

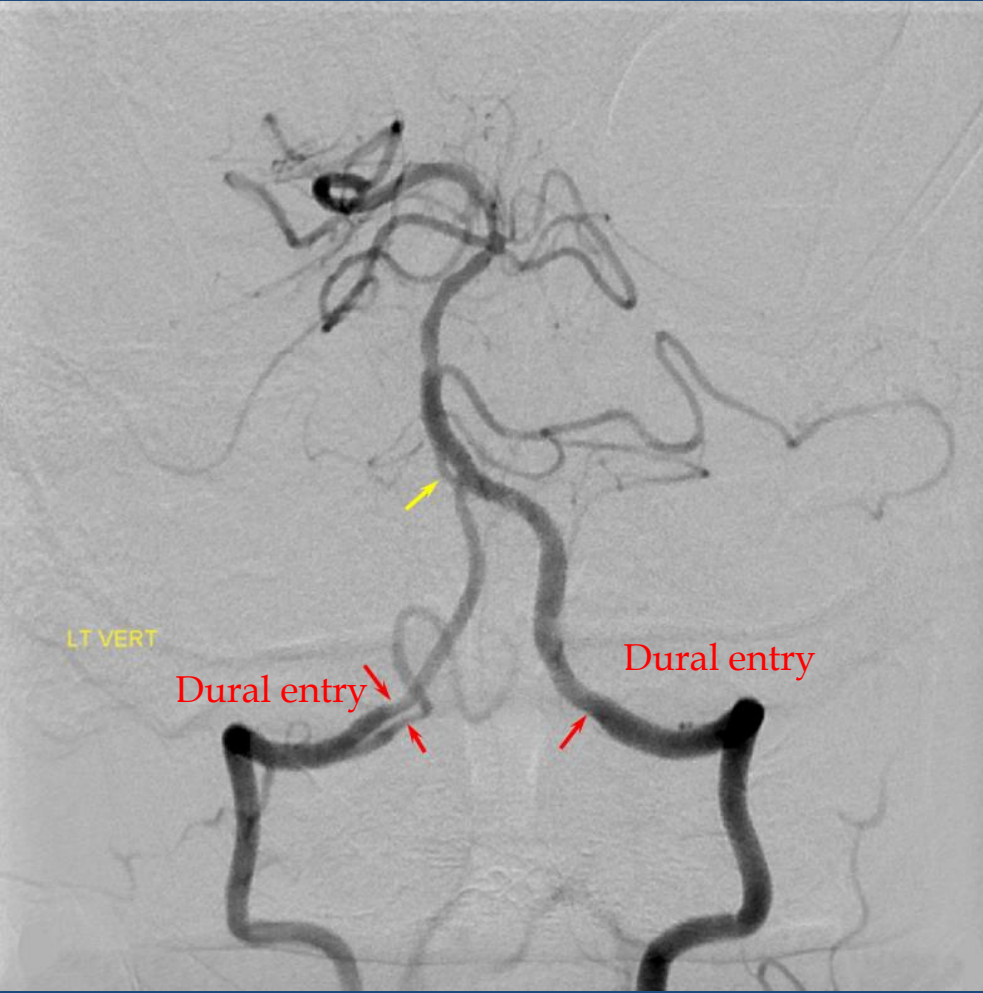
# ΑΡΤΗΡΙΑΚΗ ΑΝΑΤΟΜΪΑ ΟΠΪΣΘΙΑΣ ΚΥΚΛΟΦΟΡΪΑΣ

