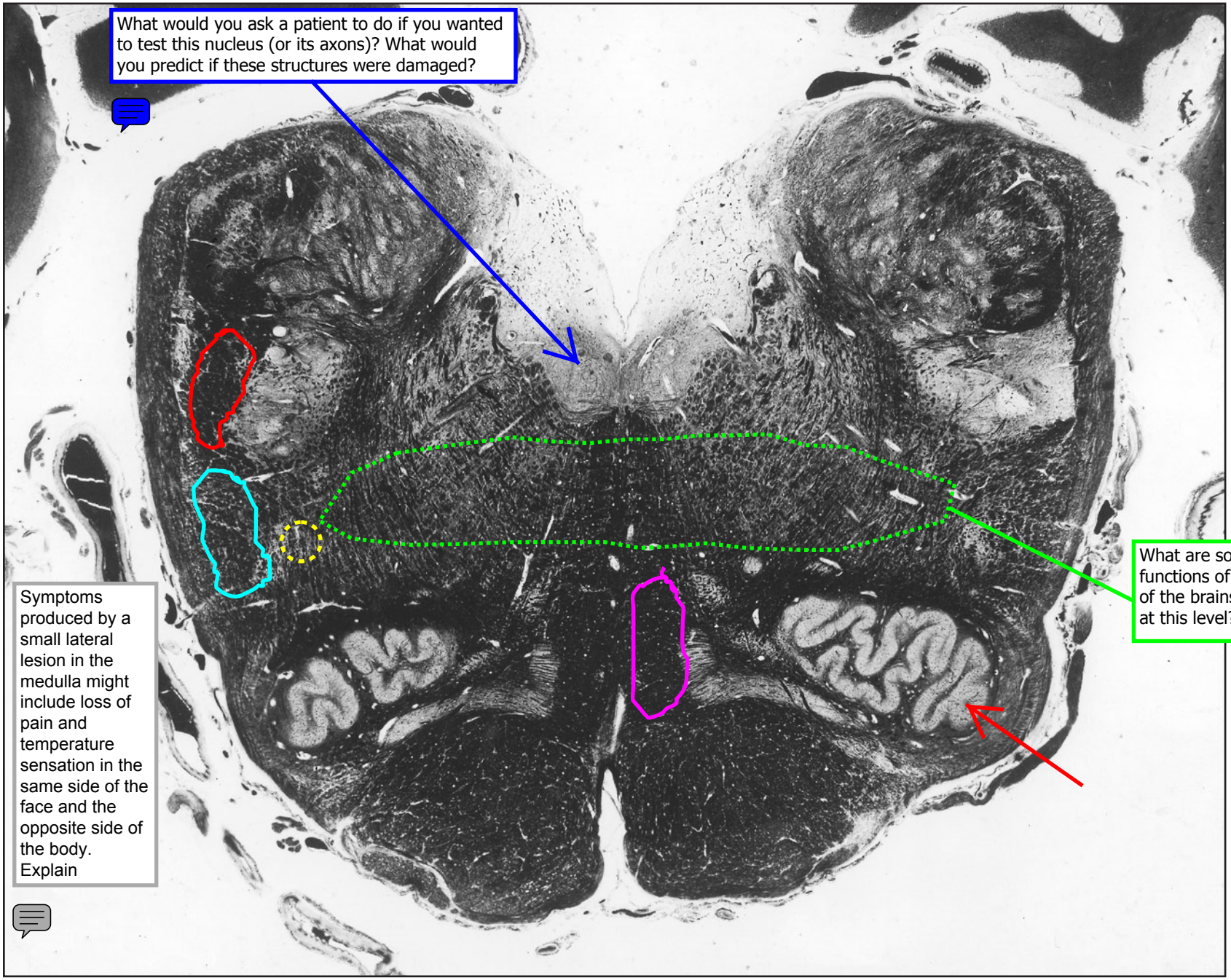


Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

Brainstem B-6



What would you ask a patient to do if you wanted to test this nucleus (or its axons)? What would you predict if these structures were damaged?

Symptoms produced by a small lateral lesion in the medulla might include loss of pain and temperature sensation in the same side of the face and the opposite side of the body. Explain

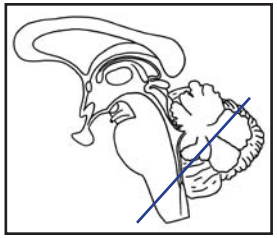
FIRST QUESTION
What level of the brainstem is this? Explain your answer.

Which cranial nerve MOTOR nuclei are present here (visible or not so visible)?
What about SENSORY nuclei?

What arteries provide the major blood supply to this region of the brainstem?

What are some of the functions of this central region of the brainstem, particularly at this level?

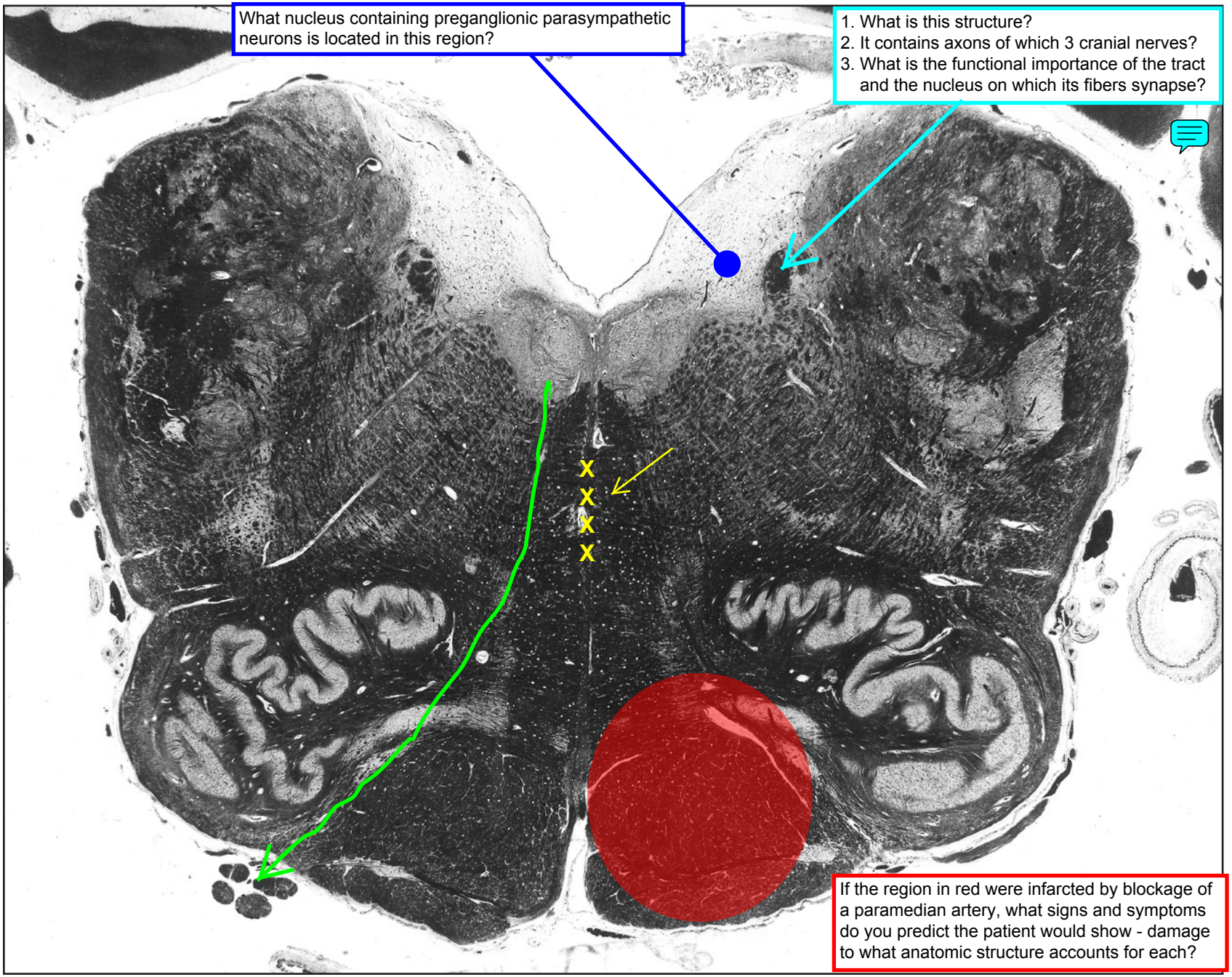
Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

Brainstem B-7

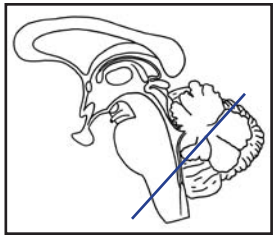
Rostral Medulla



Anatomic Note:
Trigeminothalamic axons originating from cell bodies in the caudal part of the spinal trigeminal nucleus (concerned with pain and temperature in the face) cross the midline before they synapse in the contralateral somatosensory thalamus. However where these ascending axons travel in the medulla, and where they cross the midline, is not known for certain.

MORE INFORMATION

Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

Brainstem B-8

Rostral Medulla

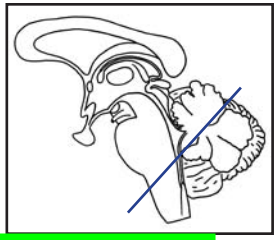
Can you name some of the individual tracts or fibers that together make up the circled structure?

