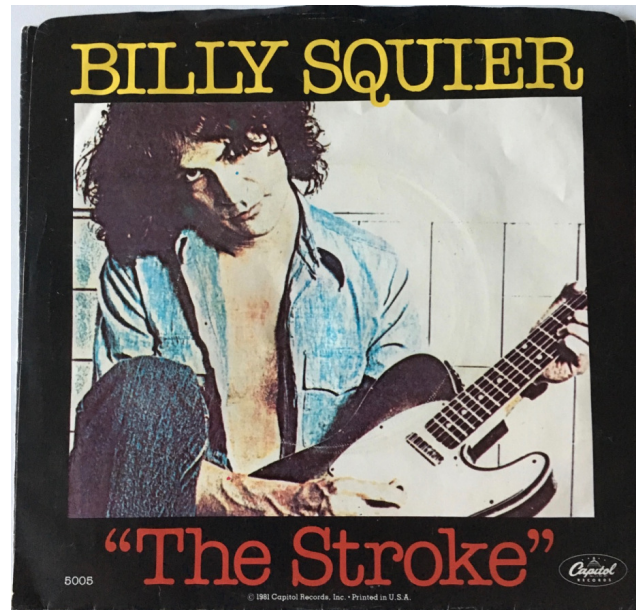


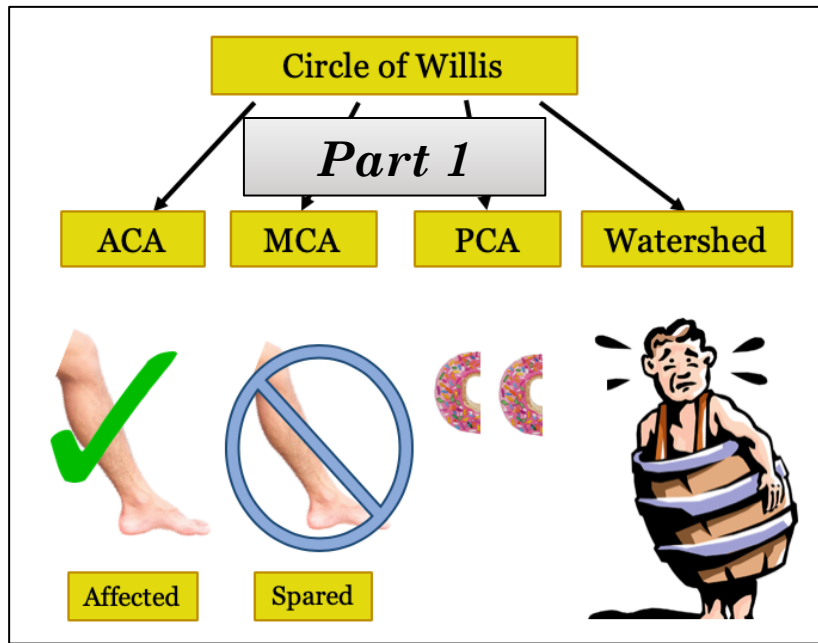
# Stroke Localization (Part 3)

*for USMLE Step One*



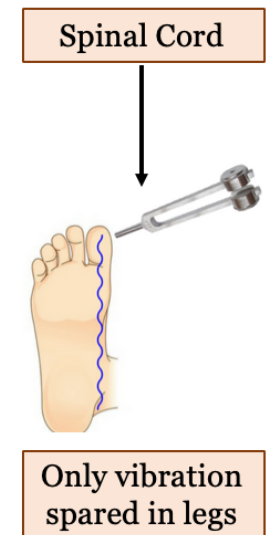
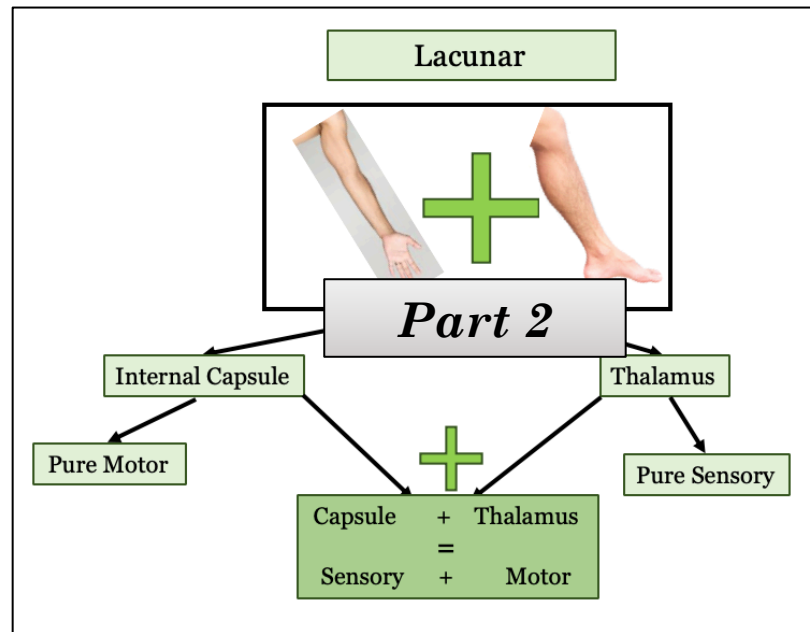
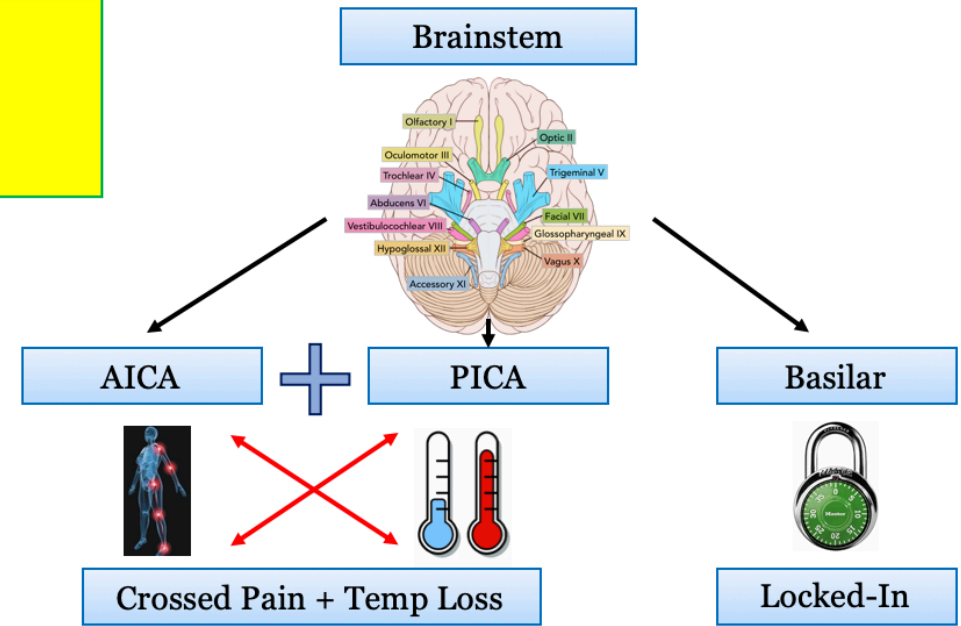
Benjamin Tanenbaum  
UMass Class of 2021

*www.12daysinmarch.com*  
*email: Howard@12daysinmarch.com*



# Roadmap

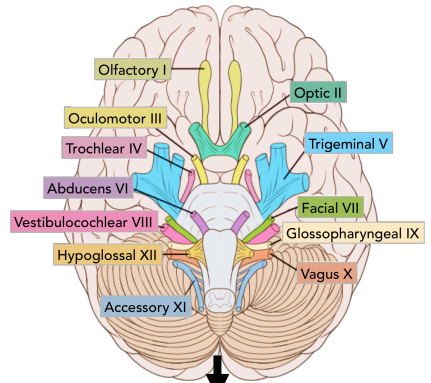
(Strokes for the Boards)



# Roadmap

*(Strokes for the Boards)*

Brainstem

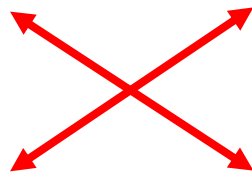


AICA



PICA

Basilar



Crossed Pain + Temp Loss

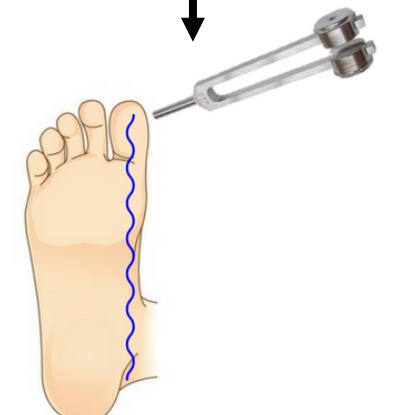


Locked-In

# Roadmap

*(Strokes for the Boards)*

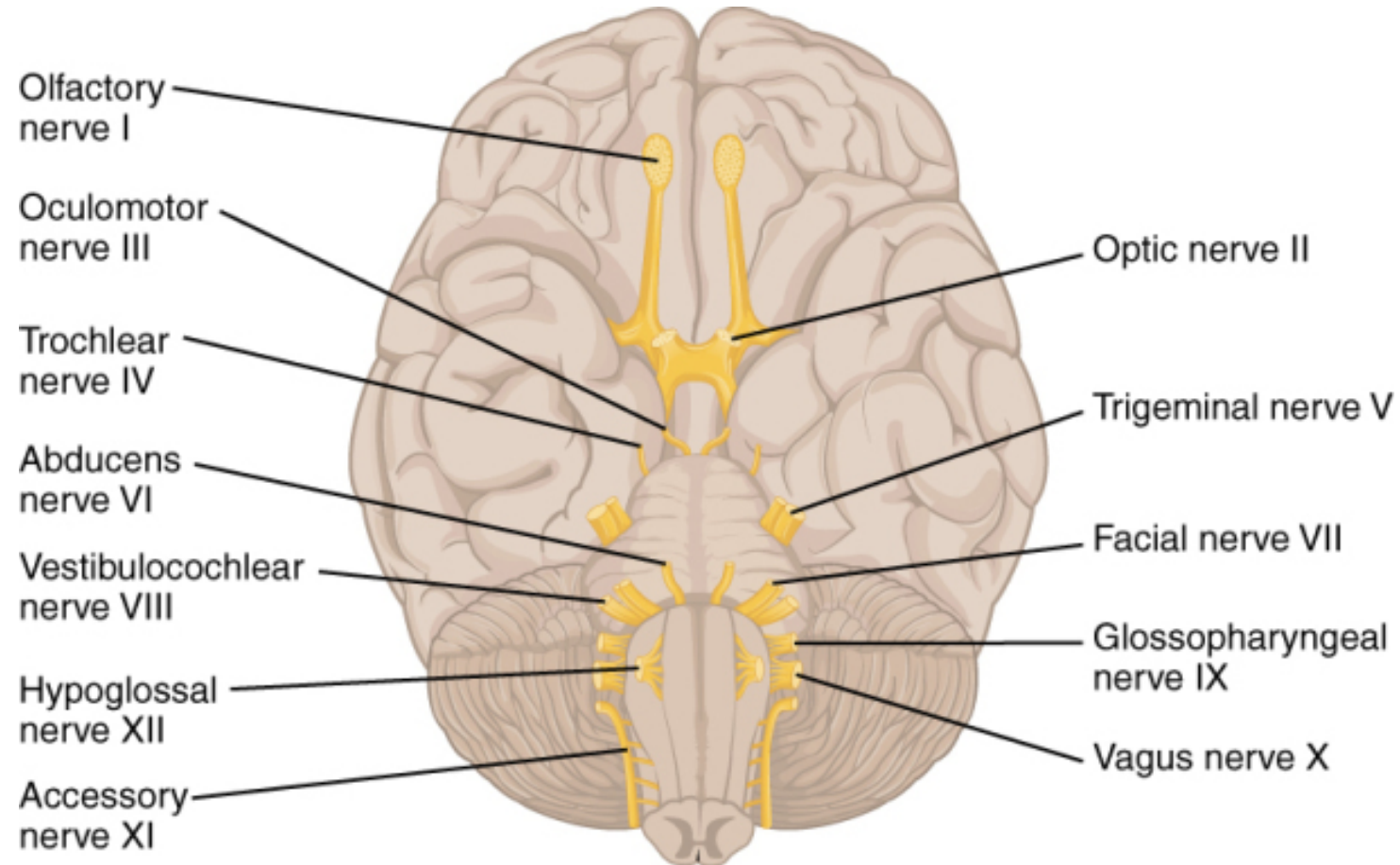
Spinal Cord



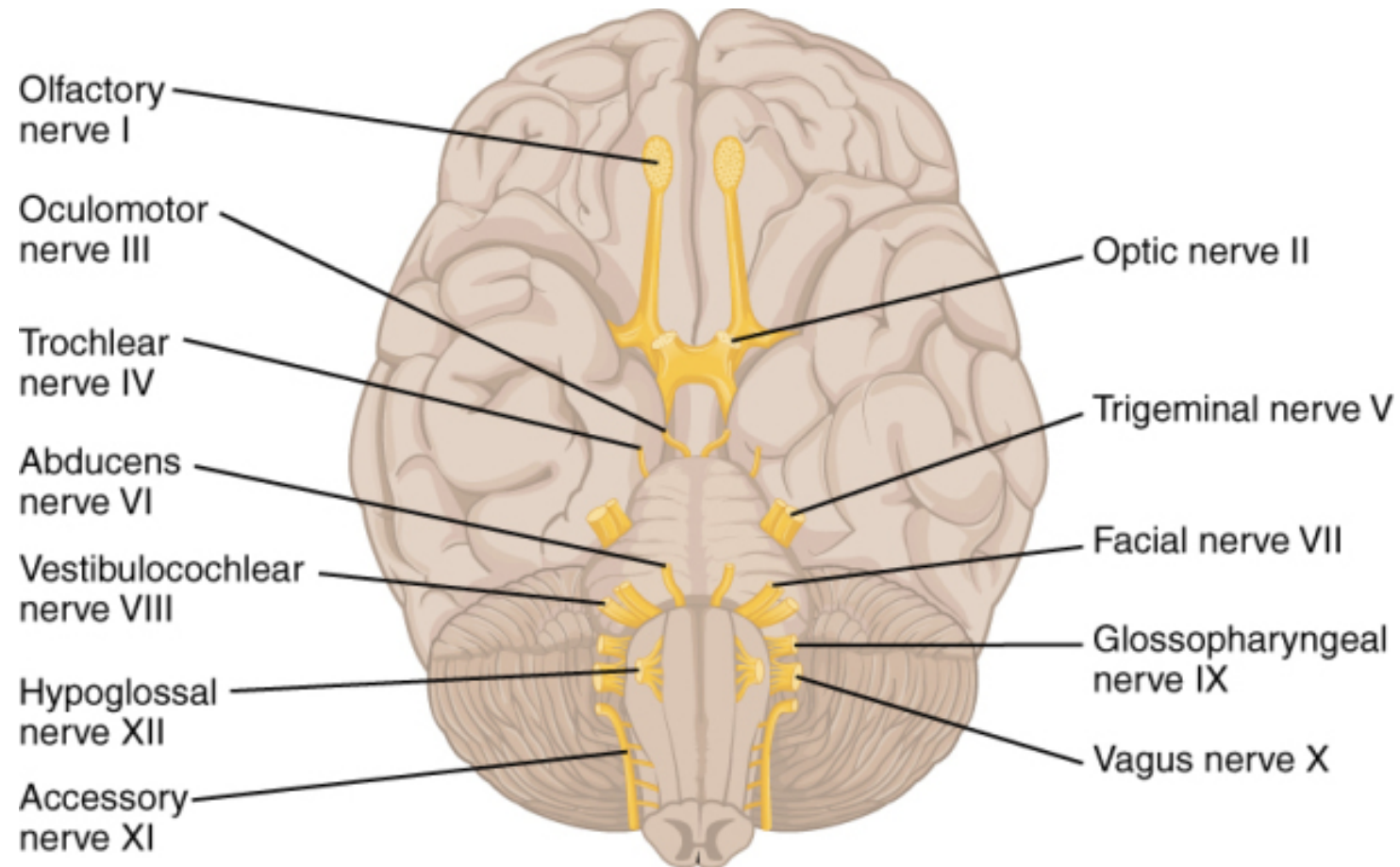
Only vibration  
spared in legs

Q: How do you Localize a Stroke to the Brainstem?