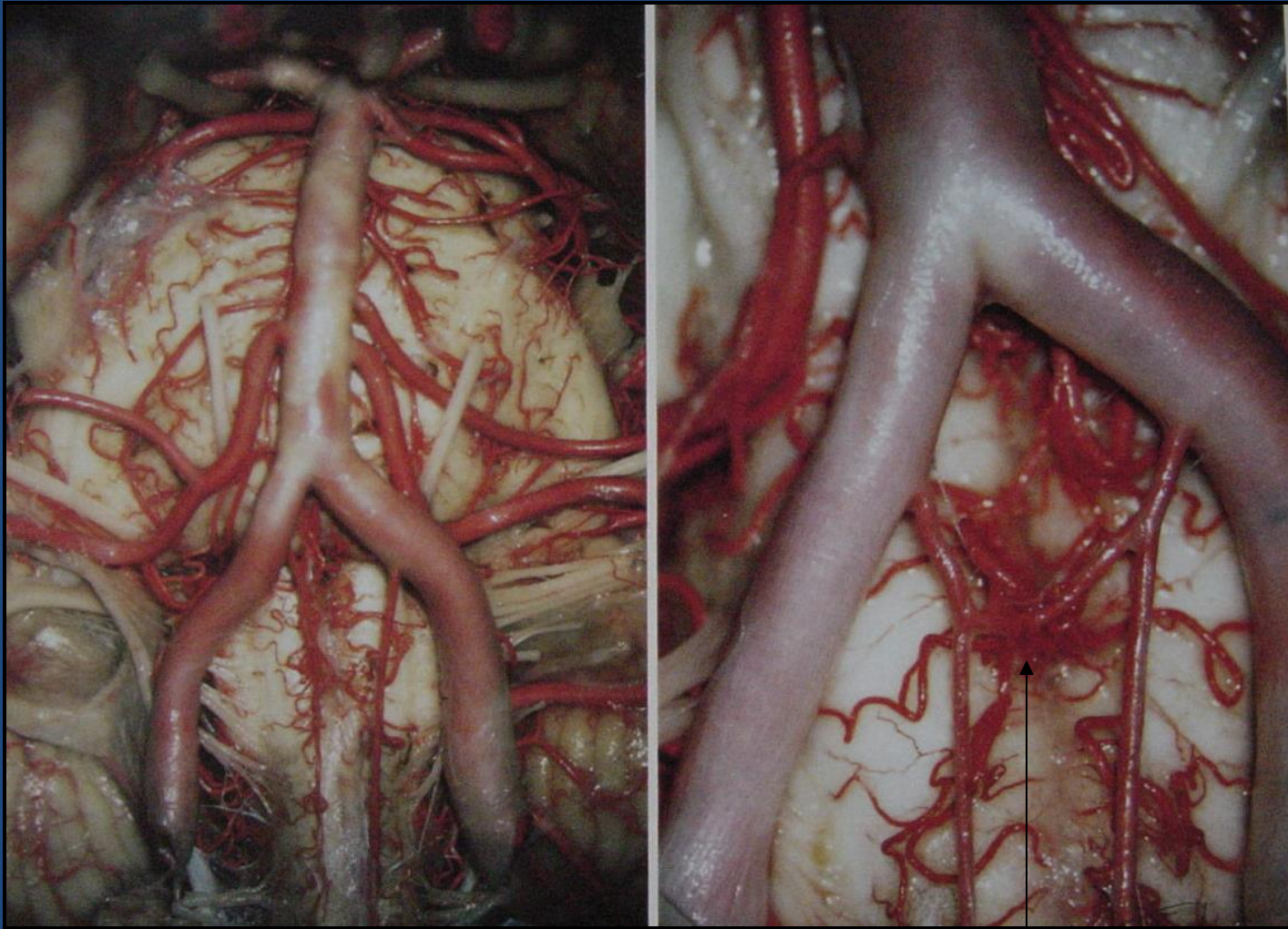
Χρήστος Γκόγκας  
Επεμβατικός Νευροακτινολόγος

# INTRADURAL VERTEBRAL ARTERY(V4 SEGMENT)

## BRANCHES

- Posterior spinal artery
- Anterior spinal artery
- PICA
- Small perforators to olive and inferior cerebellar peduncle