A lesion here produces problems with pain and temperature sensation. What parts of the patient would be affected, and what tracts have been damaged to account for those problems.

The same lesion would likely produce a hoarse voice, difficulty swallowing, and perhaps paralysis of one vocal cord. Why?

The same lesion also produces uncoordinated movements of the arm and leg on one side, and an unsteady gait. Why is this? Do you predict that the ATAXIA on movement of the extremities would occur on the same side as the lesion or on the opposite side?

Mid Sagittal

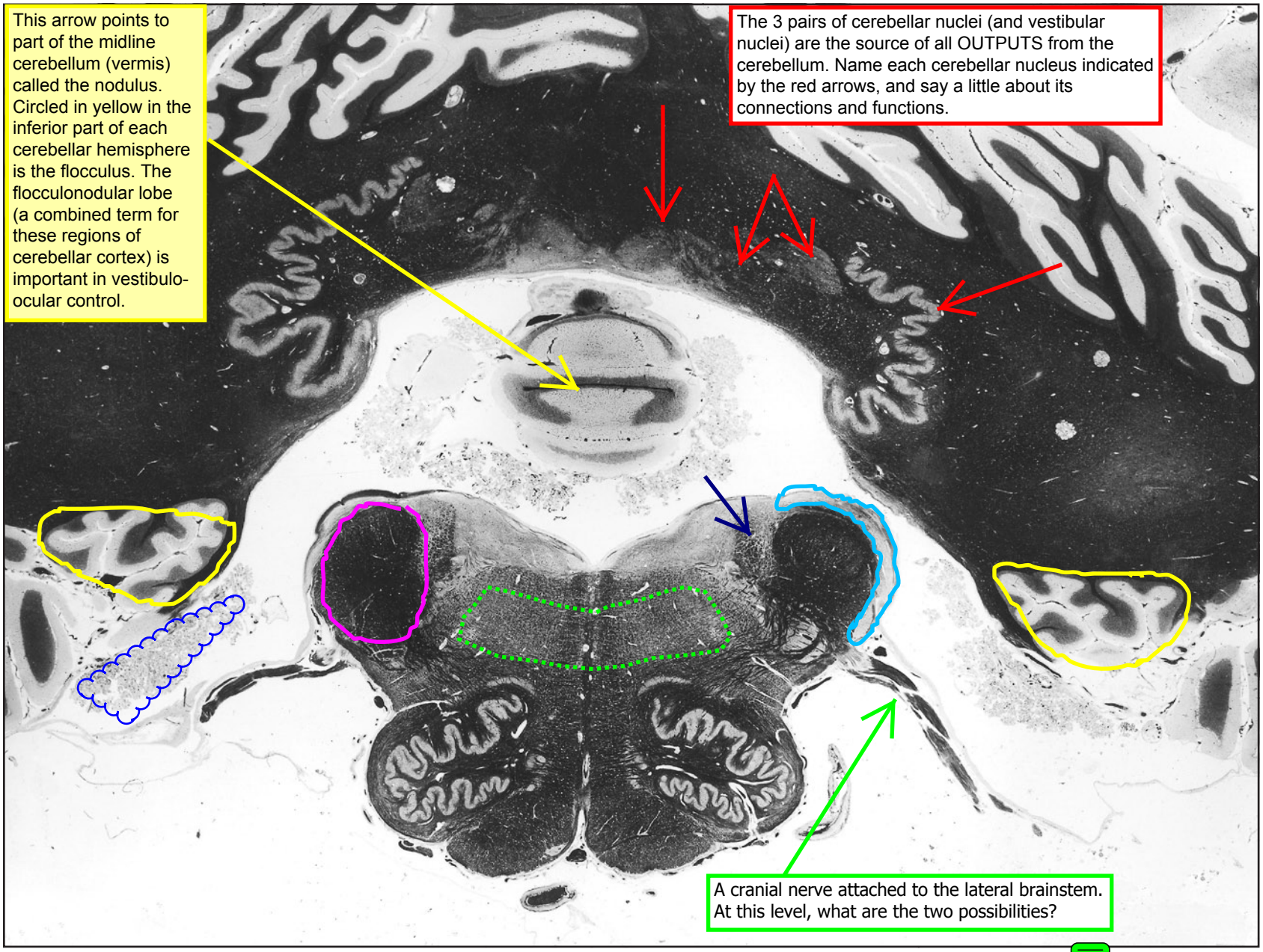


Posterior inferior cerebellar artery, a major branch of the vertebral artery. While blockage of this branch could infarct the region shown in red, clinical evidence suggests that most lateral medullary strokes are caused by thrombosis of the ipsilateral vertebral artery itself. More info: **StrokeSTOP**

UMass Medical School
Mind Brain Behavior 1

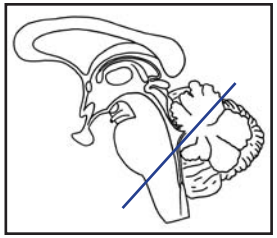
Brainstem B-9

Rostral Medulla



No, the brainstem doesn't suddenly shrink in the Rostral Medulla. The image magnification has been reduced so the field can include the cerebellum.

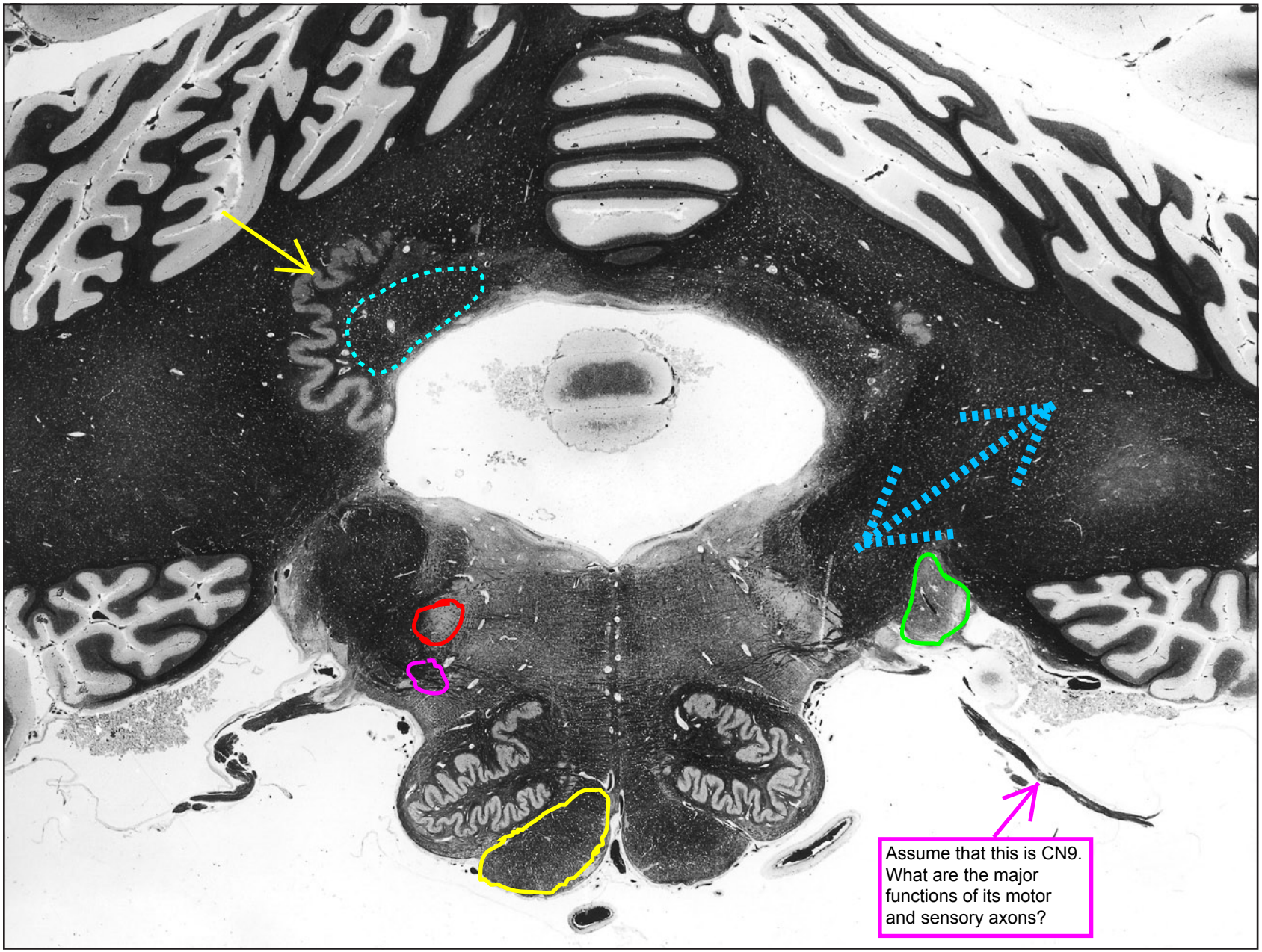
Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

Brainstem B-10

Rostral Medulla

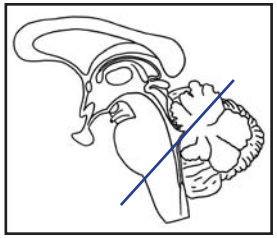


Damage to the cerebellum, or one of its peduncles, or to cerebellar circuitry in the brainstem can all produce **ataxia**. What does this clinical term mean?