**A: CRANIAL NERVE DEFICITS**



# Brainstem and Cranial Nerves



# Brainstem and Cranial Nerves

Spared

~~Olfactory nerve I~~

Oculomotor nerve III

Trochlear nerve IV

Abducens nerve VI

Vestibulocochlear nerve VIII

Hypoglossal nerve XII

Accessory nerve XI

~~Optic nerve II~~

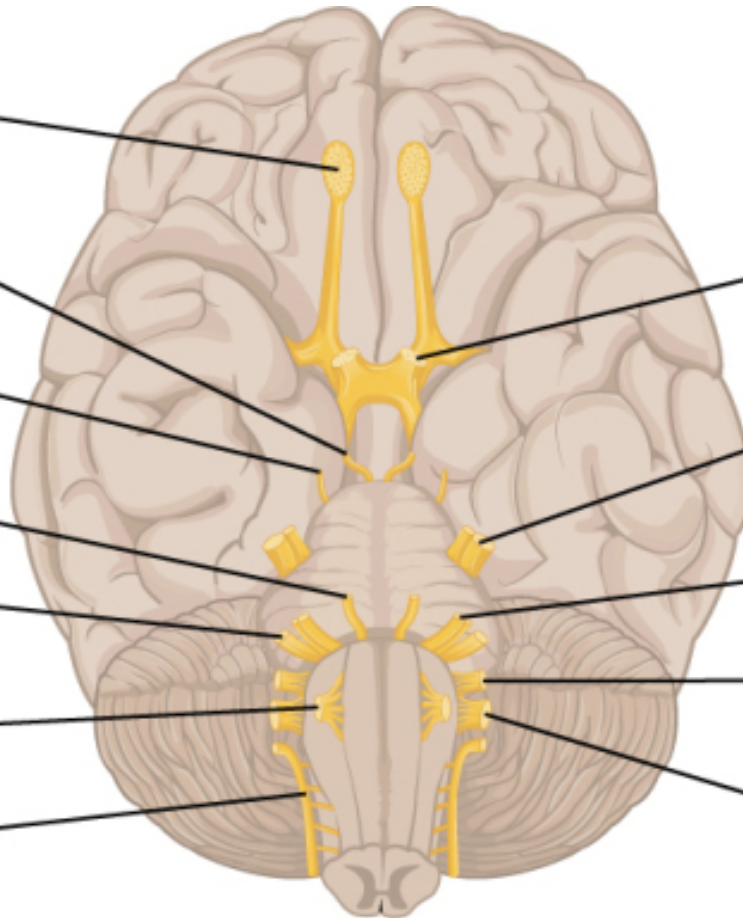
Spared

Trigeminal nerve V

Facial nerve VII

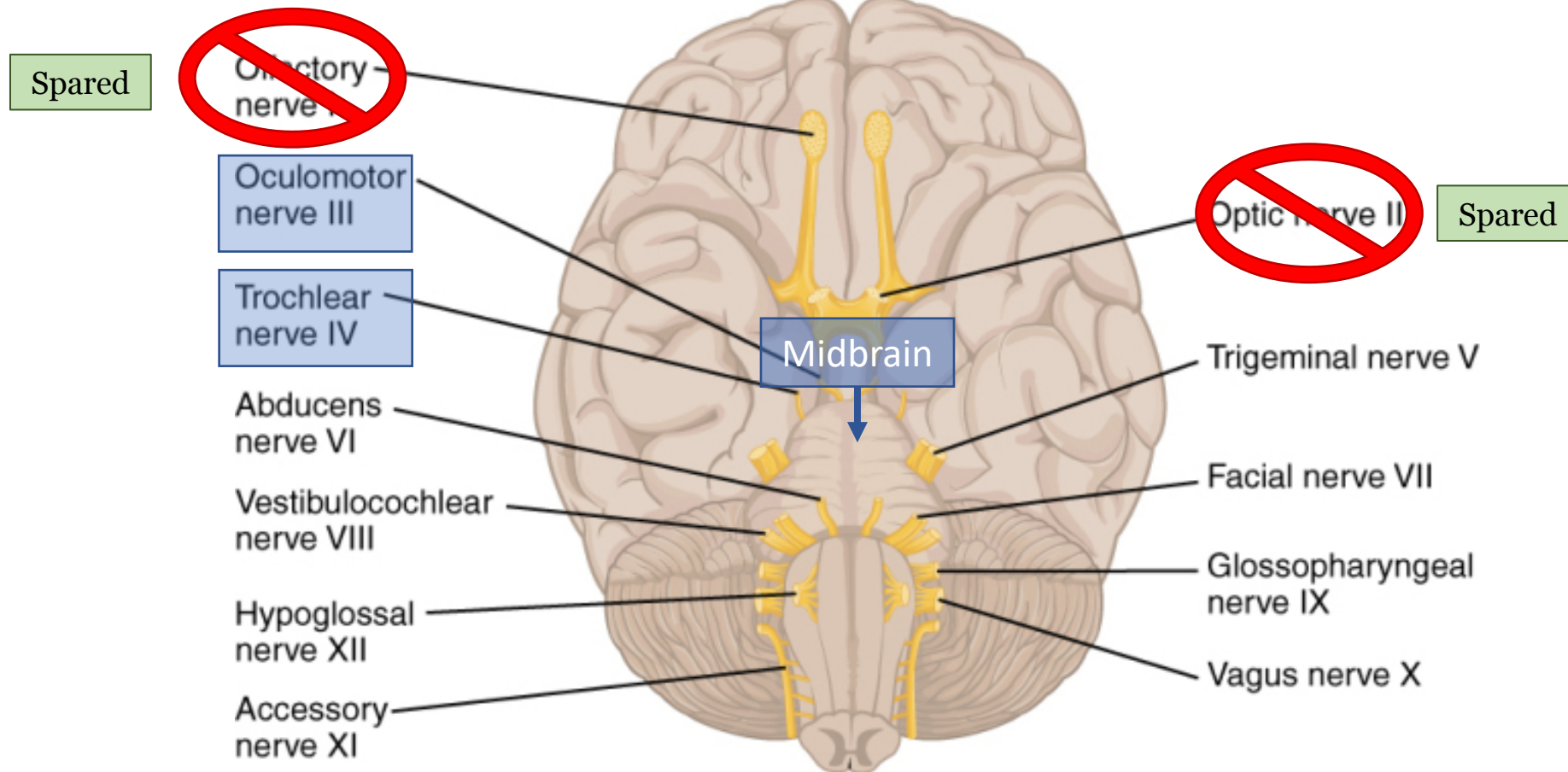
Glossopharyngeal nerve IX

Vagus nerve X



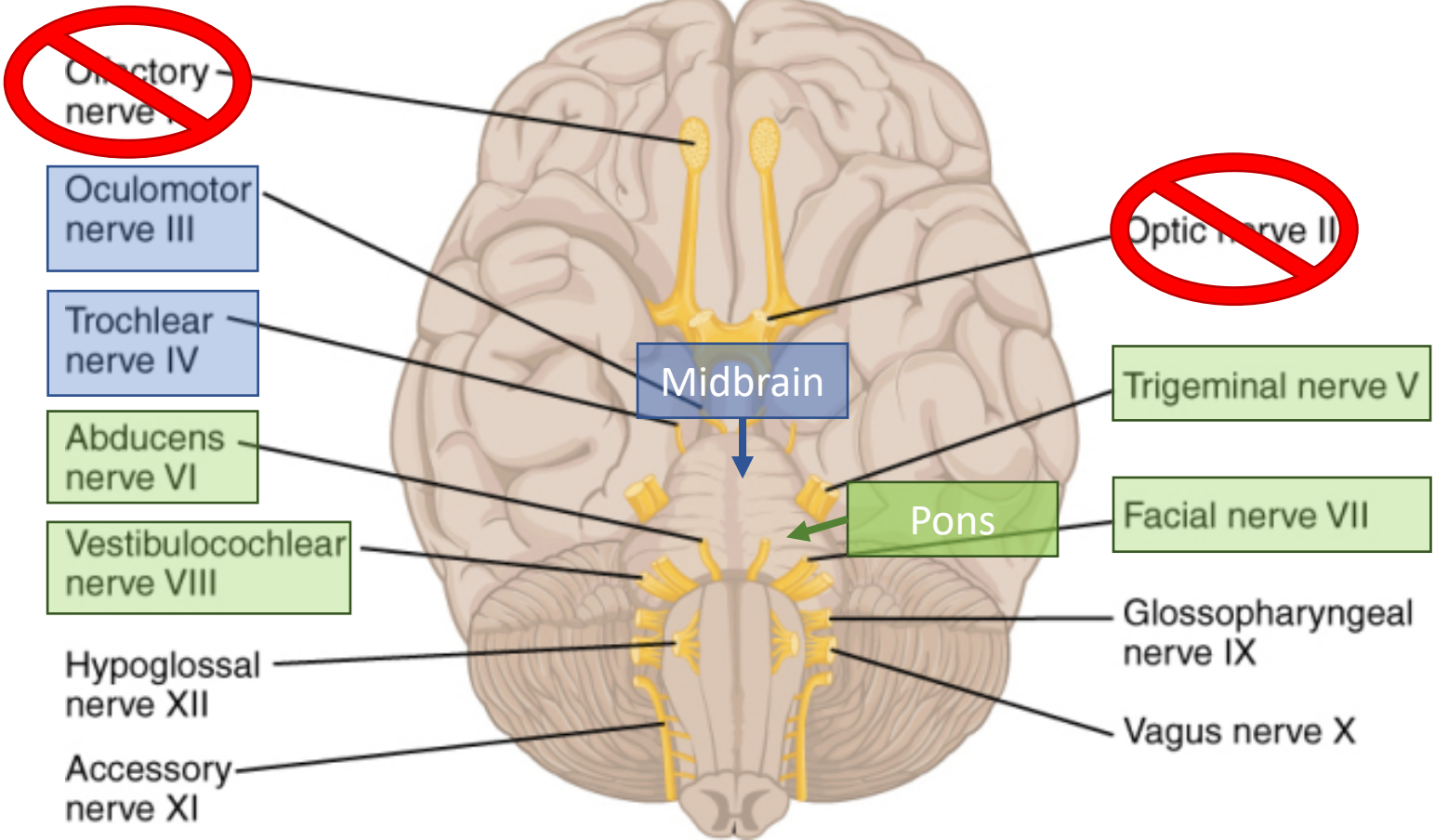
# Midbrain

*The midbrain is the most cranial brainstem region, located closest to the forebrain*



