

Lesions and blood supply of brainstem

Rule of 4s

There are 4 cranial nerves in:

- above the pons (1,2,3 & 4)
 - o Only 3 and 4 are in the midbrain
- the pons (5,6,7 & 8)
- the medulla (9,10, 11 & 12)

There are 4 cranial nerves that can divide into 12:

- 3, 4, 6 & 12
- These are all motor and all are in the midline

Other cranial nerves don't divide into 12 (5, 7,8,9,10,11) are located laterally

There are 4 midline columns: all start with "M"

- Motor pathway (Corticospinal tract)
- Medial longitudinal fasciculus
- Medial lemniscus
- Motor nuclei (3,4, 6 & 12)

There are 4 lateral columns: all start with "S"

- Spinothalamic
- Spinocerebellar
- Spinal trigeminal nucleus
- Sympathetic pathway (hypothalamospinal)

Don't forget lateral nuclei (5,7,8,9,10,11)

Rules to remember:

Recall that nuclei of the brainstem (motor or sensory) are almost always ipsilateral.

Damage:

- Spinothalamic => contralateral loss of pain and temperature
- Spinal trigeminal nucleus => **ipsilateral** loss of pain and temperature of the **face**
- Motor pathway => contralateral paralysis
- Spinocerebellar => ataxia
- Medial lemniscus => contralateral loss of proprioception & vibration
- Sympathetic pathway => Horner syndrome (constriction of the pupil)

It's also helpful to know damage to each cranial nerve, but doctor mentioned not memorize them. I am going to state them just in case:

- CN III (oculomotor) => Dilation of the pupil (loss of parasympathetic) & external strabismus (eyes looking down & out)
- CN VI => external strabismus (eyes looking towards nose)
- CN VII => paralysis of facial muscles
- CN VIII => hearing loss & loss of balance
- CN IX => Dysphagia
- CN X => Hoarseness
- CN XI => Shoulder droop
- CN XII => tongue deviation.

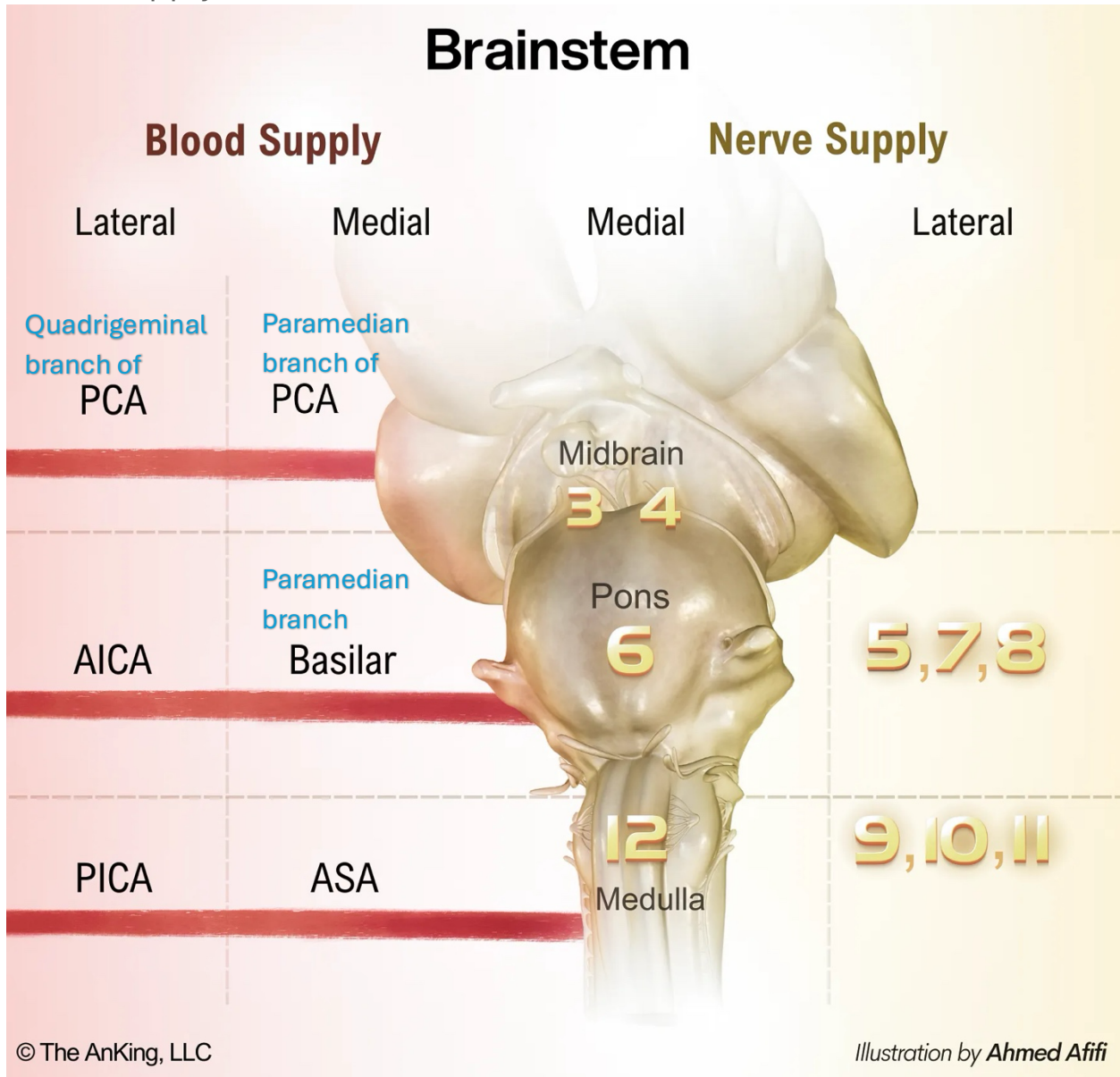
Memorize each syndrome:

- Damage to lateral medulla => Wallenberg syndrome
- Damage to medial medulla => Dejerine syndrome

- Damage to medial pons => Either: Foville, Millard-Gublar or midpontine base. *You can go to the slides and memorize the differences between these.*
- Damage to lateral pons (not mentioned)

- Damage to medial midbrain => Weber
- Claude syndrome is also medial but for the sake of some symptoms let's consider it lateral
- Damage to both medial and lateral midbrain is benedikt (has both medial and lateral symptoms)

Blood Supply:



Vertebral arteries => PICA & ASA that supply medulla
Vertebral arteries combine to become basilar

Basilar => Paramedian & AICA that supply pons.
Basilar artery terminates as Posterior cerebral artery (PCA)

PCA => paramedian & Quadrigeminal that supply midbrain

PICA (posterior) supplies medulla. AICA (anterior) supplies pons.

Keep in mind: AICA is a branch of the basilar. PICA is not a branch of basilar. This question was in past-papers

Let's use the rules in past paper questions:

211. A 60 years old man with a history of hypertension and smoking brought to neurology clinic. The neurologic examination reveals hemiparesis and loss of proprioception and vibratory sense on the right side of the body and a deviation of the tongue to the left side when it is protruded; This patient is likely suffering from:

- A) Benedikt Syndrome
- B) Medial medullary syndrome
- C) Millard-Gubler syndrome
- D) Lateral medullary syndrome
- E) Claude syndrome

=> loss of proprioception & vibratory of right side of the body => **Medial** lemniscus=> this lesion is medial.

=> Deviation of the tongue => CN 12 => Medulla

Damage to medial medulla so B is the correct answer.

212. All of the following are symptoms of Wallenberg syndrome EXCEPT?

- A) Contralateral loss of pain and temperature sensation from the body
- B) Ipsilateral loss of pain and temperature sensation from the face
- C) Vertigo and nystagmus
- D) Hoarseness and dysphagia
- E) Loss of taste from the contralateral half of the tongue

Recall: Nuclei damage is ipsilateral. Therefore, loss of taste should also be ipsilateral.

Correct answer is E

But for the sake of it lets continue with our method:

Wallenberg is damage to lateral medulla:

Lateral = "S"

- Spinothalamic => Contra lateral loss of pain and temperature from the body
- Spinal trigeminal nucleus => **Ipsilateral** loss of pain and temperature from the face
- Spinocerebellar => **Ipsilateral** ataxia
- Sympathetic Pathway => Horner syndrome

Don't forget the non-medial cranial nerves that don't divide into 12 (5,7,8,9,10,11). Since we are at medulla we will only see symptoms of 9, 10, 11 => dysphagia, hoarseness & shoulder droop.

Extra: Option C shows nystagmus. Recall that in the medulla, vestibular nucleus is also found laterally. Damage to vestibular nucleus will lead to nystagmus (eye complication).

213. Anterior inferior cerebellar artery is branch from:

- A) Basilar artery
- B) Anterior spinal artery
- C) Posterior cerebral artery
- D) Vertebral artery
- E) Posterior spinal artery

Recall: AICA (anterior) supplies pons and is a branch of basilar. A is correct.

214. The union of the two vertebral arteries forms:

- A) Posterior spinal artery
- B) Basilar artery
- C) Anterior spinal artery
- D) Vertebral artery
- E) Posterior cerebral artery

Recall: Vertebral arteries give ASA & PICA of the medulla. The two vertebral arteries join to become basilar.