The blue double-headed arrow indicates one of the cerebellar peduncles. Which one?
In general, what structures does it interconnect?

A lesion involving one inferior cerebellar peduncle is likely to produce both truncal (proximal) and appendicular (distal) ataxia. Explain why. Will the appendicular ataxia be ipsilateral or contralateral to the lesion? Explain this as well

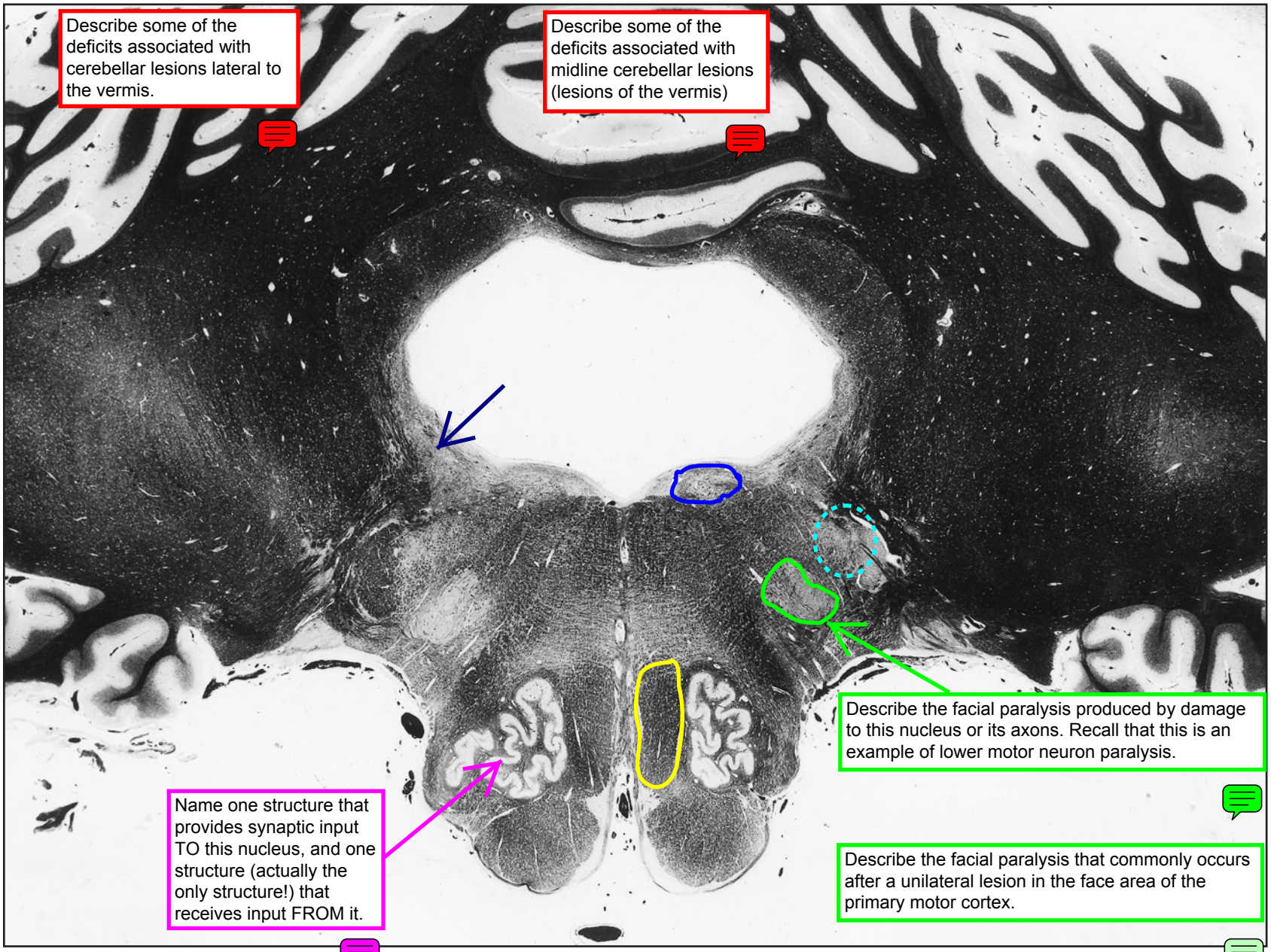
Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

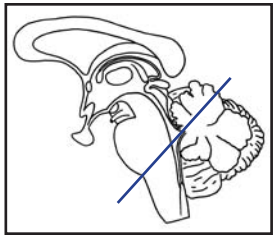
Brainstem B-11

Medulla/Pons



This section is at the transition between the medulla and pons. Because of the plane of section (see diagram below), it includes structures associated with the pons (like the abducens nucleus) caudally, and structures characteristic of the medulla (like the inferior olives) more ventrally.

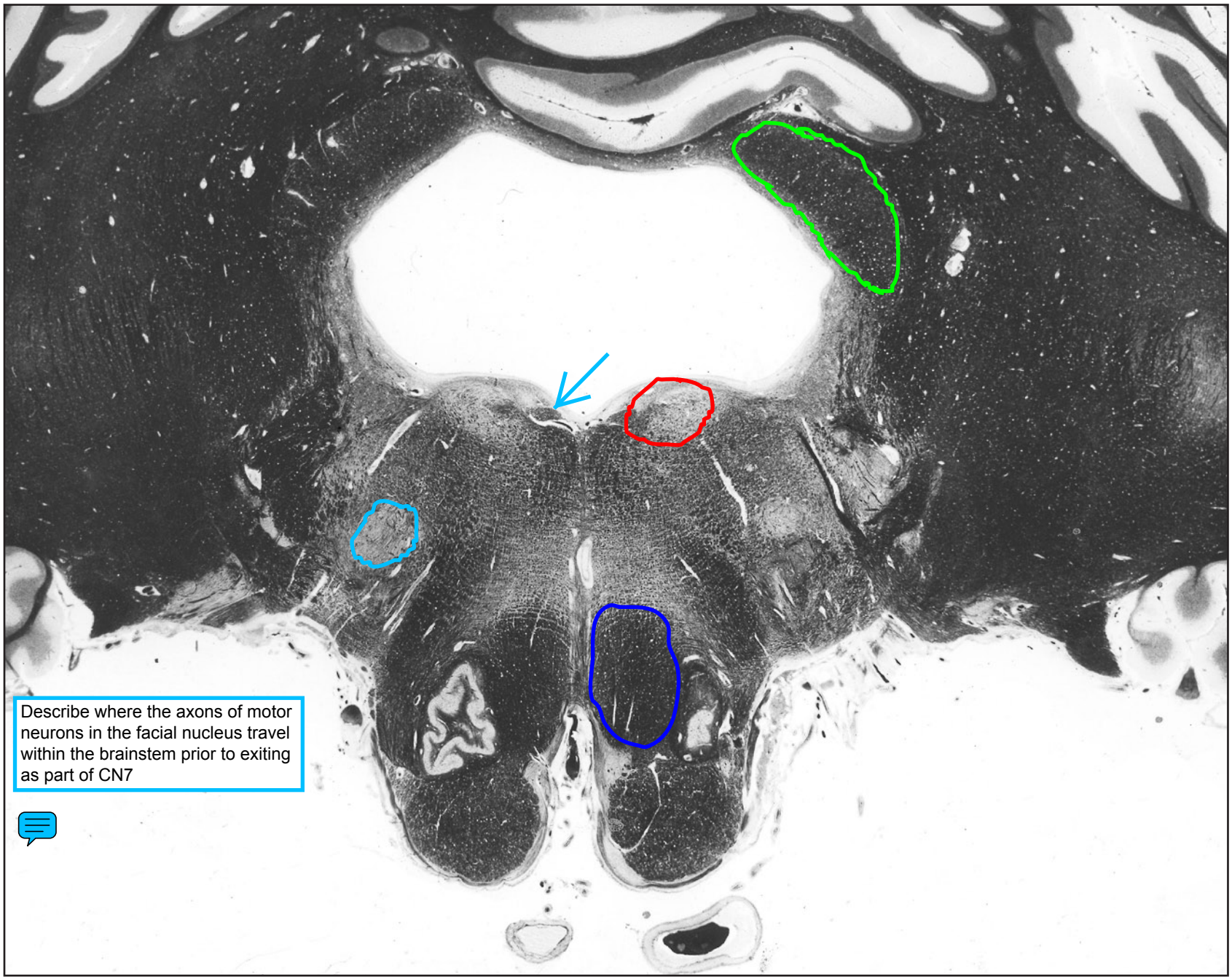
Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

Brainstem B-12

Medulla/Pons

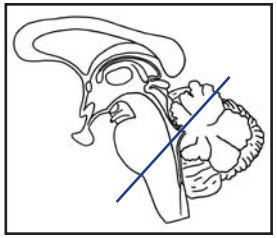


Describe where the axons of motor neurons in the facial nucleus travel within the brainstem prior to exiting as part of CN7

Symptoms produced by a lateral lesion in the medulla or in the other regions of the brainstem may include an *ipsilateral* slightly droopy upper eyelid (ptosis), small pupil (miosis), and impaired sweating on the side of the face and neck (anhidrosis).