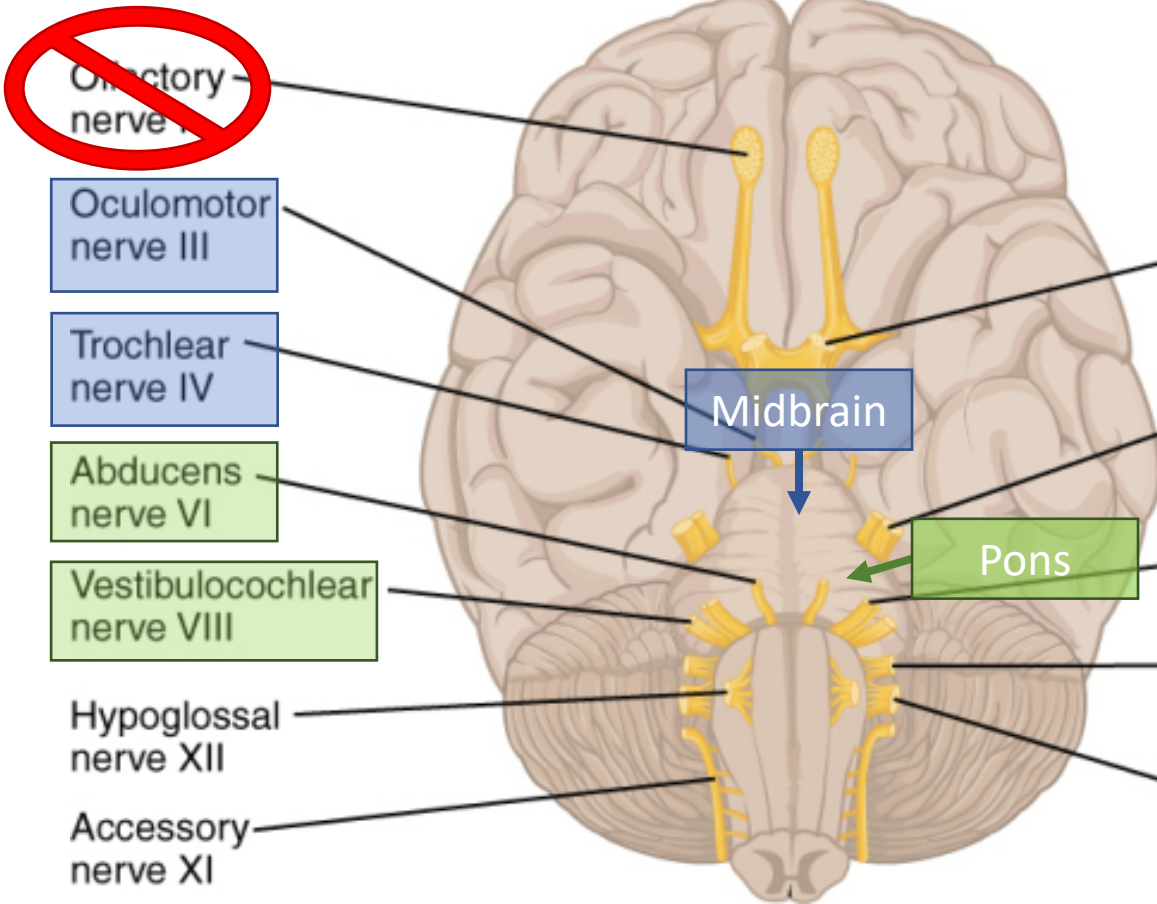


# Pons

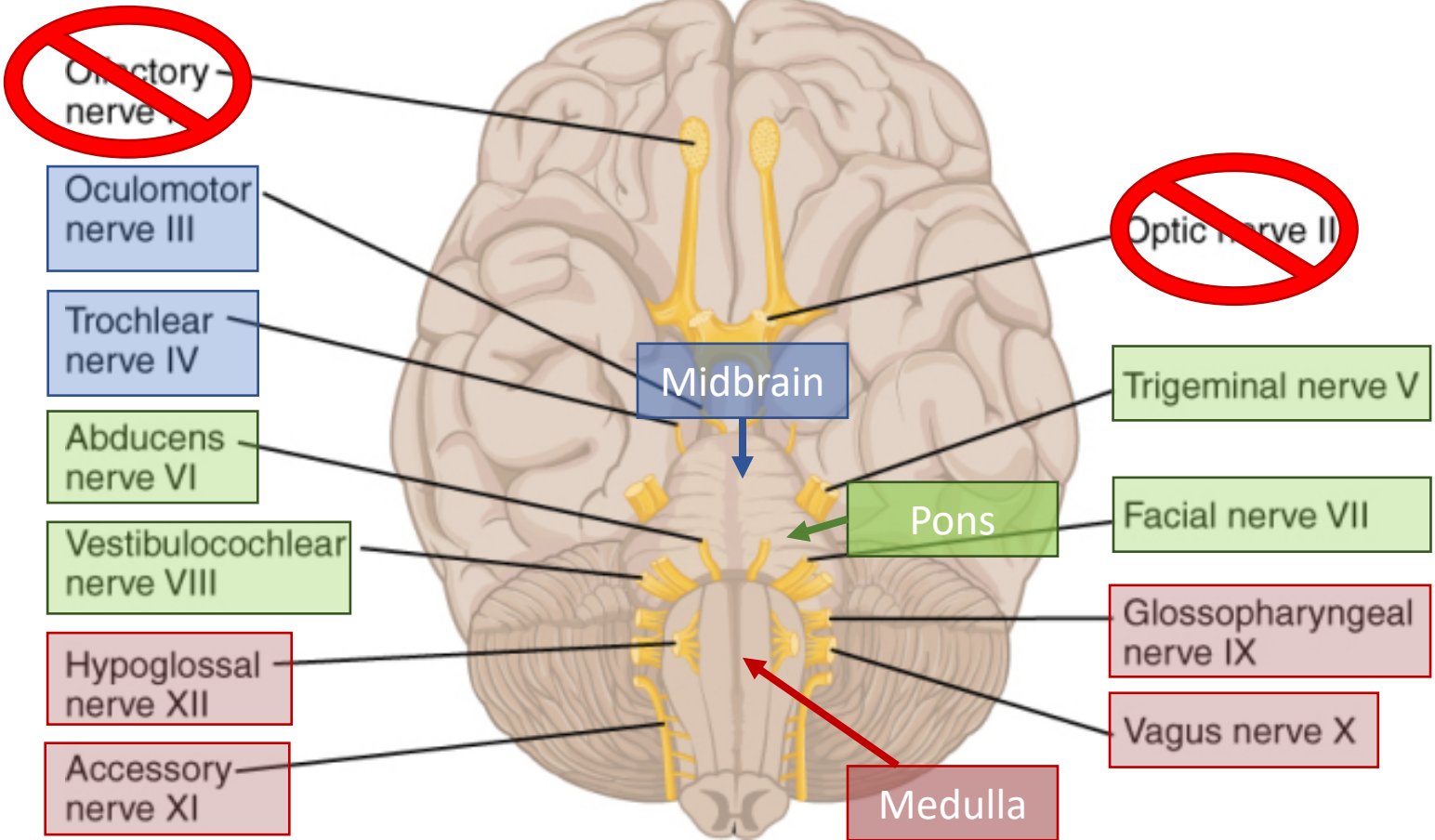


# Pons

## Big Fat Pons



# Medulla

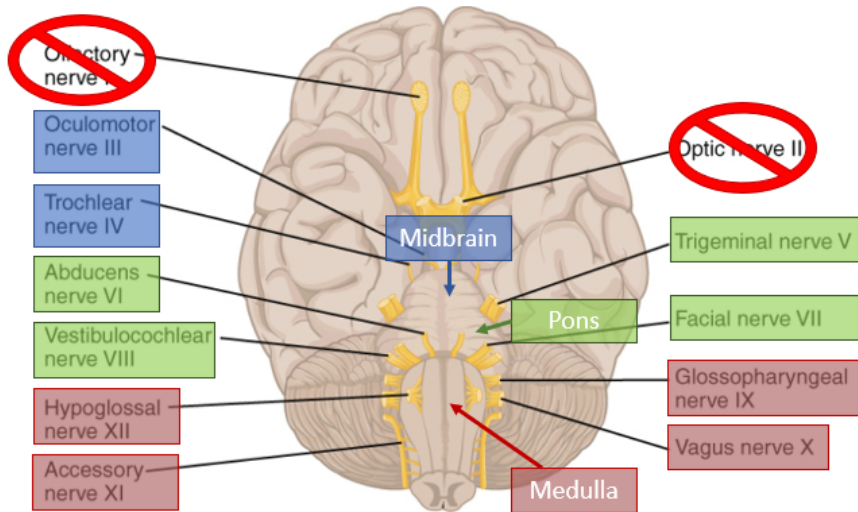


# Brainstem **Rule of 4's**

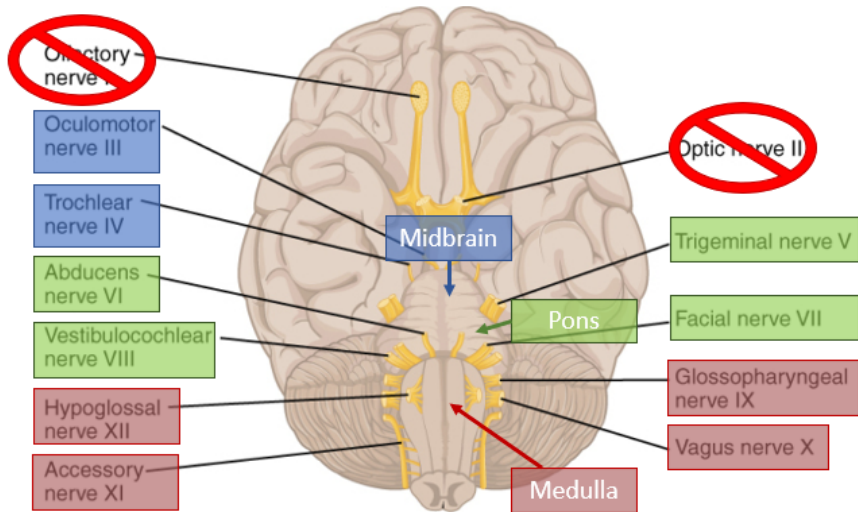
## 4 Rules

### 1. Midline (Medial) Structures

- 4 Midline structures beginning with 'M'
  - MLF (Medial Longitudinal Fasciculus)
  - Motor- Corticospinal tracts (**contralateral** motor control)
  - Motor- **Ipsilateral** Cranial Nerves (3, 4, 6, 12)
  - Medial Lemniscus (Vibration/proprioception in **contralateral** leg)



# Brainstem **Rule of 4's**



## 4 Rules

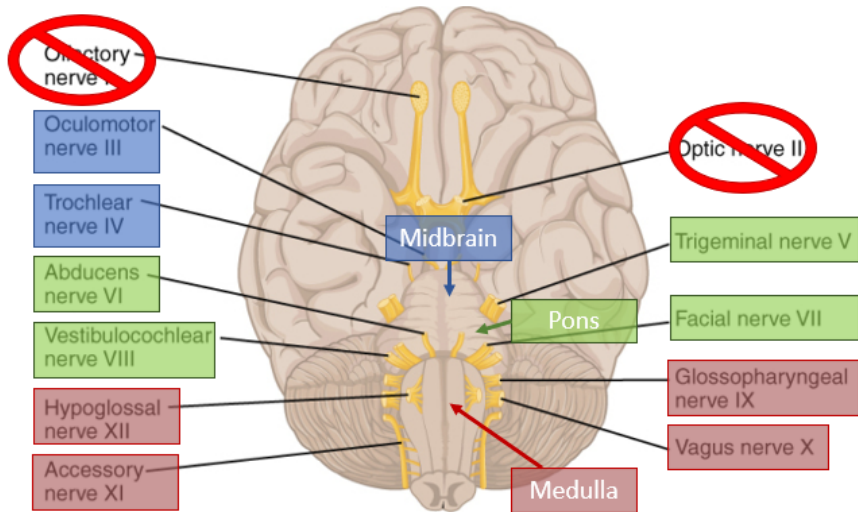
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  - Medial Lemniscus (Vibration/proprioception in **contralateral** leg)

### 2. Side (Side) Structures

- 4 Side (lateral) structures beginning with 'S'
  - Sensory- Trigeminothalamic tract (**Ipsilateral** pain/temp control)
  - Sensory- Spinothalamic tract (**contralateral** pain/temp control)
  - Spinocerebellar tracts (**Ipsilateral**)
  - Sympathetic (**Ipsilateral**)

# Brainstem Rule of 4's



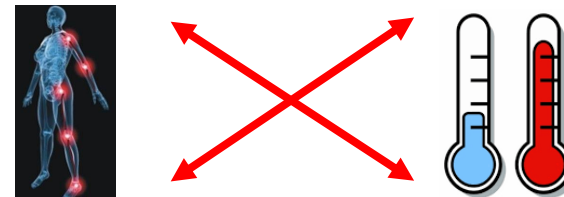
## 4 Rules

### 1. Midline (Medial) Structures

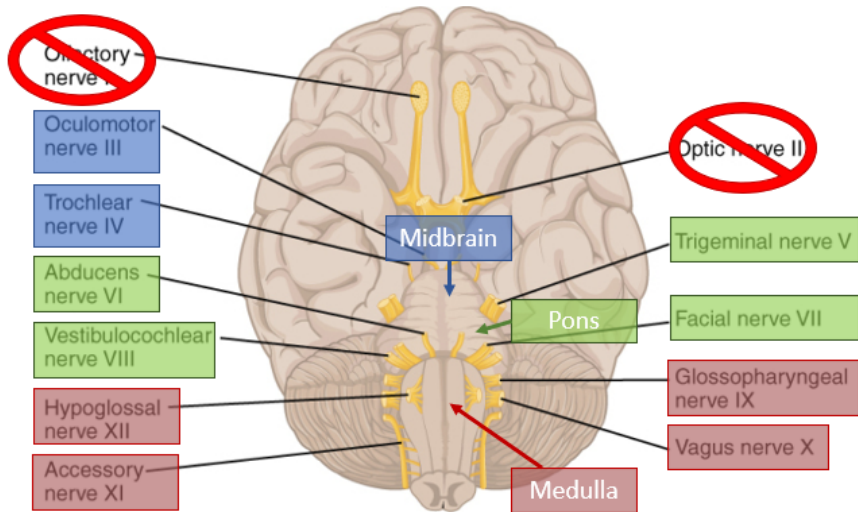
- 4 Midline structures beginning with 'M'
  - MLF (Medial Longitudinal Fasciculus)
  - Motor- Corticospinal tracts (**contralateral** motor control)
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  - Medial Lemniscus (Vibration/proprioception in **contralateral** leg)

### 2. Side (S lateral) Structures

- 4 Side (lateral) structures beginning with 'S'
  - **Sensory- Trigeminothalamic tract (*Ipsilateral* pain/temp)**
  - **Sensory- Spinothalamic tract (*contralateral* pain/temp)**
  - Spinocerebellar tracts (**Ipsilateral**)
  - Sympathetic (**Ipsilateral**)



# Brainstem Rule of 4's



## 4 Rules

### 1. Midline (Medial) Structures

- 4 Midline structures beginning with 'M'
  - MLF (Medial Longitudinal Fasciculus)
  - Motor- Corticospinal tracts (**contralateral** motor control)
  - Motor- **Ipsilateral** Cranial Nerves (3, 4, 6, 12)
  - Medial Lemniscus (Vibration/proprioception in **contralateral** leg)

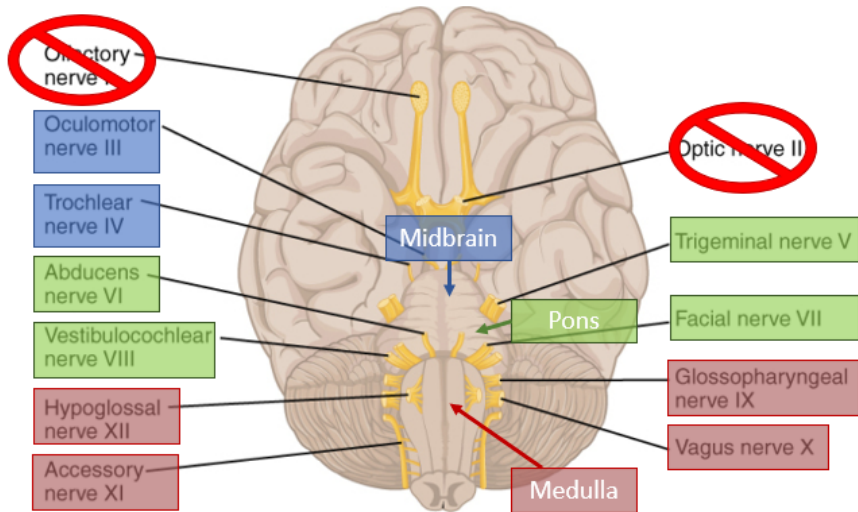
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- 4 Side (lateral) structures beginning with 'S'
  - Sensory- Trigeminothalamic tract (**Ipsilateral** pain/temp control)
  - Sensory- Spinothalamic tract (**contralateral** pain/temp control)
  - Spinocerebellar tracts
  - Sympathetic