215. All of the following are branches of basilar artery EXCEPT:

- A) Labyrinthine artery
- B) Posterior inferior cerebellar artery
- C) Anterior inferior cerebellar artery
- D) Pontine arteries
- E) Superior cerebellar artery

Recall: AICA (anterior) supplies pons and is a branch of basilar artery. PICA (posterior) supplies medulla and is branch of vertebral arteries.

216. Brain lesion causes loss of pain and temperature in left side of the body and right side of face with hoarseness, name the region of the lesion:

- A) Medial medullary lesion
- B) lateral medullary lesion
- C) Millard Gubler
- D) Benedikt syndrome
- E) Weber syndrome

- ⇒ Loss of pain and temperature in the left side of body => Spinothalamic
- ⇒ **S**pinothalamic starts with "S" => lateral
- ⇒ Hoarseness => vagus nerve => medulla

Answer is B: Lateral medullary lesion

218. Regarding Foville syndrome, Choose the wrong statement:

- A) It causes Ipsilateral dilatation of pupil
- B) It causes contralateral hemiparesis
- C) It occurs due to occlusion of the paramedial branches of basilar artery
- D) It causes variable contralateral sensory loss
- E) It causes ipsilateral abducens nerve paralysis

- ⇒ Foville => Medial pons
- ⇒ **M**edial = "M"

- ⇒ Motor pathway (corticospinal) => contralateral paralysis
- ⇒ Medial lemniscus => contralateral loss of proprioception and vibration
- ⇒ Medial longitudinal fasciculus => Loss of coordination between eyes
- ⇒ Motor nuclei (3,4,6,12). Since we are in pons => CN VI => Internal strabismus (inward gaze)

All options are true except A.

Notice no damage to CN III => no dilation of pupil

221. Occlusion of Anterior spinal artery may cause:

- A) Foville syndrome
- B) Benedikt syndrome
- C) Millard-Gubler syndrome
- D) Wallenberg syndrome
- E) Dejerine syndrome

Recall: ASA (anterior spinal artery) is a branch of vertebral and supplies medial medulla
Damage to Medial medulla = Dejerine syndrome

222. All of the following are symptoms of the Syndrome of the midpontine base EXCEPT:

- A) Ataxia
- B) Ipsilateral paralysis of the masticatory muscles
- C) Ipsilateral loss of pain and thermal sense
- D) Contralateral dilatation of pupil
- E) Contralateral hemiparesis

Midpontine => medial pons

- ⇒ Motor pathway => contralateral paralysis
- ⇒ Medial lemniscus => contralateral loss of proprioception and vibration
- ⇒ Medial longitudinal fasciculus => loss of coordination between eyes
- ⇒ Motor nuclei (3,4, 6 & 12). Since we are in pons. CN 6 (abducens) => internal strabismus (eyes looking towards nose)

Notice no damage to dilation of pupil (CN III)

223. A 65 years old man with a history of hypertension and smoking brought to neurology clinic. The neurologic examination reveals loss of pain and temperature sensation from the right side of the body, loss of pain and temperature sensation from the left side of the face, loss of taste from the left half of the tongue and hoarseness, which of the following arteries is likely affected in this patient?

- A) Posterior inferior cerebellar artery
- B) Anterior inferior cerebellar artery
- C) Anterior cerebral artery
- D) Middle cerebral artery
- E) Anterior spinal artery

ANSWER . A

- ⇒ Pain and temperature from the right side of the body = left spinothalamic => “S” = lateral
- ⇒ Pain and temperature from the left side of the face = left spinal trigeminal nucleus => “S” = lateral
- ⇒ Hoarseness = Vagus nerve damage = Medulla

Damage to lateral medulla.

Recall lateral medulla is supplied by PICA (posterior). And there's our answer

226. The medial medullary syndrome includes:

- A) Contralateral hemiplegia
- B) Ipsilateral paralysis of the tongue
- C) Contralateral loss of the deep sensations .
- D) All of the above
- E) None of the above

Medial Medulla

- ⇒ Motor pathway (corticospinal) => contralateral paralysis
- ⇒ Medial lemniscus => contralateral loss of proprioception and vibration
- ⇒ Medial longitudinal fasciculus => Loss of coordination between eyes
- ⇒ Motor nuclei (3,4,6,12). Since we are in the medulla => 12 => deviation of the tongue.

Keep in mind: Deep sensations = proprioception

Recall: Brainstem nuclei (motor, sensory) almost always are ipsilateral => ipsilateral paralysis of the tongue.

A, B & C all are correct. Therefore, answer is D.