What is the name of this clinical syndrome, and how could a lateral brainstem lesion produce it? Remember that there aren't any preganglionic sympathetic neurons in the brainstem. They're all located in the intermediolateral cell column of the T1 to L2,3 spinal cord.

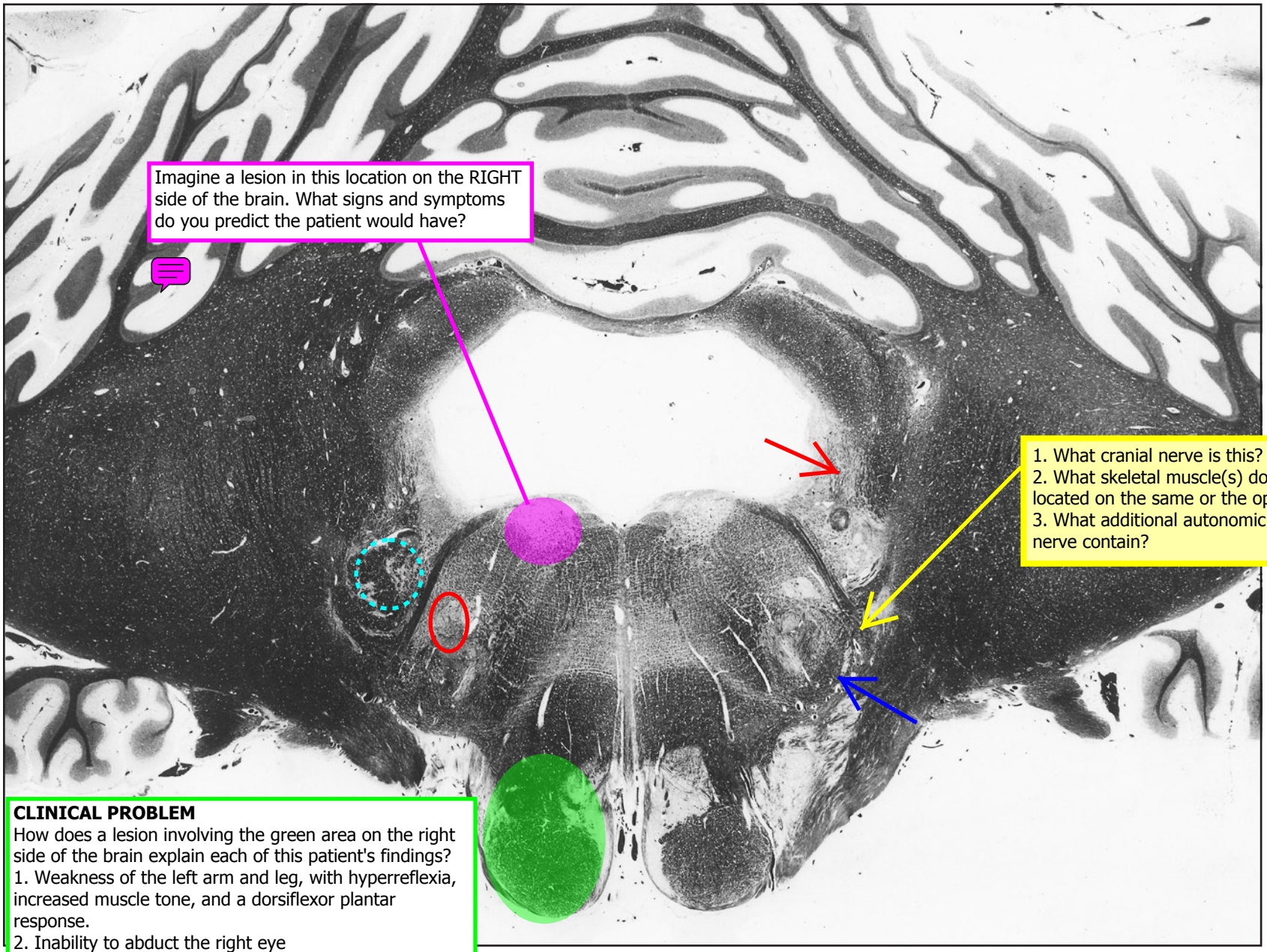
Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

Brainstem B-13

Caudal Pons



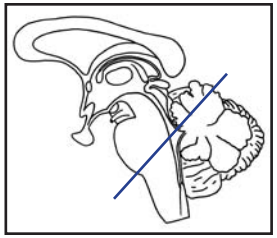
What arteries provide the major blood supply to this region of the brainstem?

Imagine a lesion in this location on the RIGHT side of the brain. What signs and symptoms do you predict the patient would have?

1. What cranial nerve is this?
2. What skeletal muscle(s) do its axons innervate? Are they located on the same or the opposite side of the patient?
3. What additional autonomic and sensory fibers does the nerve contain?

CLINICAL PROBLEM
How does a lesion involving the green area on the right side of the brain explain each of this patient's findings?
1. Weakness of the left arm and leg, with hyperreflexia, increased muscle tone, and a dorsiflexor plantar response.
2. Inability to abduct the right eye

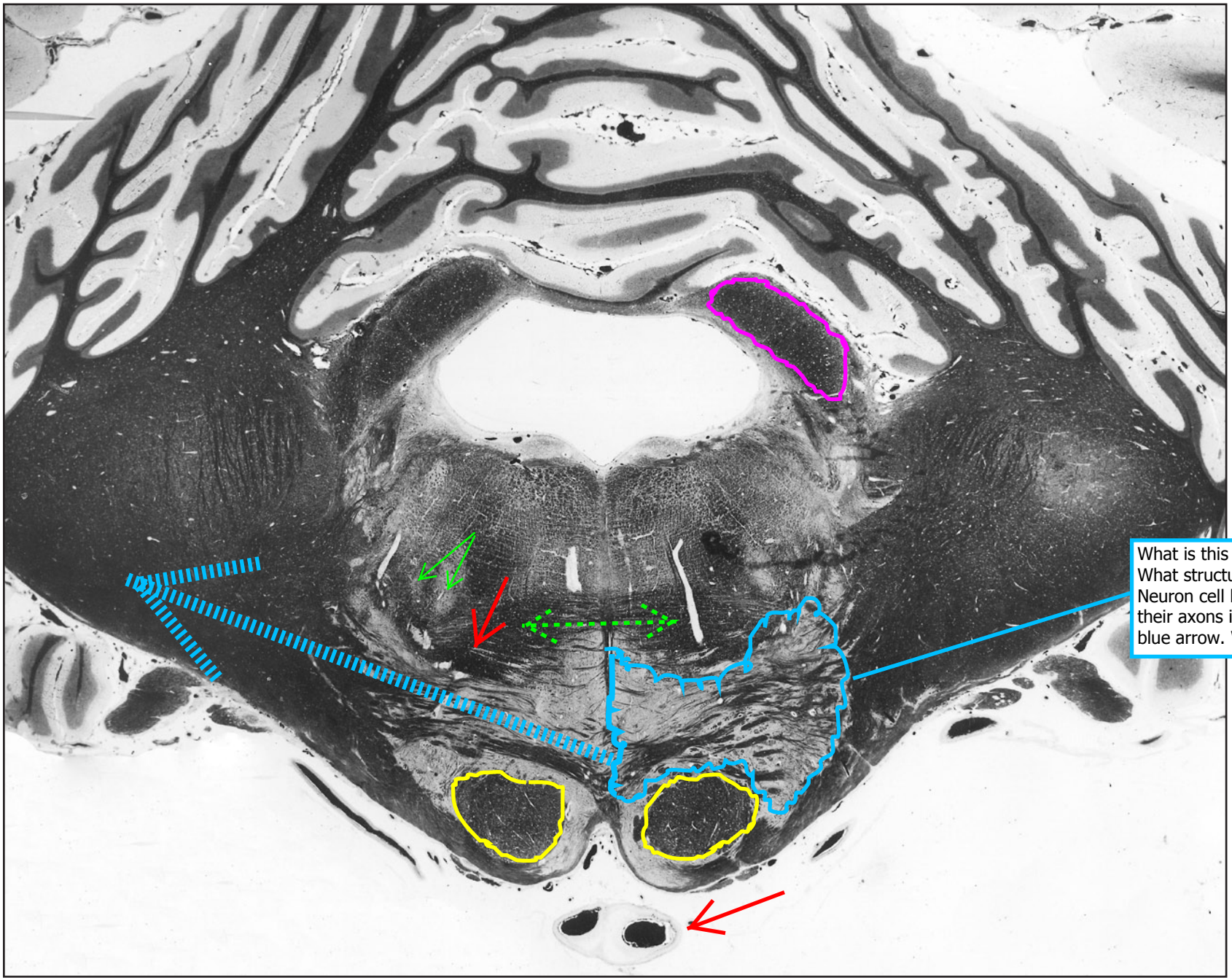
Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

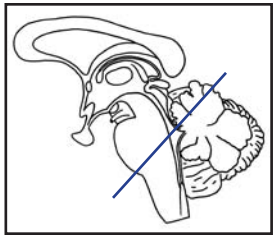
Brainstem B-14

Mid Pons



What is this enormous mass of gray matter? What structure provides its major input? Neuron cell bodies in the gray matter send their axons in a trajectory outlined by the blue arrow. What is their synaptic target?