### 3. *Geographical Locations*

- **4 CNs in Medulla (IX, X, XI, XII)**
- **4 CNs in Pons (V, VI, VII, VIII)**
- **4 CNs Above Pons (I, II, III, IV)**

# Brainstem **Rule of 4's**



## 4 Rules

### 1. Midline (Medial) Structures

- 4 Midline structures beginning with 'M'
  - MLF (Medial Longitudinal Fasciculus)
  - Motor- Corticospinal tracts (**contralateral** motor control)
  - Motor- **Ipsilateral** Cranial Nerves (3, 4, 6, 12)
  - Medial Lemniscus (Vibration/proprioception in **contralateral** leg)

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- 4 Side (lateral) structures beginning with 'S'
  - Sensory- Trigeminothalamic tract (**Ipsilateral** pain/temp control)
  - Sensory- Spinothalamic tract (**contralateral** pain/temp control)
  - Spinocerebellar tracts
  - Sympathetic

### 3. Geographical Locations

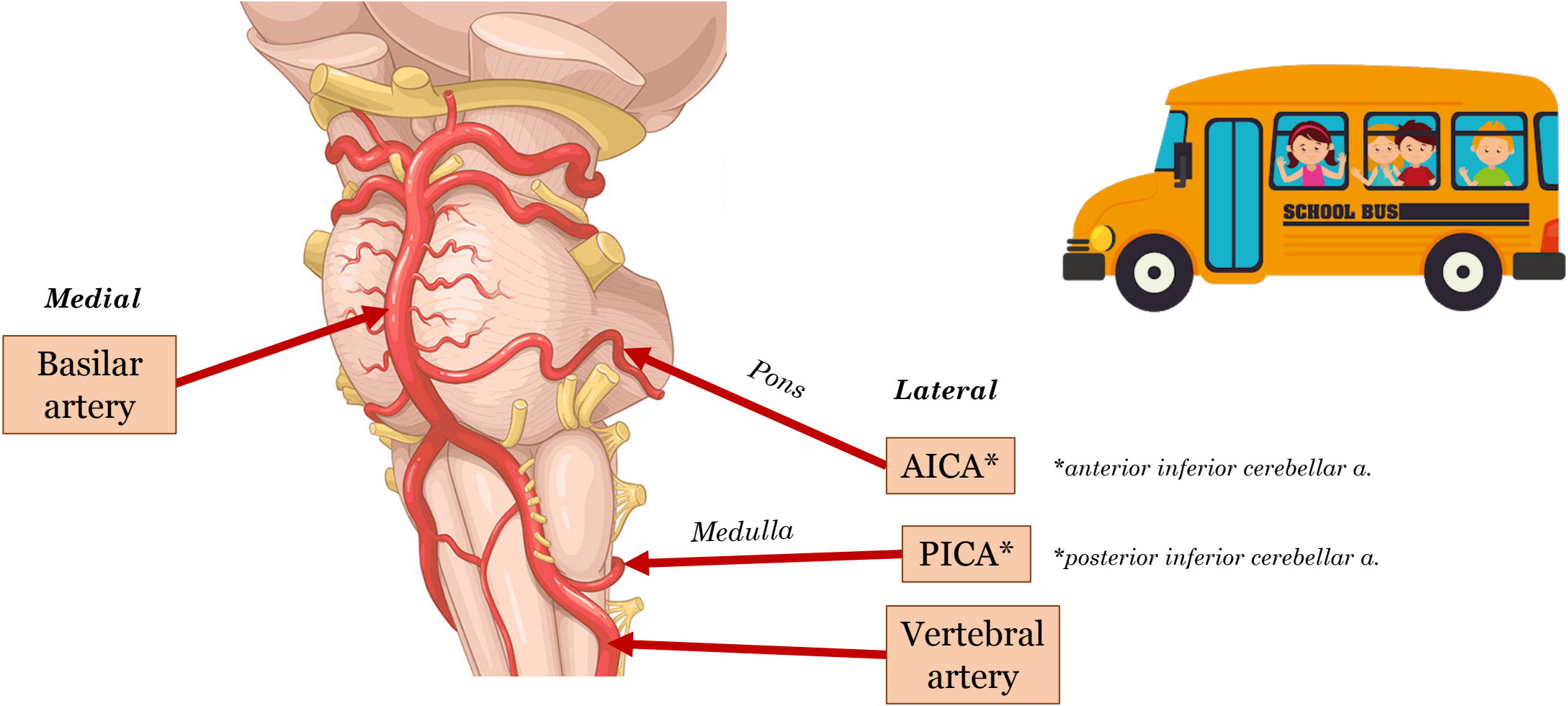
- 4 **CNs in medulla (IX, X, XI, XII)**
- 4 **CNs in Pons (V, VI, VII, VIII)**
- 4 **CNs Above Pons (I, II, III, IV)**

### ***4. Four midline motor nuclei divide evenly into 12***

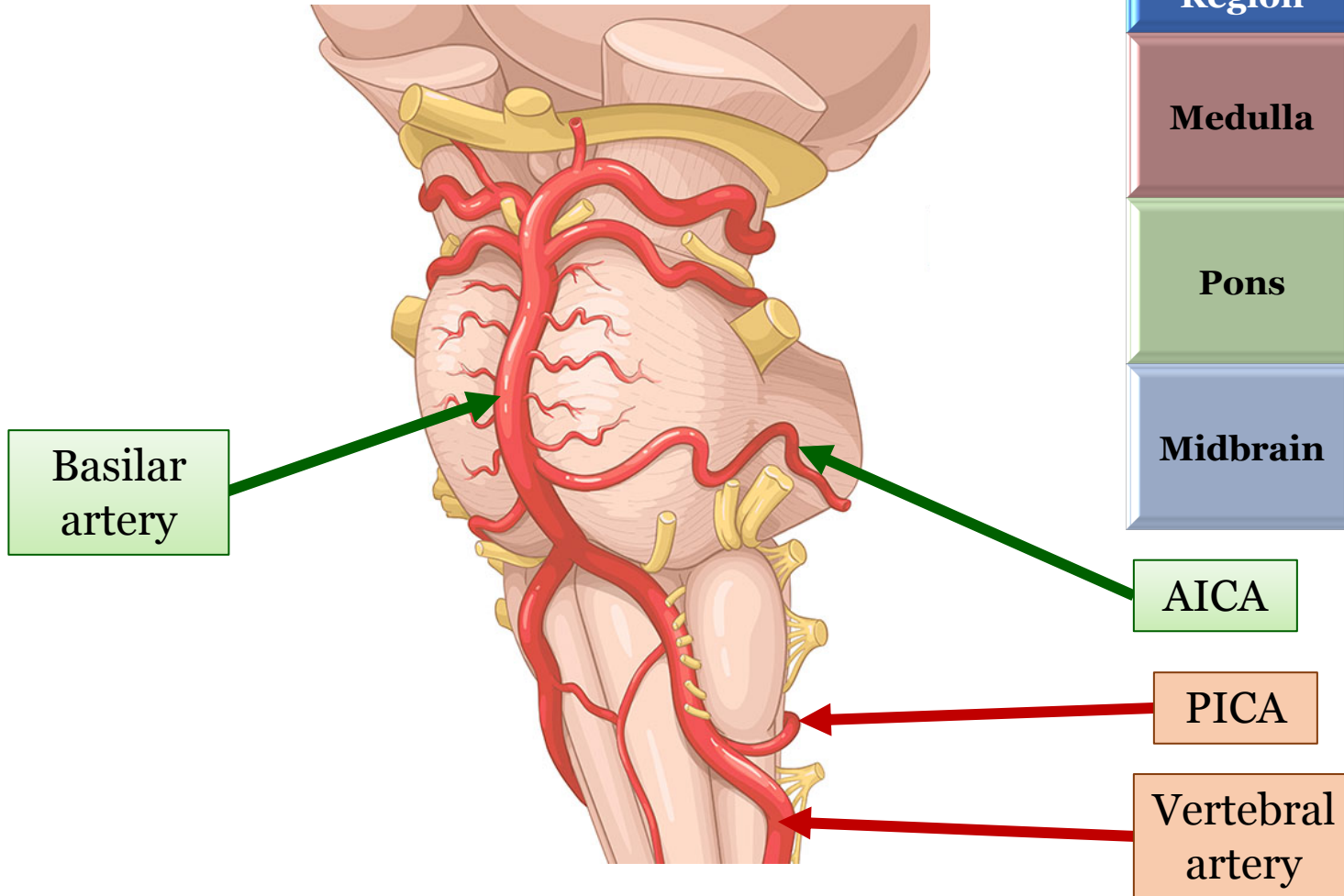
- CN III, IV, VI, XII
- Excludes CN I and II



# Review of Brainstem Blood Supply

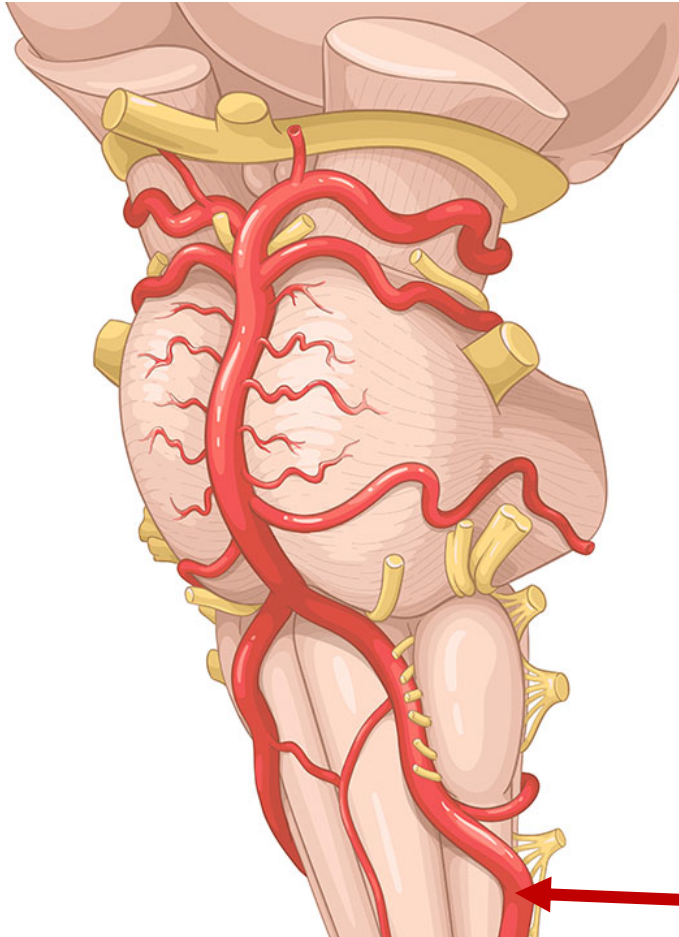


# Review of Brainstem Blood Supply



Brainstem Region	Medial/Lateral?	AICA	PICA	Vertebral	Basilar
Medulla	Medial				
	Lateral				
Pons	Medial				
	Lateral				
Midbrain	Medial				
	Lateral				

# Review of Brainstem Blood Supply



Basilar artery

Brainstem Region	Medial/Lateral?	AICA	PICA	Vertebral	Basilar
Medulla	Medial			✓	
	Lateral				
Pons	Medial				
	Lateral				
Midbrain	Medial				
	Lateral				

AICA

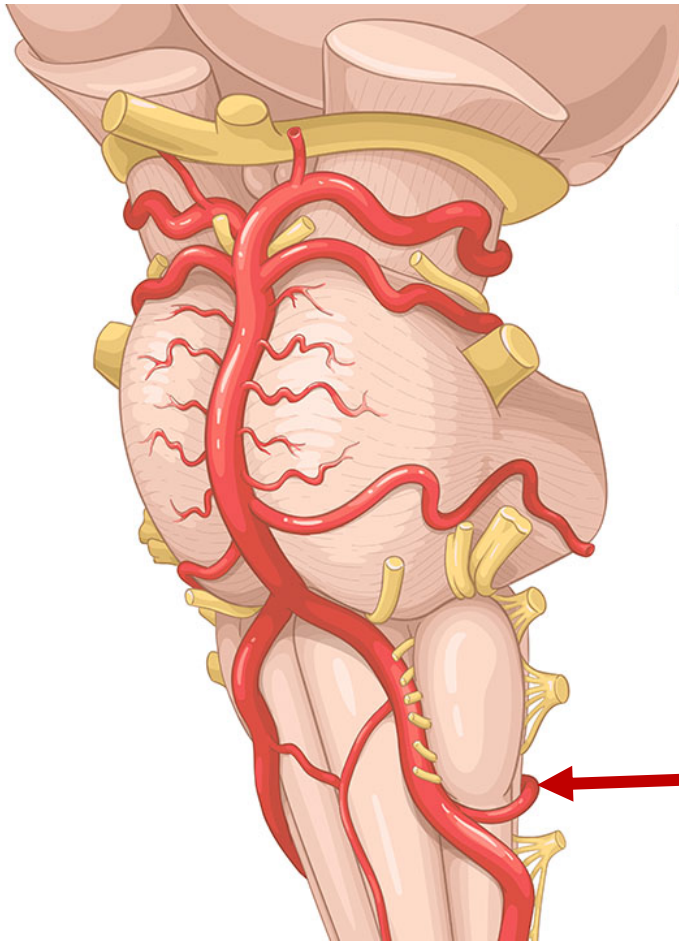
PICA

Vertebral artery

Medial

Medulla

# Review of Brainstem Blood Supply



Basilar artery

Brainstem Region	Medial/Lateral?	AICA	PICA	Vertebral	Basilar
Medulla	Medial				
	Lateral		✓		
Pons	Medial				
	Lateral				
Midbrain	Medial				
	Lateral				