227. The medial medullary syndrome is caused by damage of the:

- A) corticospinal, corticobulbar and corticopontine fibers.
- B) corticospinal tract and oculomotor nerve.
- C) corticospinal tract, medial lemniscus and hypoglossal nerve.
- D) corticospinal tract and abducens nerve.
- E) crus cerebri and oculomotor nerve.

Medial Medulla

- ⇒ Motor pathway (corticospinal) => contralateral paralysis
- ⇒ Medial lemniscus => contralateral loss of proprioception and vibration
- ⇒ Medial longitudinal fasciculus => Loss of coordination between eyes

⇒ Motor nuclei (3,4,6,12). Since we are in the medulla =>CN 12 => deviation of the tongue.

C matches. It's the answer

228. Paralysis of the right upper and lower limbs with paralysis of the left lateral rectus muscle suggest lesion in the:

- A) right medulla.
- B) left medulla.
- C) right pons.
- D) left pons.
- E) right crus cerebri

Recall: Lateral rectus is supplied by CN VI. CN 5,6,7,8 are all in the pons.

Recall: Brainstem nuclei are almost always ipsilateral. Left lateral rectus is supplied by left abducens.

Therefore, Damage is in the left abducens (left pons). D is our answer

229. An MRI of vessels. Showed occlusion of vessels the medial portion of the midbrain Right side involving oculomotor nerve and cross cerebra this patient is mostly like not suffering of which of the following:

- A) deviation the tung to the left side when is protruded
- B) paralysis of extremities on the left side.
- C) loss of pain and thermal Sensation on the Right Thermal side of the face.
- D) dilatation of the pupil:
- E) Weakness of lower facial muscle

Medial Midbrain

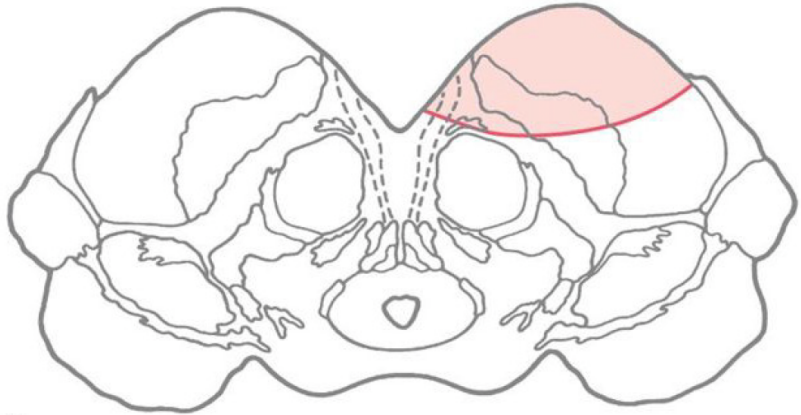
- ⇒ Motor pathway (corticospinal) => Contralateral paralysis
- ⇒ Medial lemniscus => Contralateral loss of proprioception and vibration
- ⇒ Medial longitudinal fasciculus => Loss of coordination between eyes
- ⇒ Motor nuclei (3,4,6,12). Since we are in midbrain, 3 & 4 are damaged (ignore 4).
Damage to CN 3 => dilation of pupil & external strabismus (eyes looking outward)

Notice no damage to sensations from the face. So, our answer is C.

New: Notice E mentions weakness of lower facial muscle. This is true because recall that all nuclei of the face are supplied by both sides of the cortex. An upper damage to one of these nerves will not result in any complication. **Only lower** facial muscles (CN VII) & “protrusion” muscles of the tongue (CN 12) receive one nerve from the cortex and it’s **contralateral**. This nerve can be damaged in the midbrain resulting in **contralateral** paralysis in the muscles they supply.

This explains the lowermost two complications in weber syndrome (midbrain) in the following picture.

Weber syndrome



- Due to: Occlusion of vessels serving the medial portions of the midbrain involving the oculomotor nerve and the crus cerebri.
- Ipsilateral paralysis of all extraocular muscles except the lateral rectus and superior oblique
- Paralysis of the contralateral extremities
- Ipsilateral dilatation of pupil
- Contralateral weakness of the facial muscles of the lower half of the face
- Contralateral deviation of the tongue when it is protruded

hallmark of brainstem vascular lesions, **ipsilateral cranial nerve sign coupled with a contralateral long tract sign**

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Again, there are few caveats to the rules shown above. Therefore, if you want to answer all questions correctly, you should study the actual material. Otherwise, as I have shown you, the rules give you the correct answer most of the time. Even if it doesn't, it eliminates some answers for you.

Best wishes, Abed Nawafleh.