Mid Sagittal

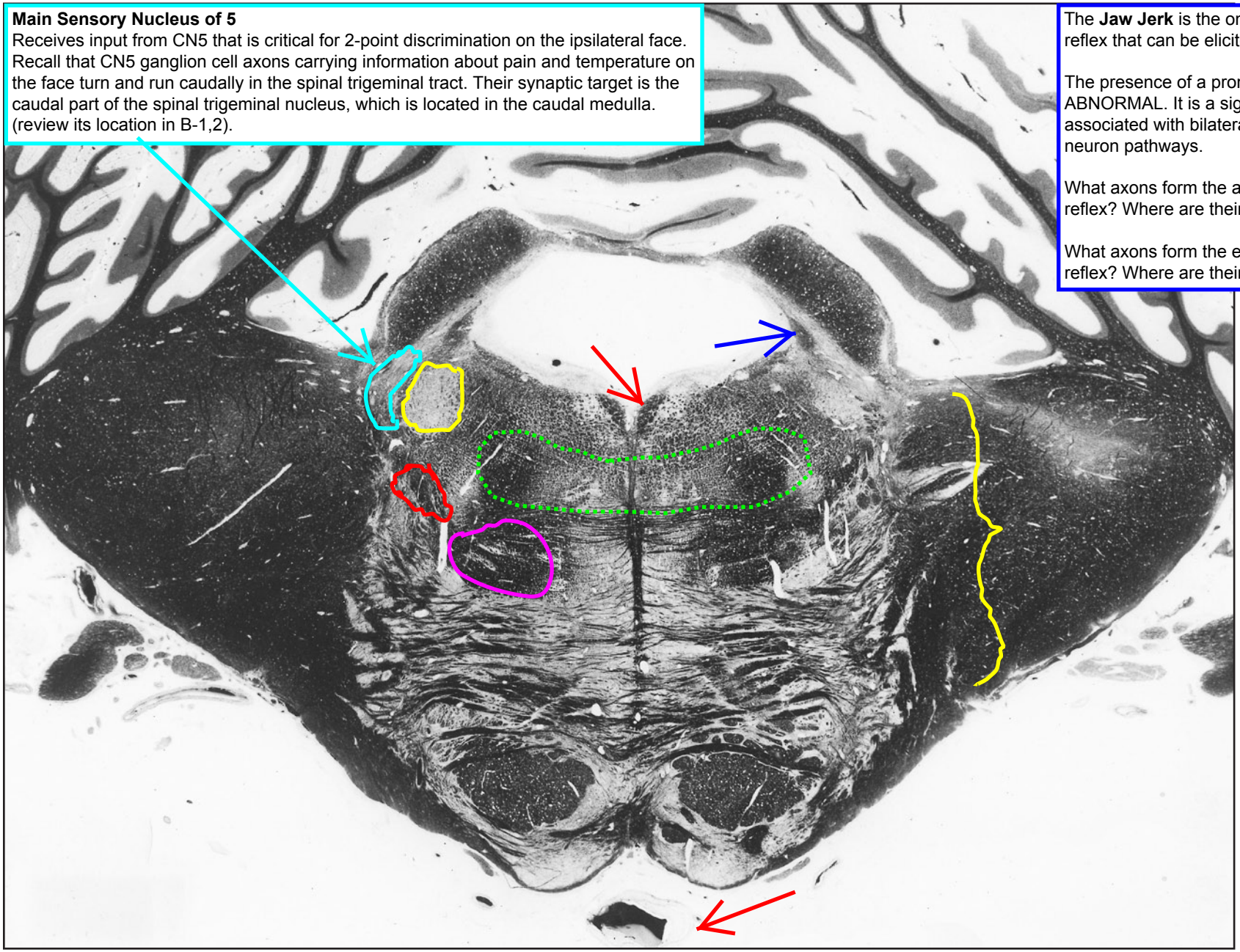


UMass Medical School
Mind Brain Behavior 1

Brainstem B-15

Mid Pons

Main Sensory Nucleus of 5
Receives input from CN5 that is critical for 2-point discrimination on the ipsilateral face. Recall that CN5 ganglion cell axons carrying information about pain and temperature on the face turn and run caudally in the spinal trigeminal tract. Their synaptic target is the caudal part of the spinal trigeminal nucleus, which is located in the caudal medulla. (review its location in B-1,2).



The **Jaw Jerk** is the only monosynaptic "stretch" reflex that can be elicited in the head.

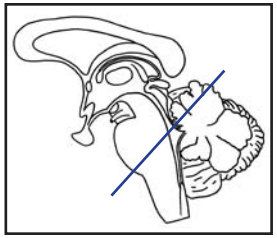
The presence of a prominent jaw jerk reflex is ABNORMAL. It is a sign of hyperreflexia usually associated with bilateral lesions in upper motor neuron pathways.

What axons form the afferent (sensory) limb of the reflex? Where are their cell bodies of origin?

What axons form the efferent (motor) limb of the reflex? Where are their cell bodies of origin?

What arteries provide the major blood supply to this region of the brainstem?

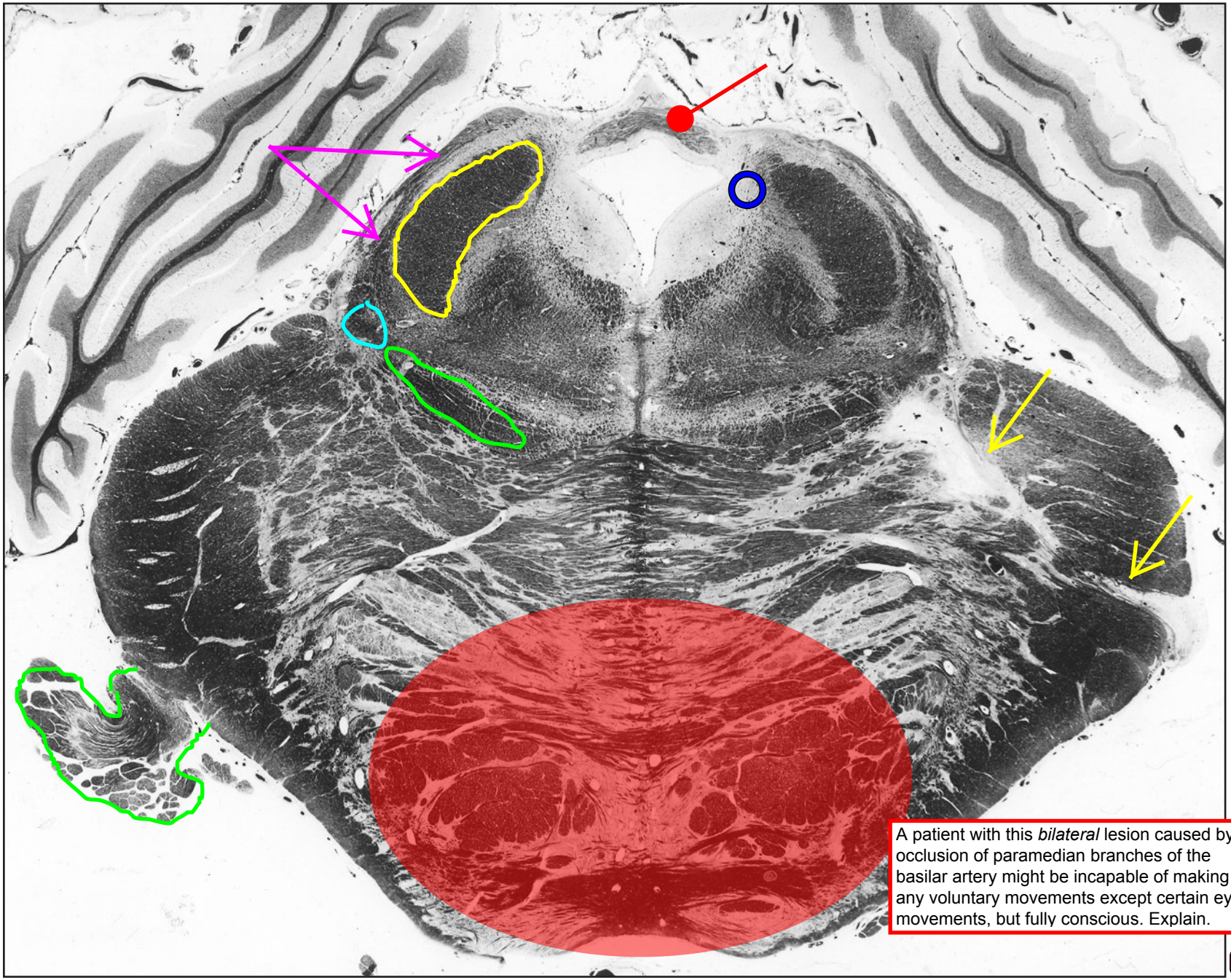
Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

Brainstem B-16

Rostral Pons

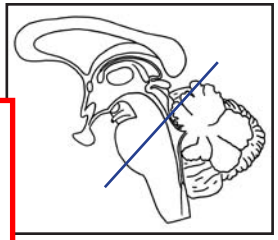


The individual whose brainstem we are studying suffered from trigeminal neuralgia that began after a head injury. In an attempt to relieve her pain after all other measures had failed, a neurosurgeon planned to cut one of the divisions of the trigeminal nerve. Unfortunately a blood vessel was accidentally damaged, producing ischemic injury that caused degeneration of virtually the entire nerve on that side.