AICA

PICA

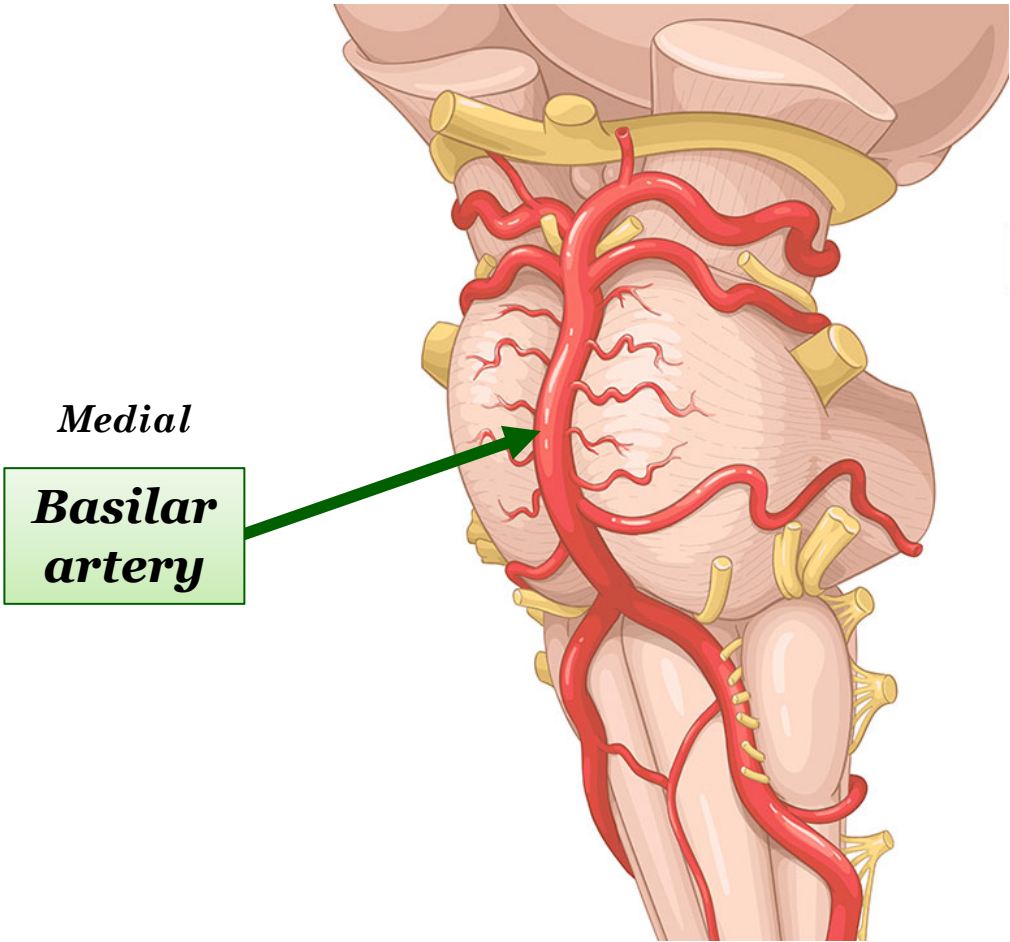
*Lateral*

Vertebral artery

*Medial*

} *Medulla*

# Review of Brainstem Blood Supply



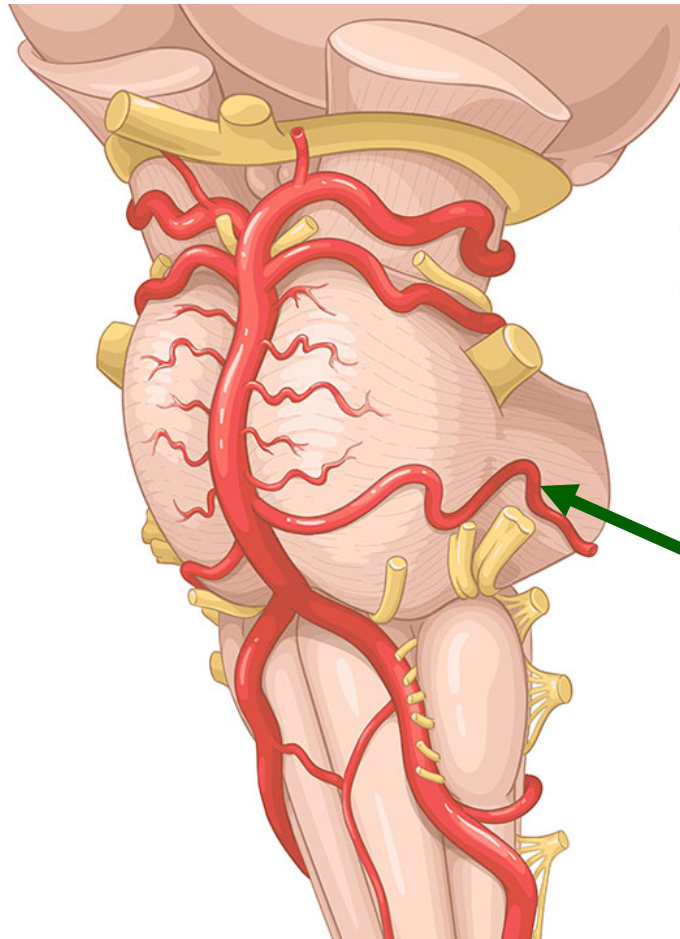
Brainstem Region	Medial/Lateral?	AICA	PICA	Vertebral	Basilar
Medulla	Medial				
	Lateral				
Pons	Medial				✓
	Lateral				
Midbrain	Medial				
	Lateral				

AICA

PICA

Vertebral artery

# Review of Brainstem Blood Supply



Basilar artery

Brainstem Region	Medial/Lateral?	AICA	PICA	Vertebral	Basilar
Medulla	Medial				
	Lateral				
Pons	Medial				
	Lateral	✓			
Midbrain	Medial				
	Lateral				

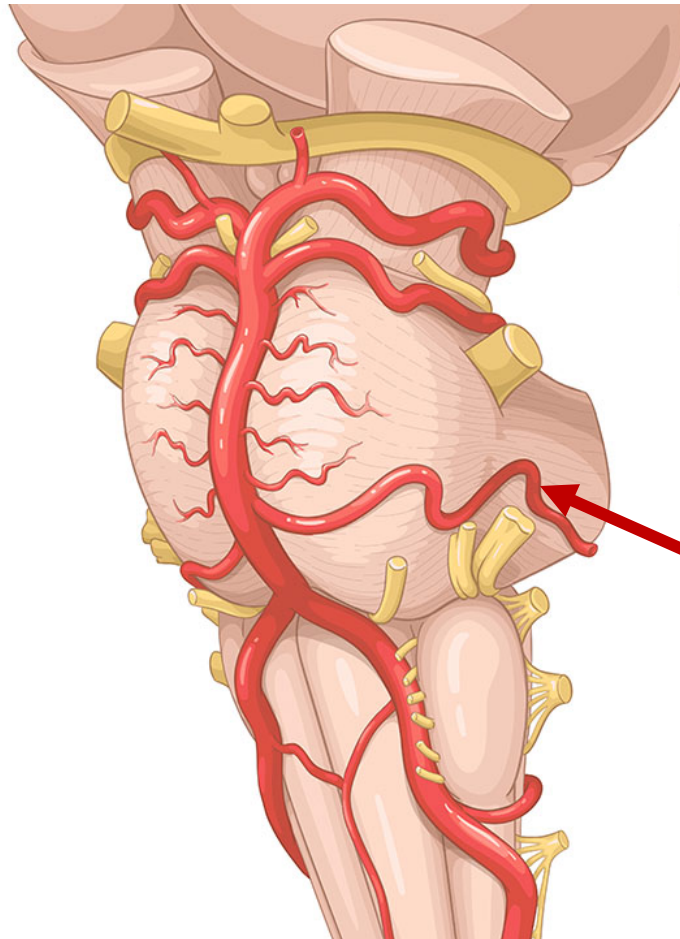
**AICA**

*Lateral (pons)*

PICA

Vertebral artery

# Horrible AICA/Pons Mnemonic



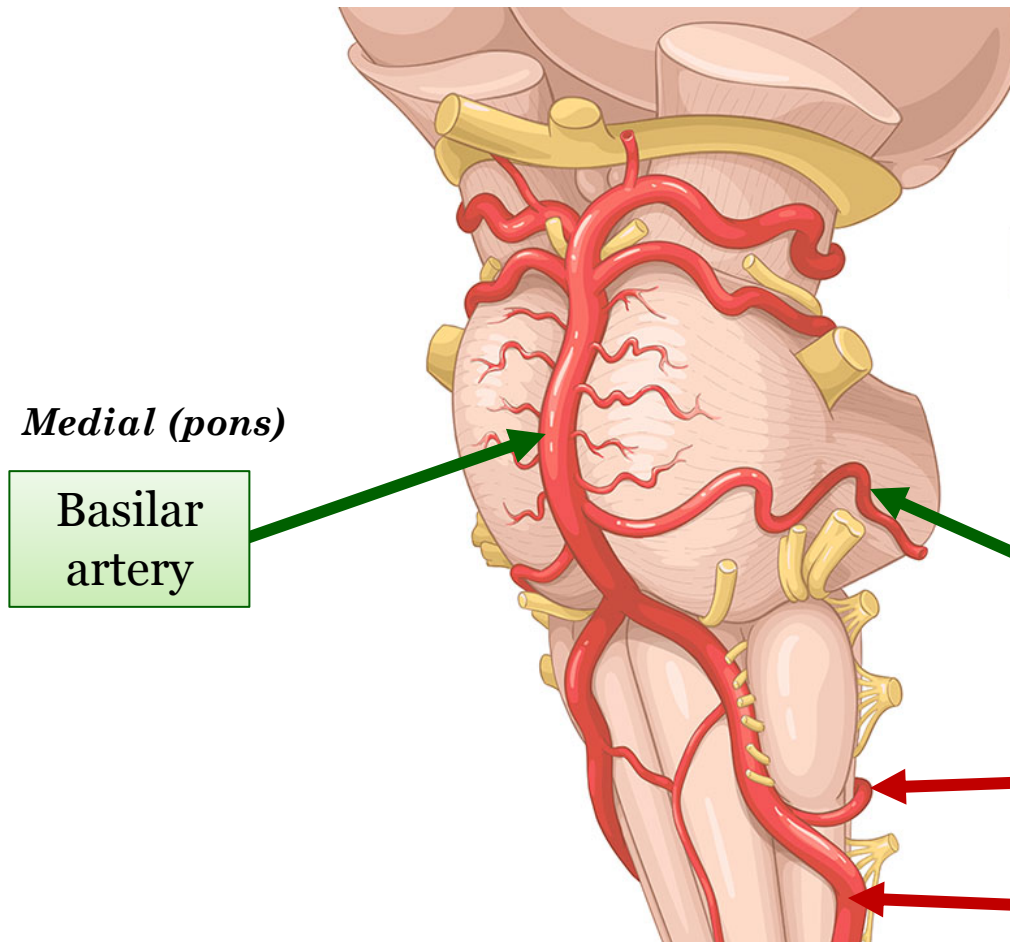
AICA



Big Fat Pons



# Back to Review of Brainstem Blood Supply

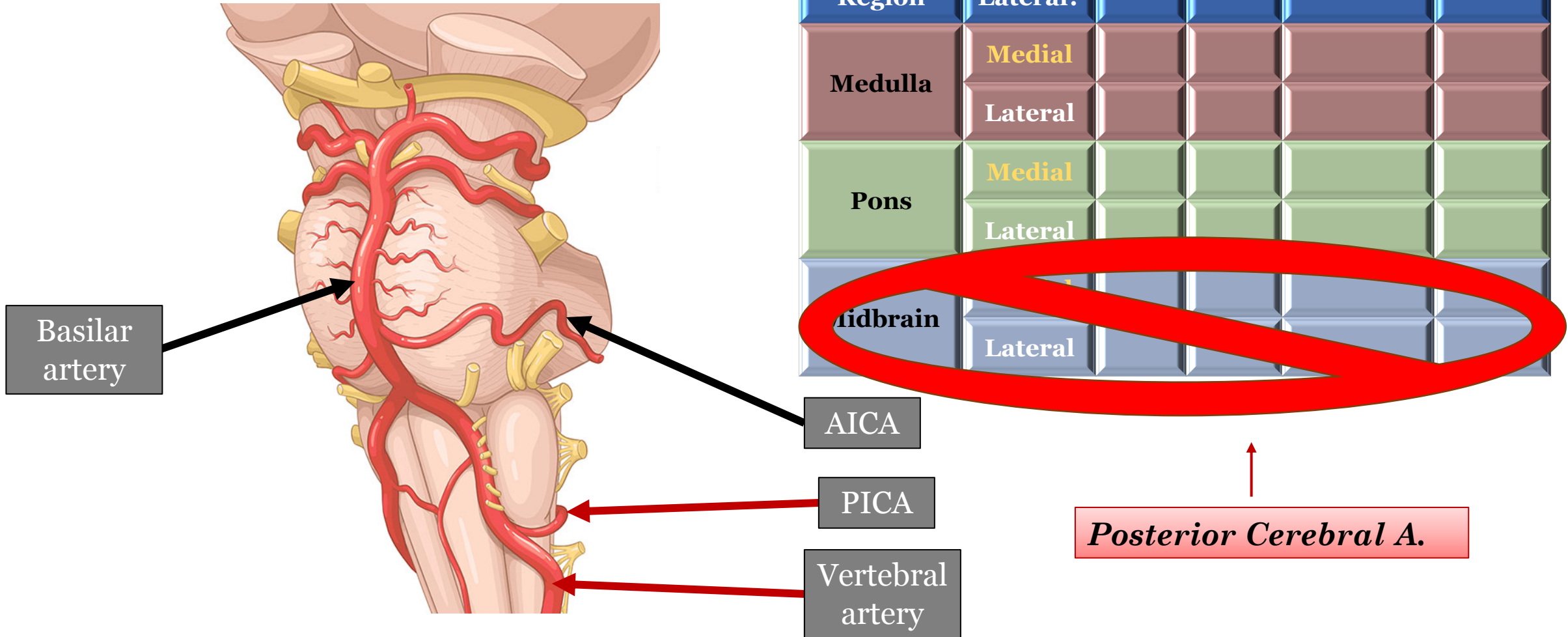


Brainstem Region	Medial/Lateral?	AICA	PICA	Vertebral	Basilar
Medulla	Medial				
	Lateral				
Pons	Medial				
	Lateral				
Midbrain	Medial				
	Lateral				

- AICA *Lateral (pons)*
- PICA *Lateral (medulla)*
- Vertebral artery *Medial (medulla)*



# Review of Brainstem Blood Supply



# Review of Brainstem Blood Supply

**Contralateral PCA infarction**

Homonymous Hemianopsia with Macular Sparing

left eye



right eye



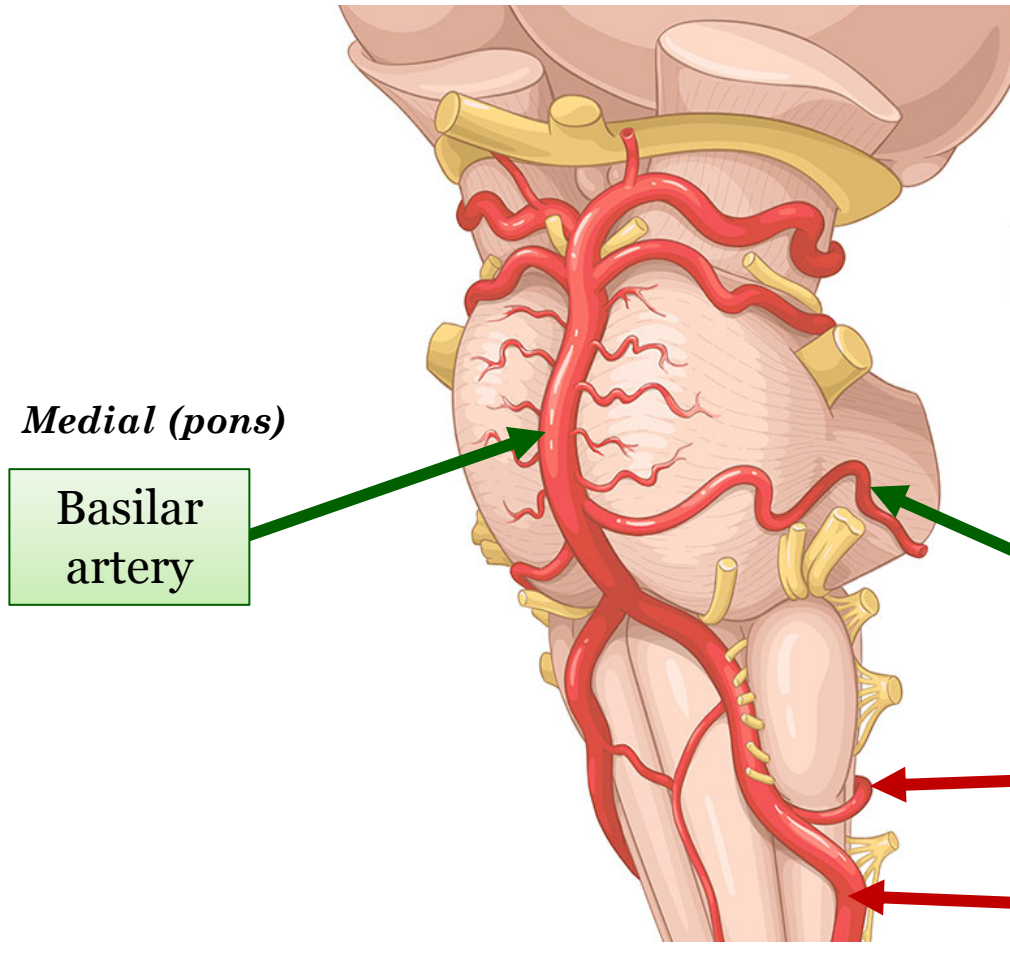
Brainstem Region	Medial/Lateral?	AICA	PICA	Vertebral	Basilar
Medulla	Medial				
	Lateral				
Pons	Medial				
	Lateral				
Midbrain	Medial				
	Lateral				



***Posterior Cerebral A.***

*Covered in Part 1*

# Review of Brainstem Blood Supply



Brainstem Region	Medial/Lateral?	AICA	PICA	Vertebral	Basilar
Medulla	Medial		✓		
	Lateral			✓	
Pons	Medial				✓
	Lateral	✓			

*Lateral (pons)*

*Lateral (medulla)*

*Medial (medulla)*

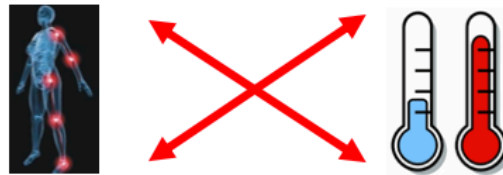
# AICA & PICA Strokes: *Lateral Brainstem*

## Rule of 4's

### 4 Rules

#### **2. Side (Lateral) Structures**

- 4 **S**ide (lateral) structures beginning with '**S**'
- **Sensory- Trigeminothalamic tract** (*Ipsilateral* pain/temp)
  - **Sensory- Spinothalamic tract** (*contralateral* pain/temp)
  - Spinocerebellar tracts (*Ipsilateral*)
  - Sympathetic (*Ipsilateral*)



# AICA & PICA Strokes: *Lateral Brainstem*

## Rule of 4's

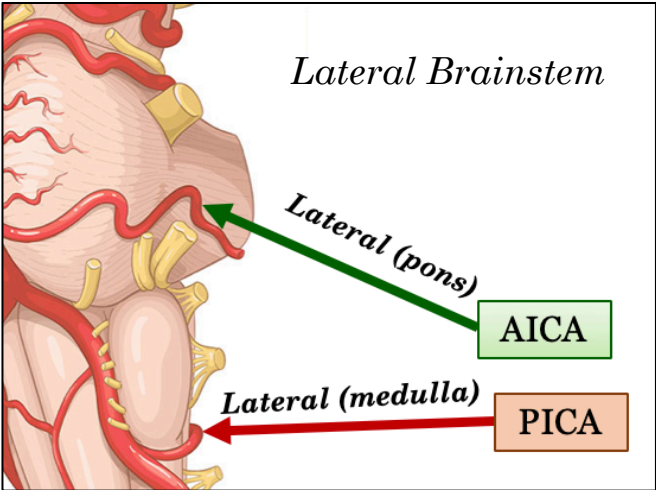
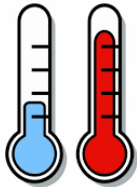
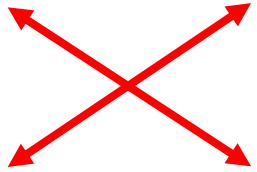
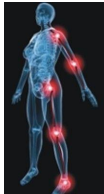
Sensory  
(Spinothalamic)

Sensory  
(Trigeminal)

Spinocerebellar

Sympathetic

AICA  
PICA  
Crossed Pain &  
Temp Loss



# AICA & PICA Strokes: *Lateral Brainstem*

## Rule of 4's

Sensory  
(Spinothalamic)

Sensory  
(Trigeminal)

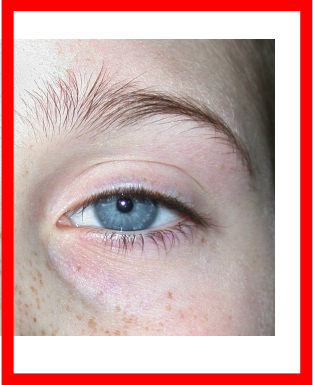
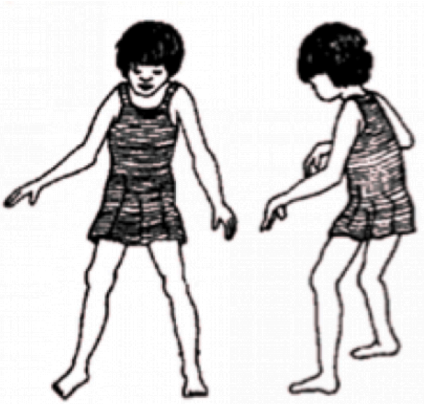
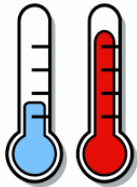
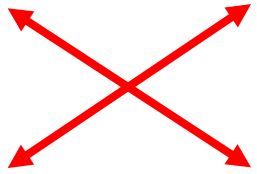
Spinocerebellar

Sympathetic

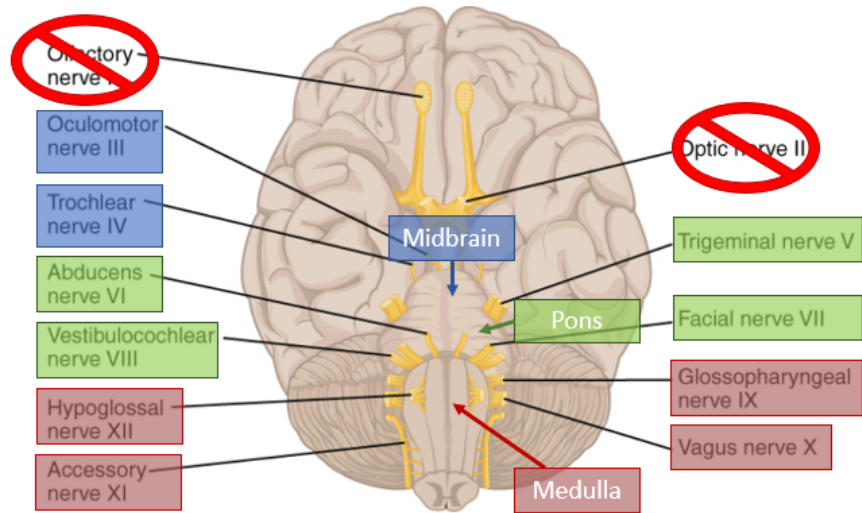
Crossed Pain &  
Temp Loss

Ataxia

Horner's Syndrome



# AICA vs PICA Stroke Findings



## Rule of 4's

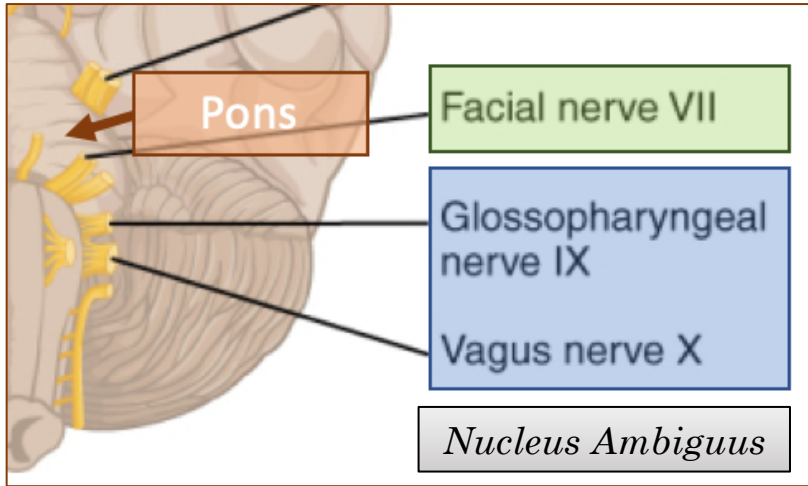
### 3. Geographical Locations

- **4 CNs in medulla (IX, X, XI, XII)**
- **4 CNs in Pons (V, VI, VII, VIII)**
- **4 CNs Above Pons (I, II, III, IV)**

**~~4. Four midline motor nuclei divide equally into 12~~**

**~~• CN III, IV, VI, XII~~**

# AICA vs PICA Stroke Findings



## Rule of 4's

### 3. Geographical Locations

- **4 CNs in medulla (IX, X, XI, XII)**
- **4 CNs in Pons (V, VI, VII, VIII)**
- **4 CNs Above Pons (I, II, III, IV)**

Lateral Pons

**Facial Nerve**

Lateral Medulla

**Glossopharyngeal Nerve  
Vagus Nerve**



# AICA vs PICA Stroke Findings

Lateral Pontine syndrome

Facial Nerve

**Complete Facial Droop**

*Upper*

+

*Lower*



Lateral Medullary Syndrome (Wallenberg Syndrome)

Glossopharyngeal Nerve  
Vagus Nerve

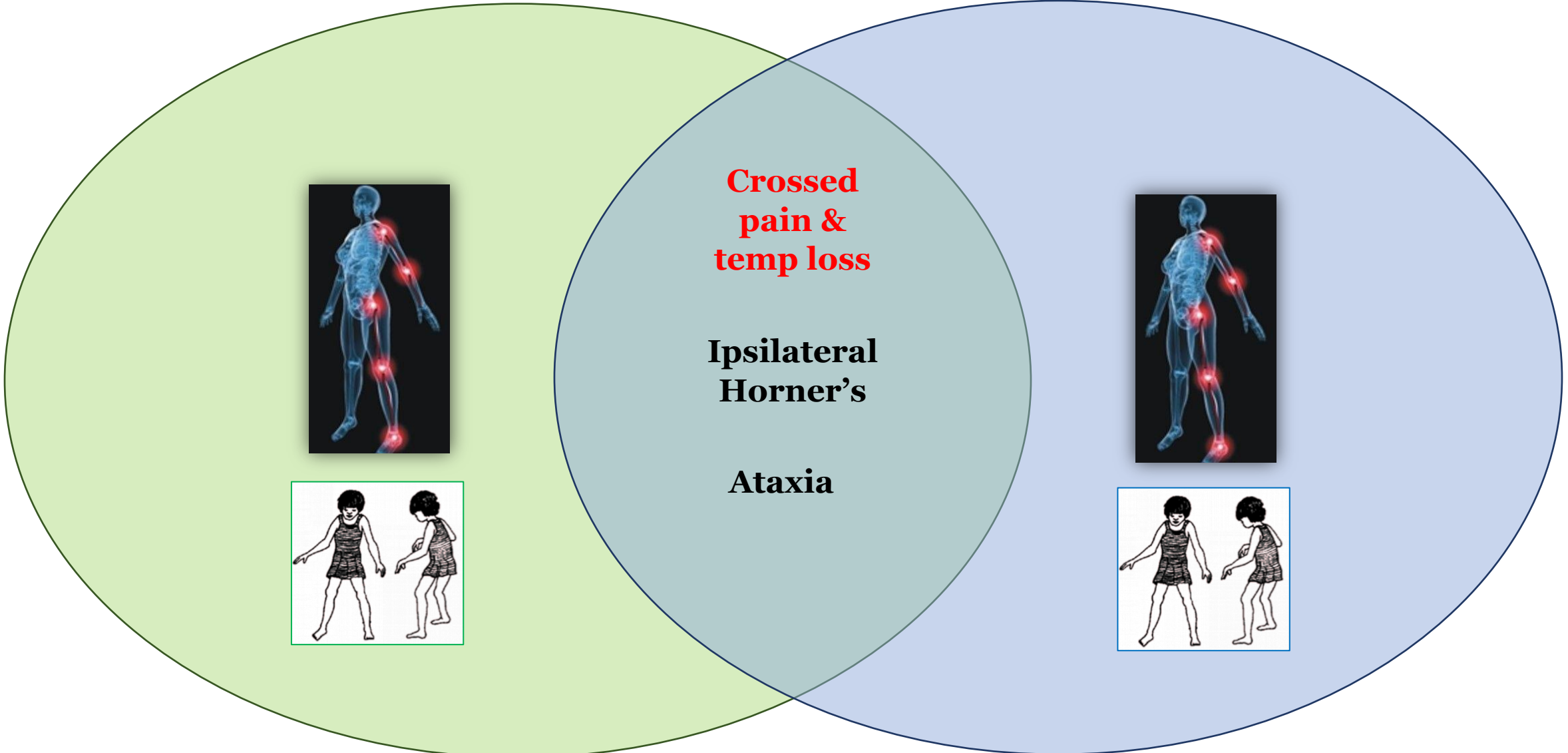
**Can't Eat**



*Unilateral Loss of Motor Control*

**AICA Stroke**  
Lateral Pontine syndrome

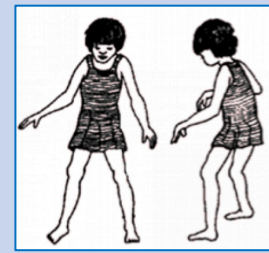
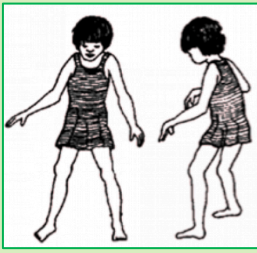
**PICA Stroke**  
Lateral Medullary Syndrome  
(Wallenberg Syndrome)