On the affected side, the region where the trigeminal nerve normally crosses the middle cerebellar peduncle (yellow arrows) looks like a "white" streak because there are few surviving axons and therefore equally few myelin sheaths present to take up the black myelin stain.

A patient with this *bilateral* lesion caused by occlusion of paramedian branches of the basilar artery might be incapable of making any voluntary movements except certain eye movements, but fully conscious. Explain.

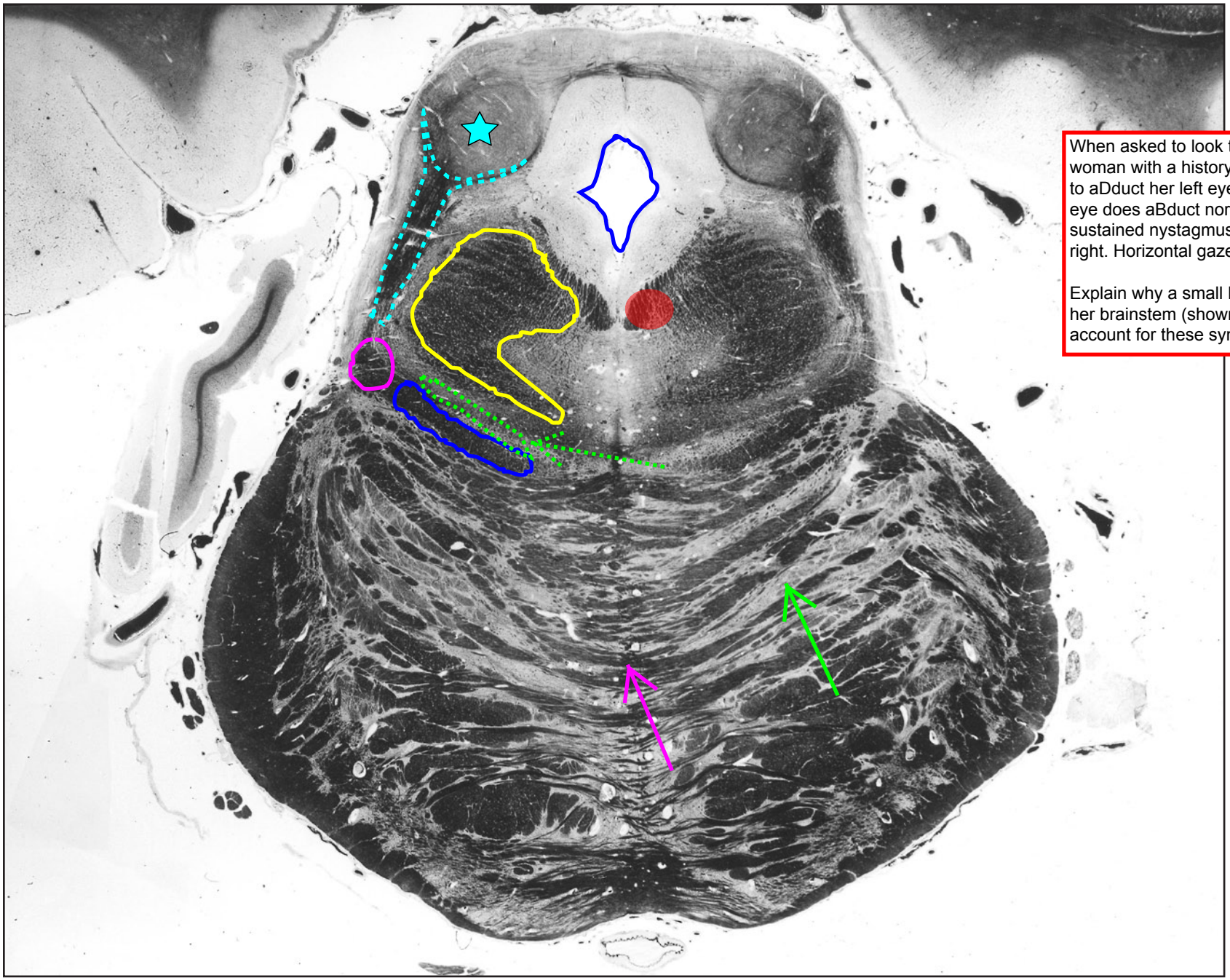
Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

Brainstem B-17

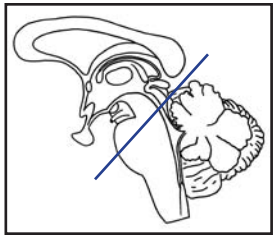
Pons/Midbrain



When asked to look to the right, a 35-year-old woman with a history of multiple sclerosis is unable to aDduct her left eye past the midpoint. The right eye does aBduct normally, although there is sustained nystagmus when she looks far to the right. Horizontal gaze to the left is normal.

Explain why a small MS plaque on the LEFT side of her brainstem (shown in red on the image) could account for these symptoms.

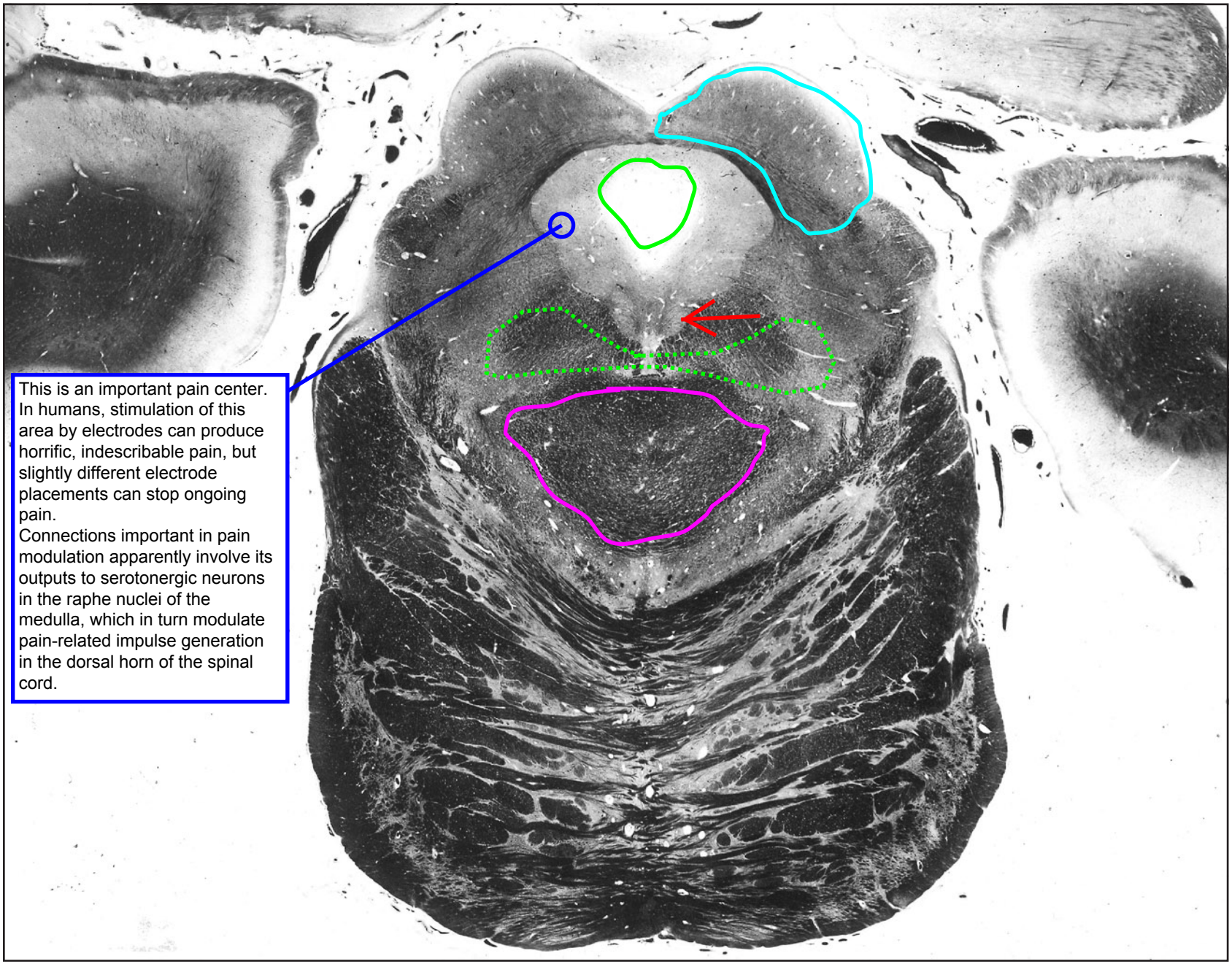
Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