**Crossed  
pain &  
temp loss**

**Ipsilateral  
Horner's**

**Ataxia**



**AICA Stroke**  
Lateral Pontine Syndrome

**PICA Stroke**  
Lateral Medullary Syndrome  
(Wallenberg Syndrome)

**Complete Facial Droop**



**Crossed pain & temp loss**

**Ipsilateral Horner's**

**Ataxia**

**Can't Eat**

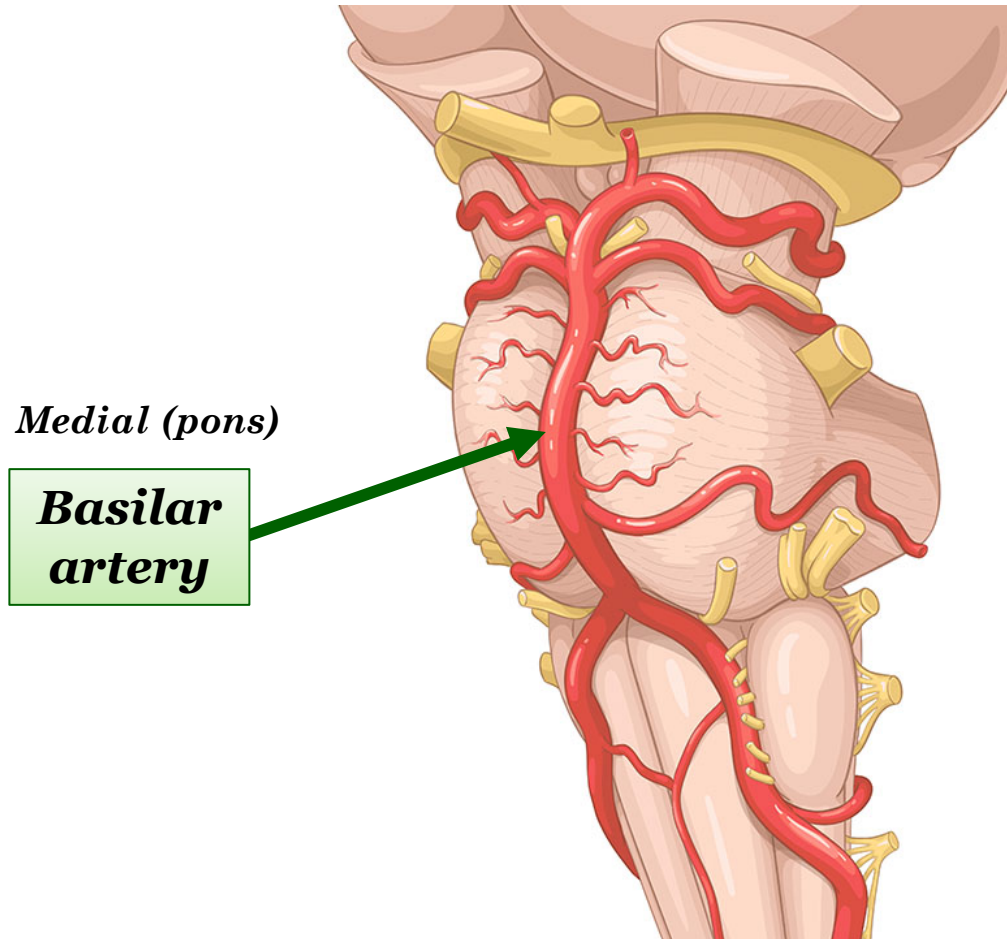


**Hoarseness**



**↓ Gag**

# Basilar Artery Stroke



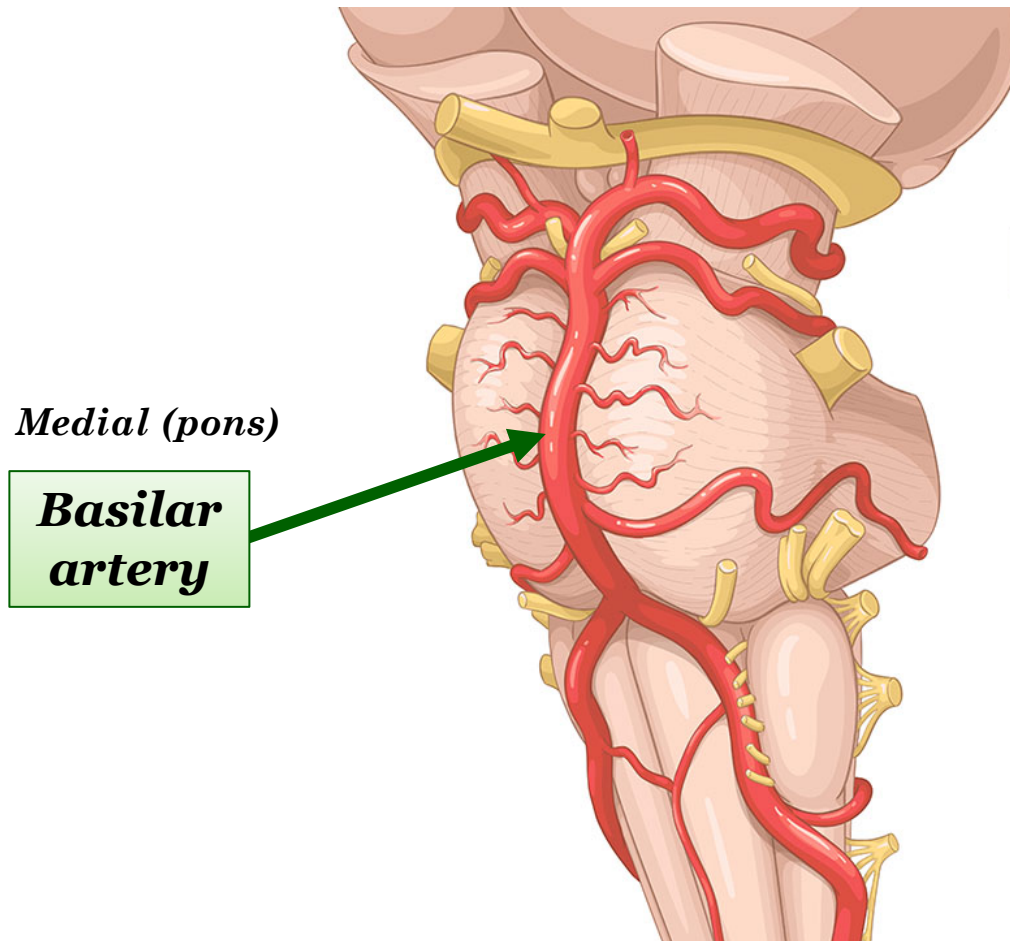
## 4 Rules

### 1. Midline (Medial) Structures

4 Midline structures beginning with 'M'

- MLF (Medial Longitudinal Fasciculus)
- Motor- Corticospinal tracts (**contralateral** motor control)
- Motor- **Ipsilateral** Cranial Nerves (3, 4, 6, 12)
- Medial Lemniscus (Vibration/proprioception in **contralateral** leg)

# Basilar Artery Stroke



**LOCKED-IN SYNDROME**

**Can't move**

**Can't talk**

**Can only blink**





# Locked-In Syndrome

Central Pontine Myelinolysis  
*(Osmotic Demyelination Syndrome)*

Basilar Artery Stroke

**LOCKED-IN  
SYNDROME**

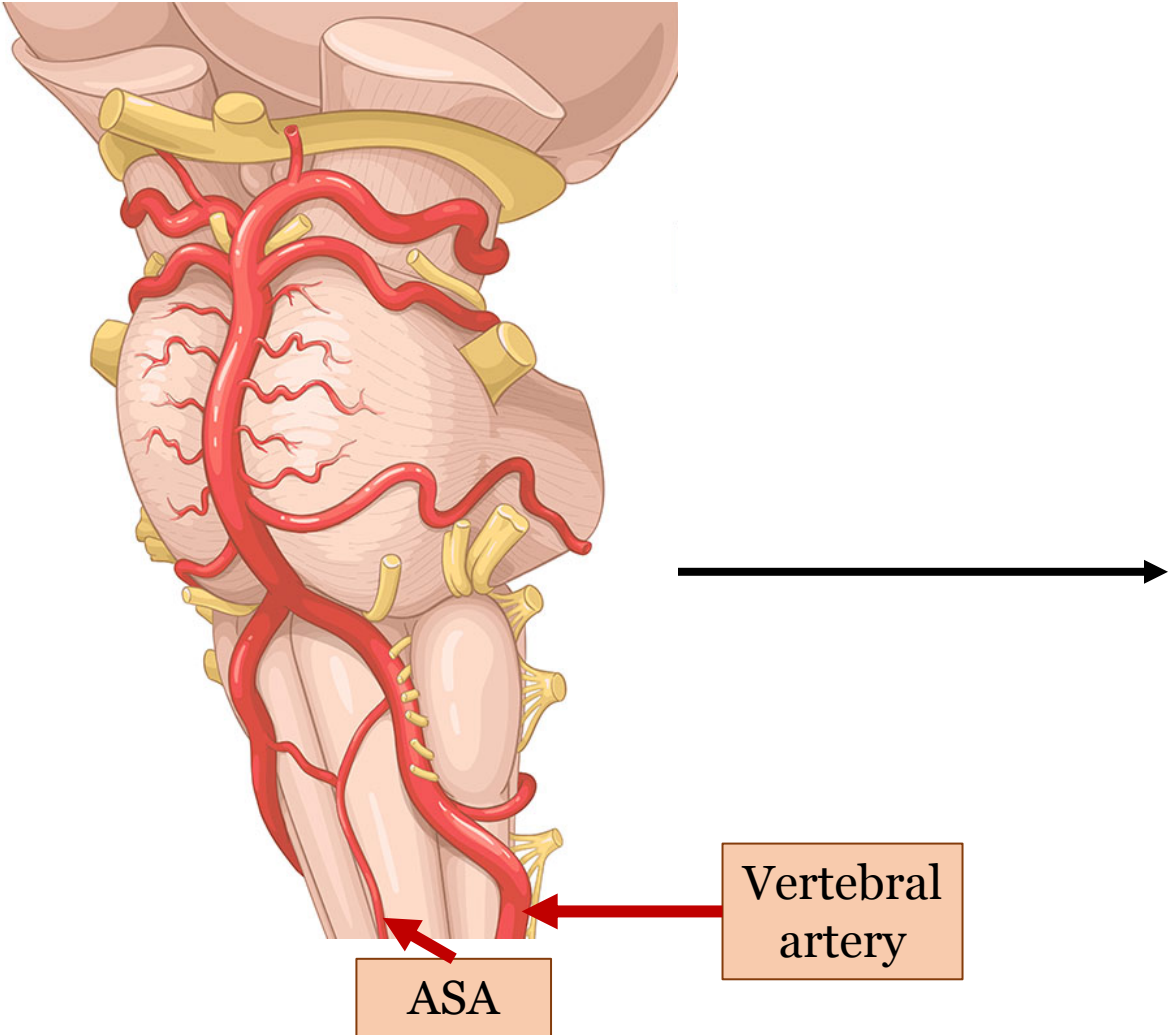
**Can't move**

**Can't talk**

**Can only blink**



# Honorable Mention: *Medial Medullary Syndrome*



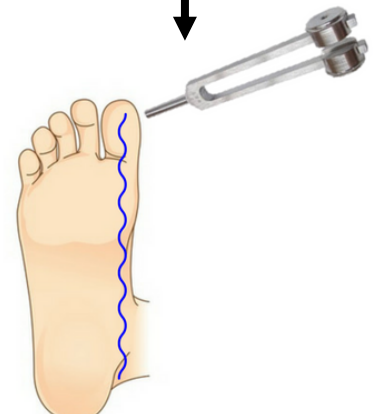
*Hypoglossal Nerve Palsy*



*Ipsilateral Tongue Deviation*

# *Anterior* Cord Syndrome

Spinal Cord

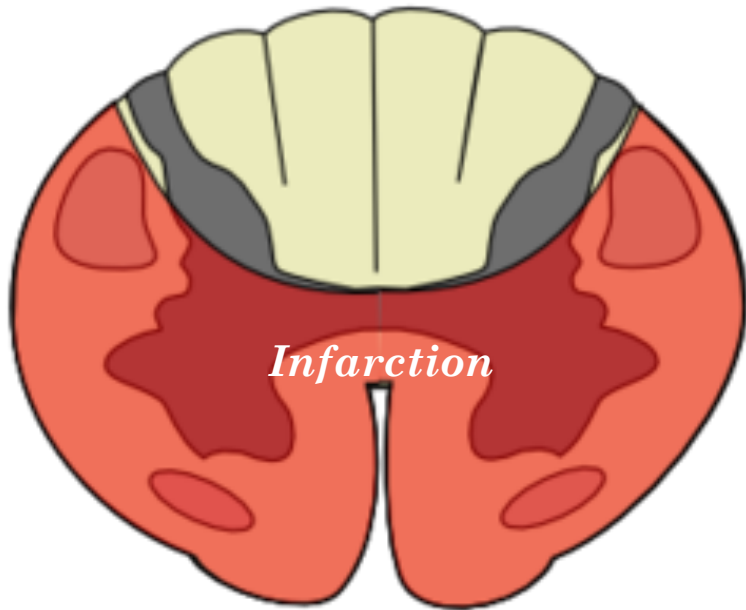


Only vibration  
spared in legs



# *Anterior* Cord Syndrome

*Posterior Columns*



*Infarction*

Anterior Cord Syndrome

*artery of Adamkiewicz.*

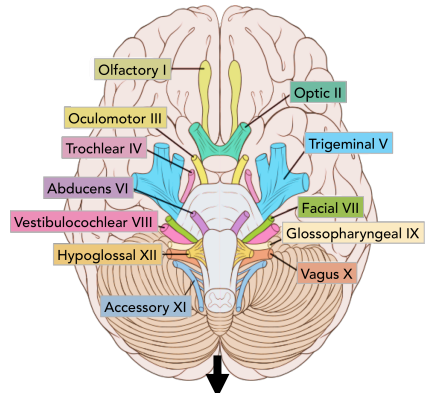


*Only vibration spared in legs*

# Roadmap

*(Strokes for the Boards)*

Brainstem

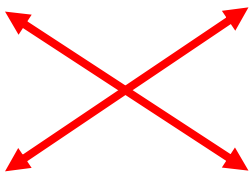
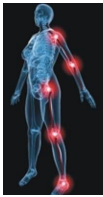
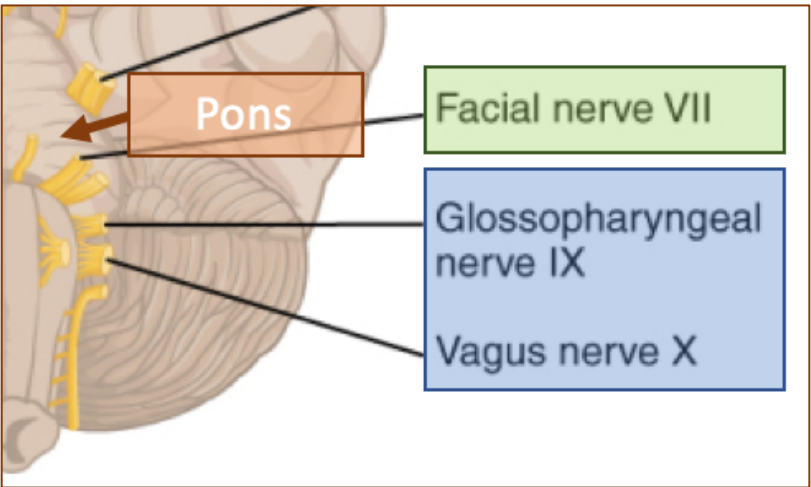


AICA

+

PICA

Basilar



Crossed Pain + Temp Loss

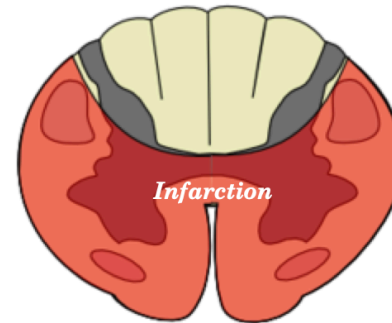


Locked-In

# Roadmap

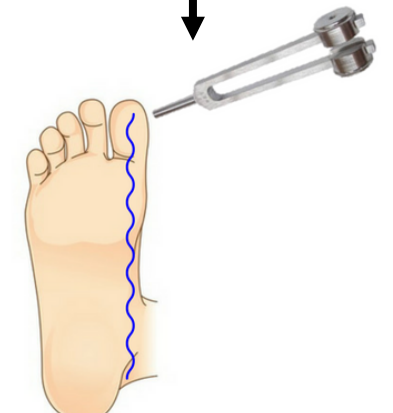
*(Strokes for the Boards)*

Spinal Cord

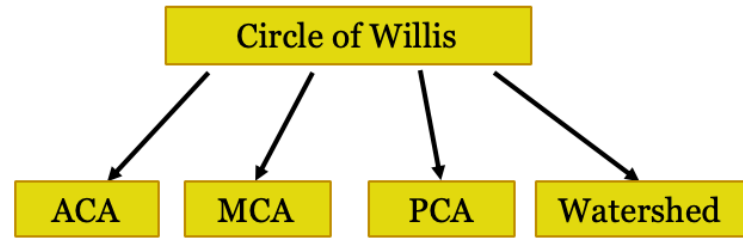


Anterior Cord Syndrome

Posterior Columns  
***Unaffected***

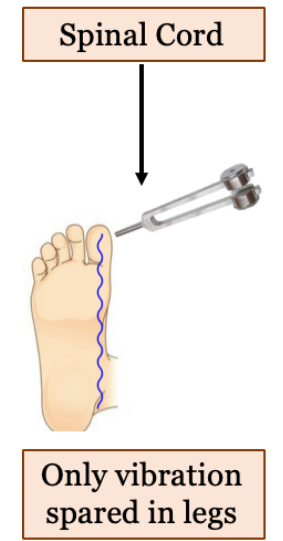
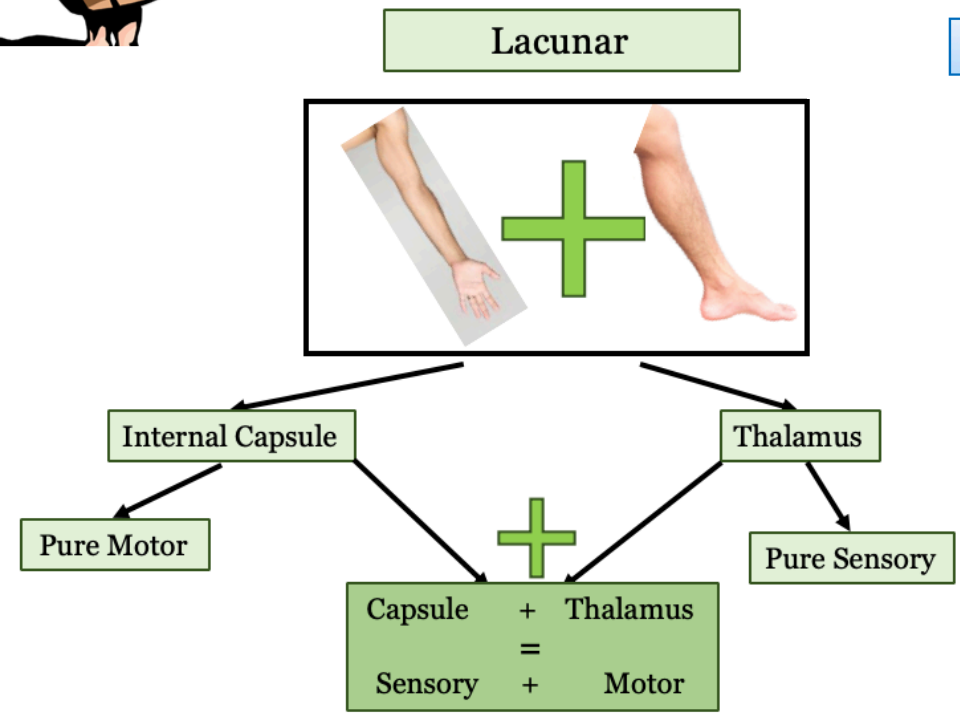
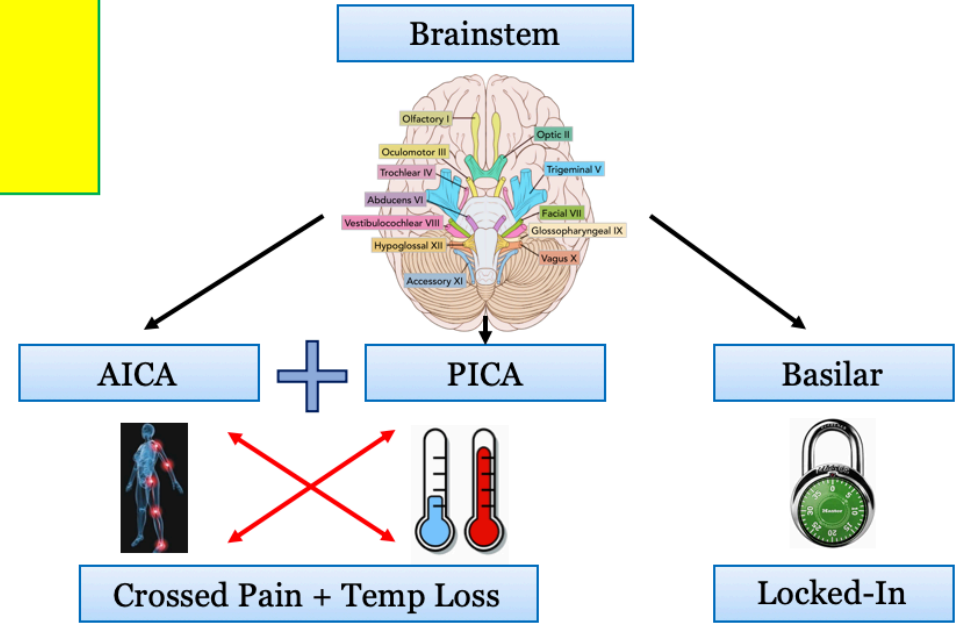


Only ***vibration***  
spared in legs



# Roadmap

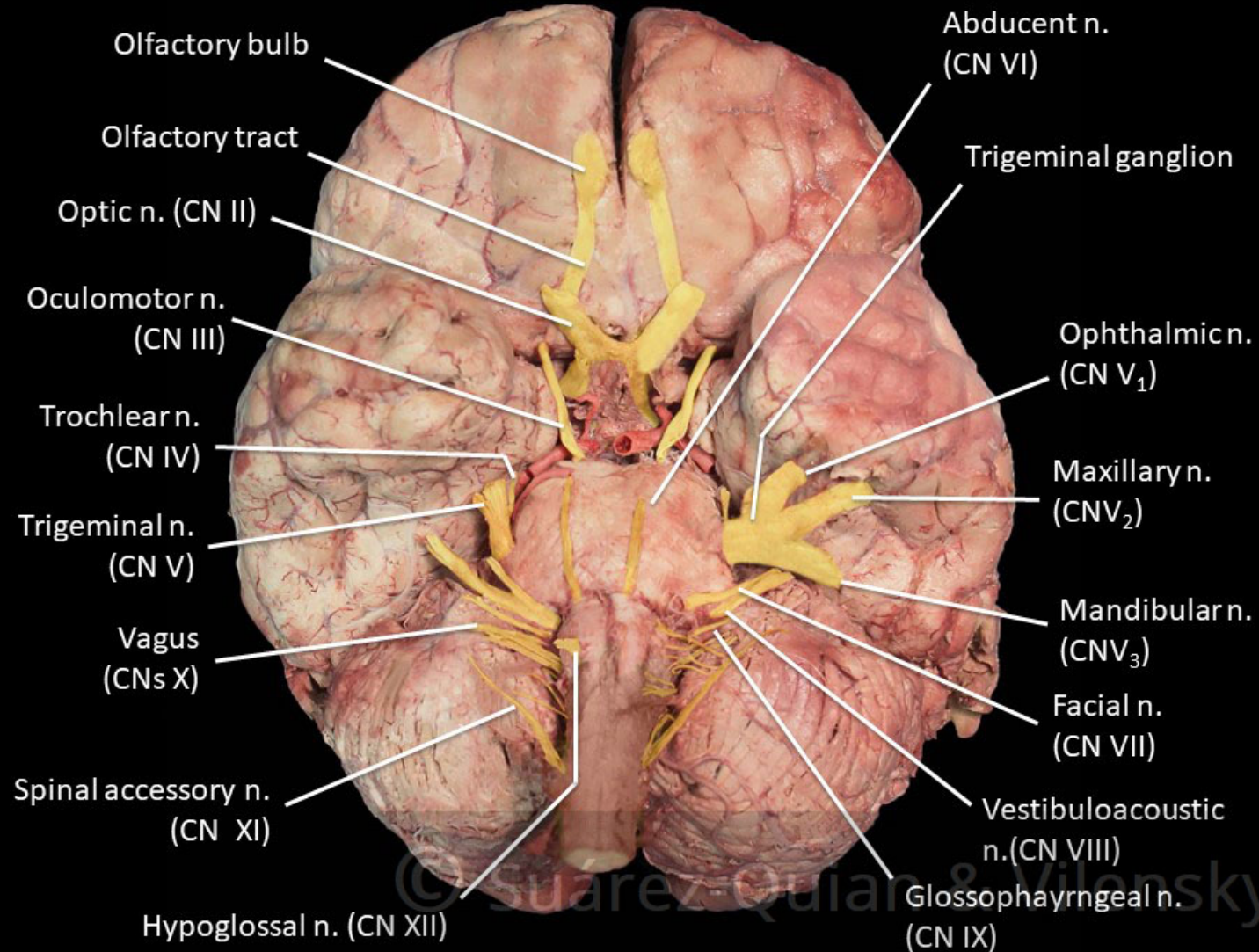
(Strokes for the Boards)



NBME

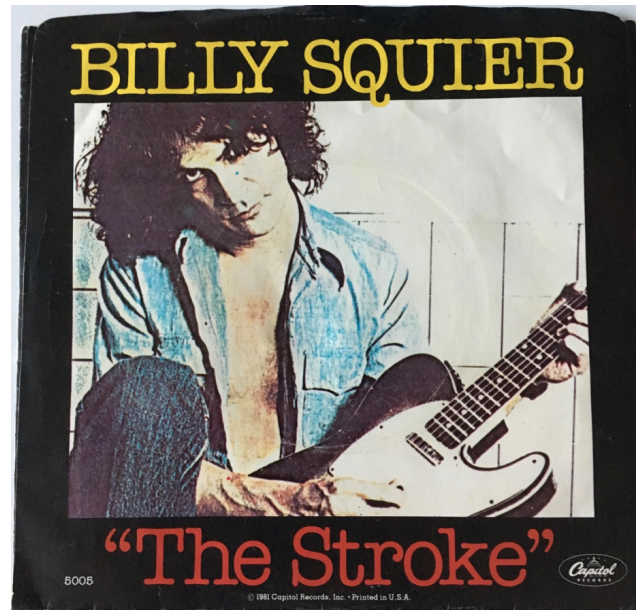


This Picture!!



# Stroke Localization (Part 3)

*for USMLE Step One*



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UMass Class of 2021

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