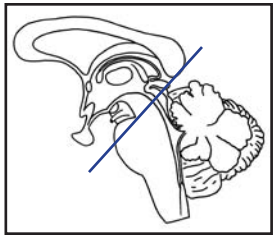
Brainstem B-18

Pons/Midbrain

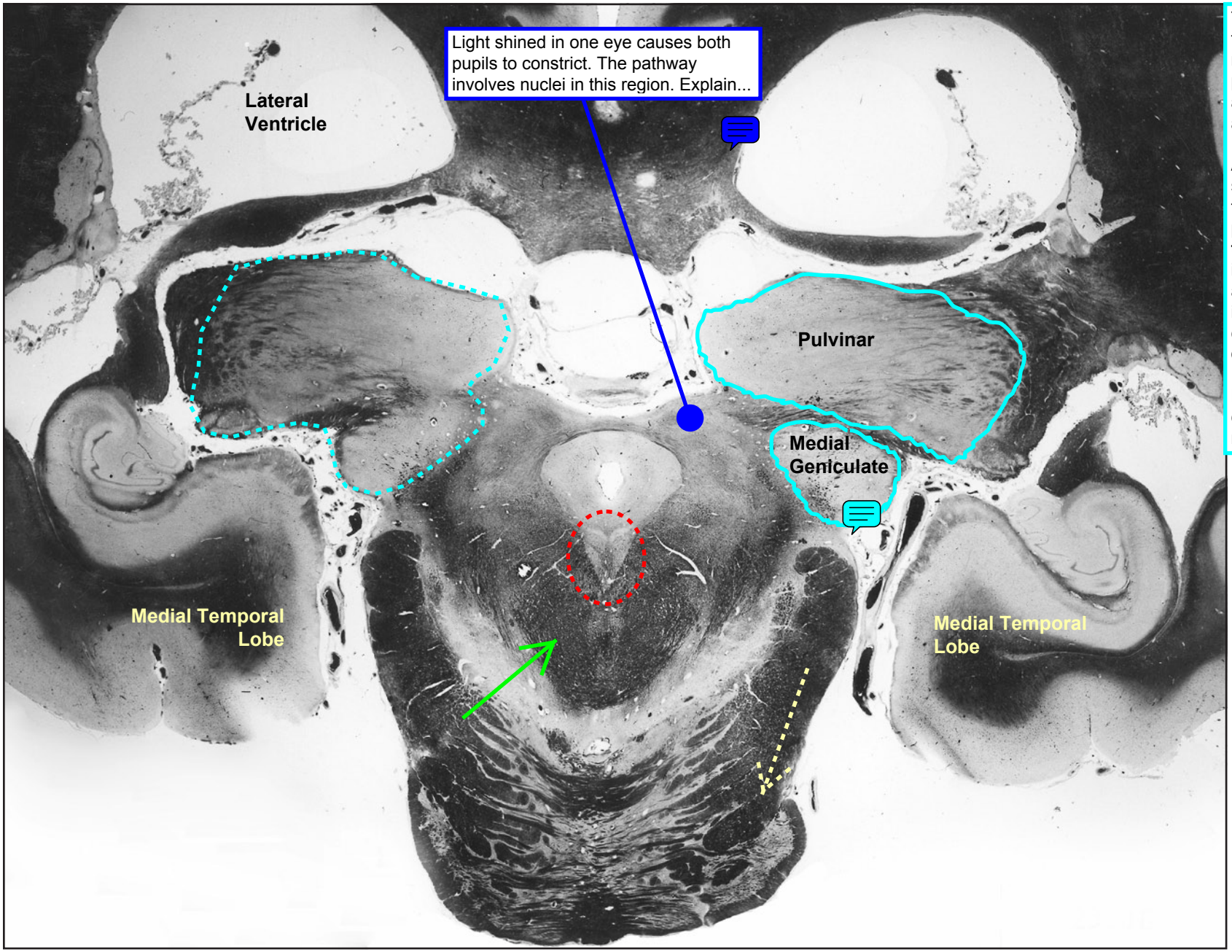


This is an important pain center. In humans, stimulation of this area by electrodes can produce horrific, indescribable pain, but slightly different electrode placements can stop ongoing pain.
Connections important in pain modulation apparently involve its outputs to serotonergic neurons in the raphe nuclei of the medulla, which in turn modulate pain-related impulse generation in the dorsal horn of the spinal cord.

Mid Sagittal



Brainstem B-19

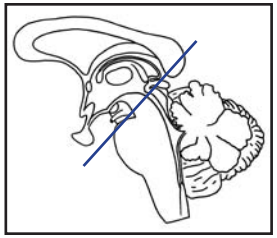


This section includes the medial temporal lobe and two major nuclei of the **thalamus** (the pulvinar and medial geniculate) as well as parts of the midbrain and pons.

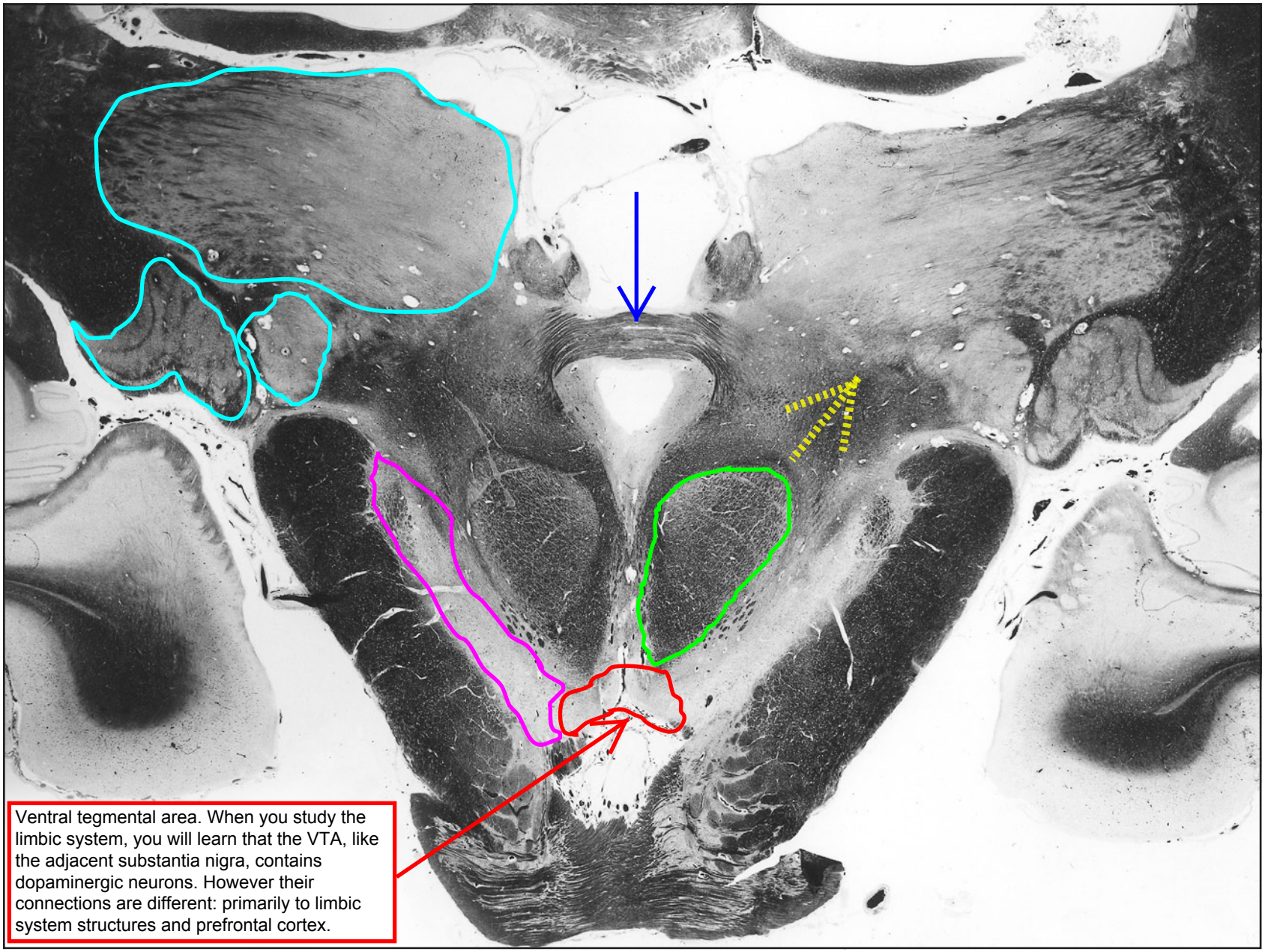
Almost all of the subcortical structures that send information to the cerebral cortex do so via pathways that first synapse in the **thalamus.** Much of the thalamus is made up of nuclei that receive and process these different inputs, and have two-way connections with relevant regions of the cerebral cortex.

MORE INFORMATION about the connections of specific thalamic nuclei discussed in this Atlas

Mid Sagittal

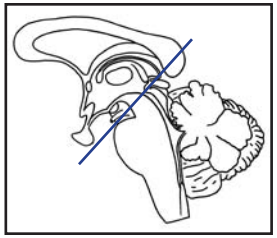


Brainstem B-20



Ventral tegmental area. When you study the limbic system, you will learn that the VTA, like the adjacent substantia nigra, contains dopaminergic neurons. However their connections are different: primarily to limbic system structures and prefrontal cortex.

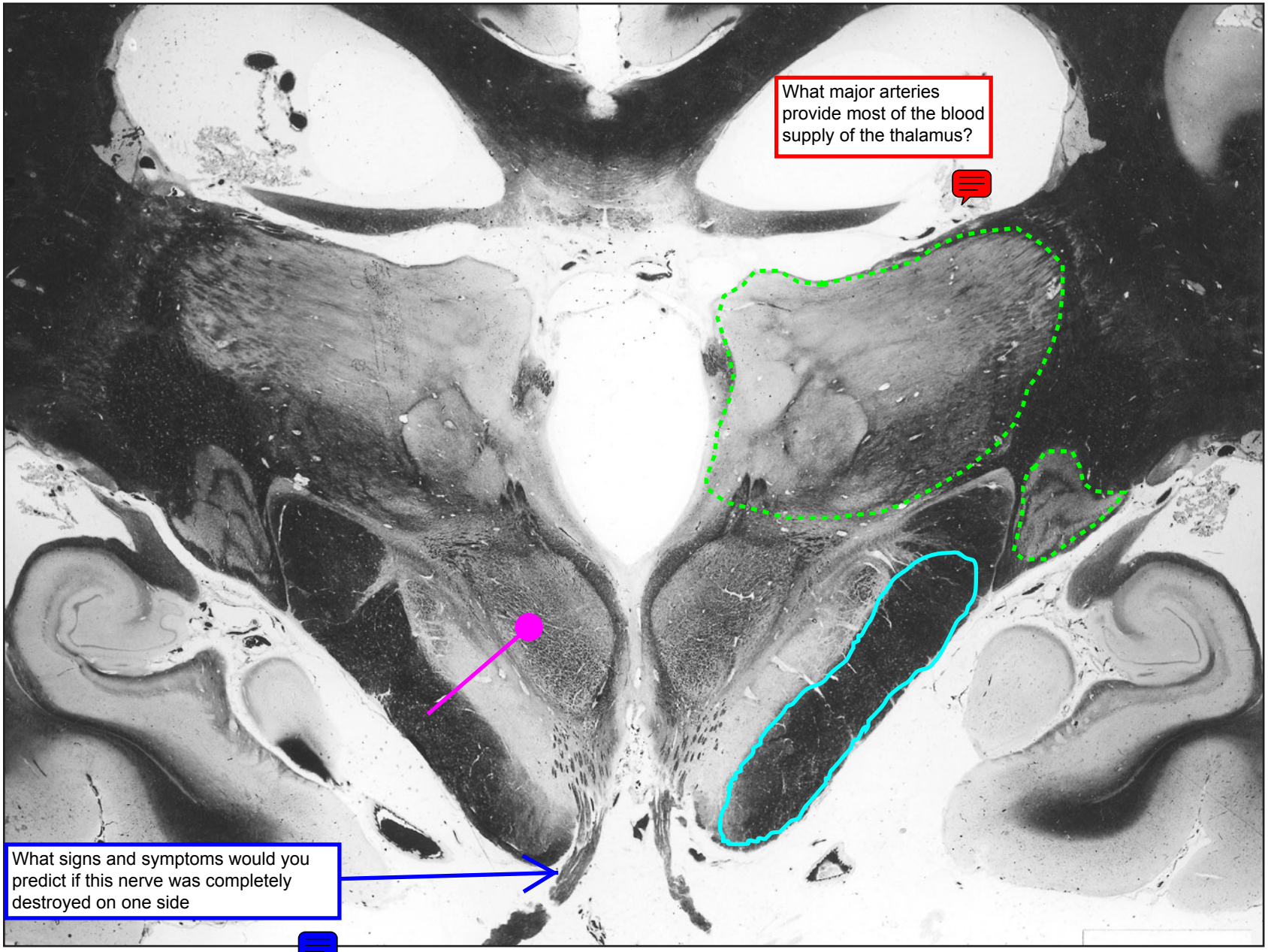
Mid Sagittal



UMass Medical School
Mind Brain Behavior 1

Brainstem B-21

Forebrain/Midbrain



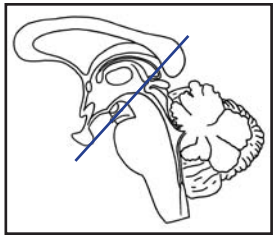
CLINICAL CASE

A patient was brought to the ER several hours following a head injury. She was evaluated and immediately sent for an urgent CT scan, which revealed an epidural bleed. She is currently in the operating room where a neurosurgeon has stopped the bleeding and evacuated the clot. The team predicts a full recovery.

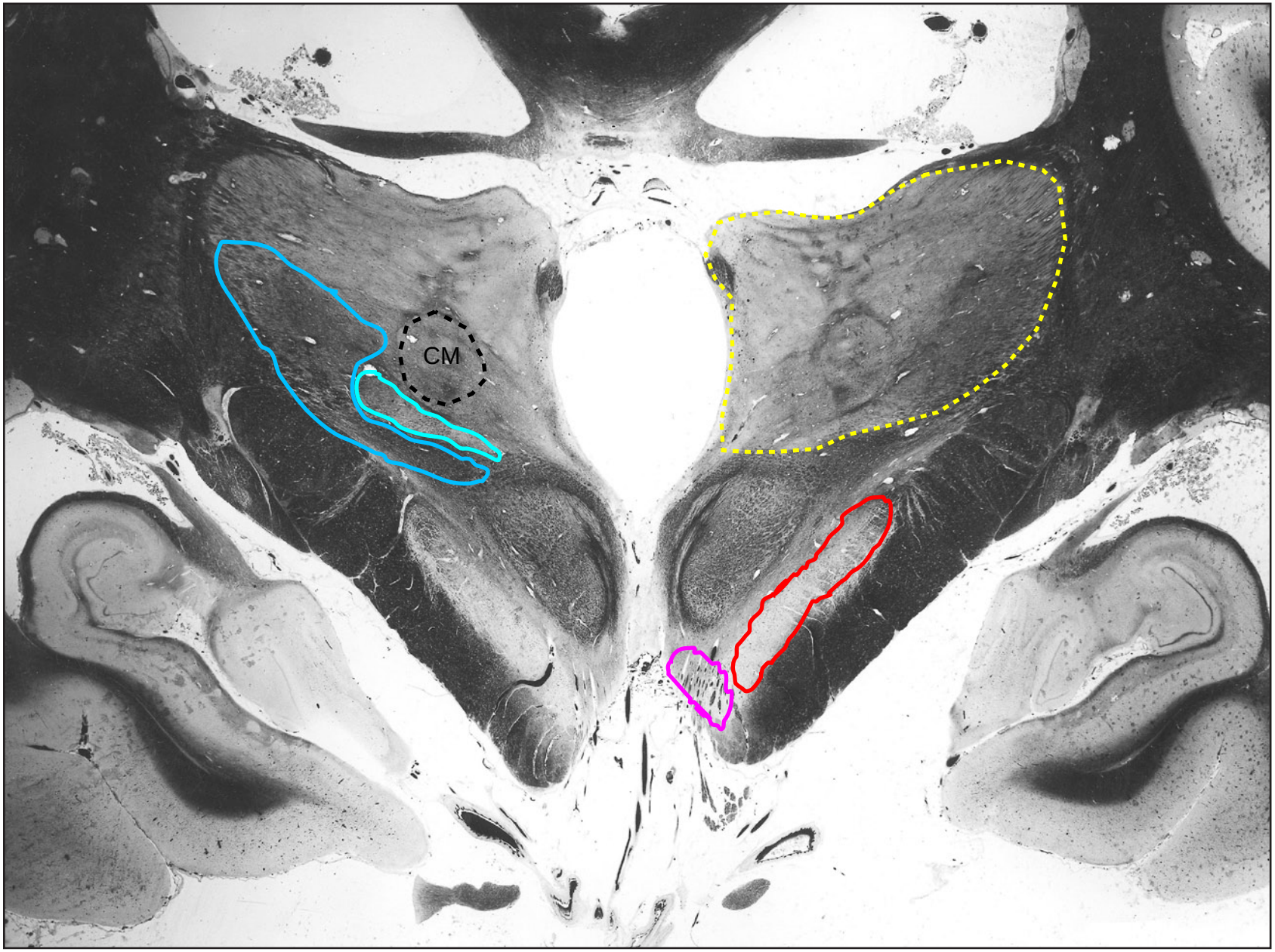
Neurological exam in the ER showed a dilated right pupil that was not responsive to light, and a paralyzed left arm and leg with a dorsiflexor left plantar response. She responded to commands occasionally, but not reliably, and was described as "sleepy but arousable."

These symptoms were produced when the accumulating blood within the skull pushed part of the medial temporal lobe downward through the tentorial notch where it compressed the midbrain. What midbrain structure do you predict is malfunctioning to account for each of this patient's symptoms?

Mid Sagittal



Brainstem B-22



Collectively the two thalamic nuclei circled in blue comprise the SOMATOSENSORY thalamus.
The nucleus for the face (which also relays information about taste) is medial and is named ventral posteromedial (VPM).
The nucleus for the body is located more lateral, and is named ventral posterolateral (VPL).

Can you name major spinal cord and brainstem tracts that synapse in each nucleus?

Additional nuclei of the thalamus are identified in the Coronal, Horizontal, and Sagittal Atlases.

What arteries supply most of the midbrain?

Mid Sagittal