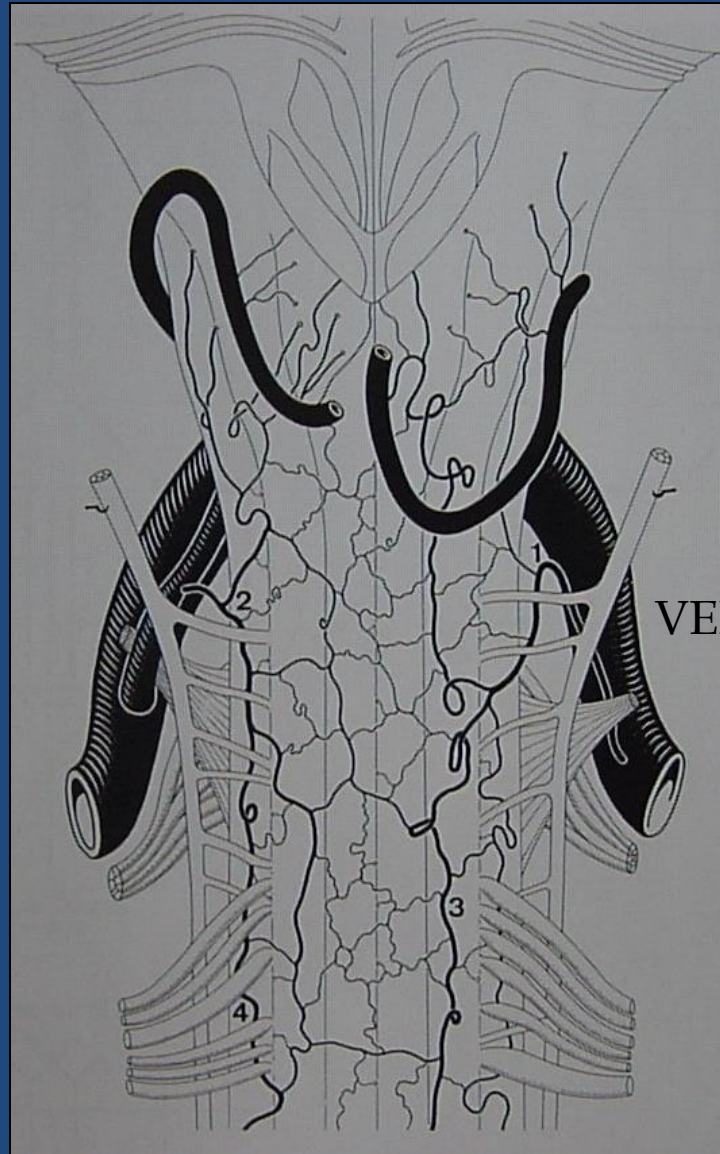




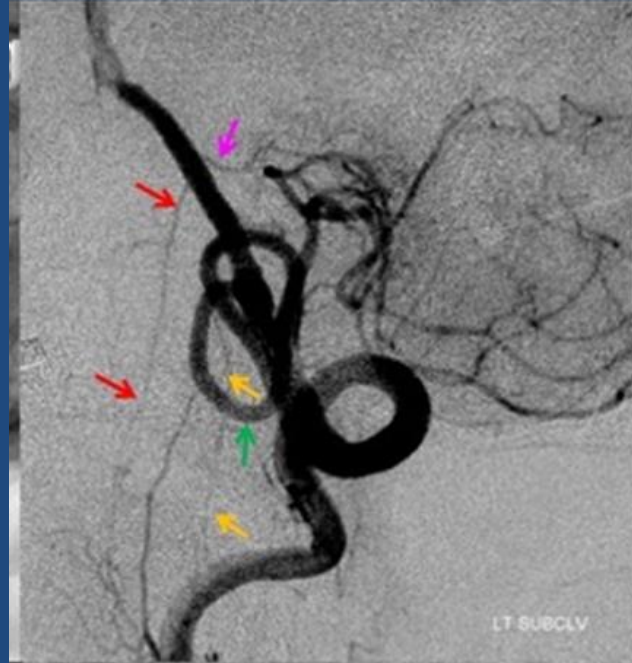
ANTERIOR SPINAL ARTERIES

# LATERAL SPINAL ARTERY

PICA ORIGIN



VERTEBRAL ARTERY ORIGIN



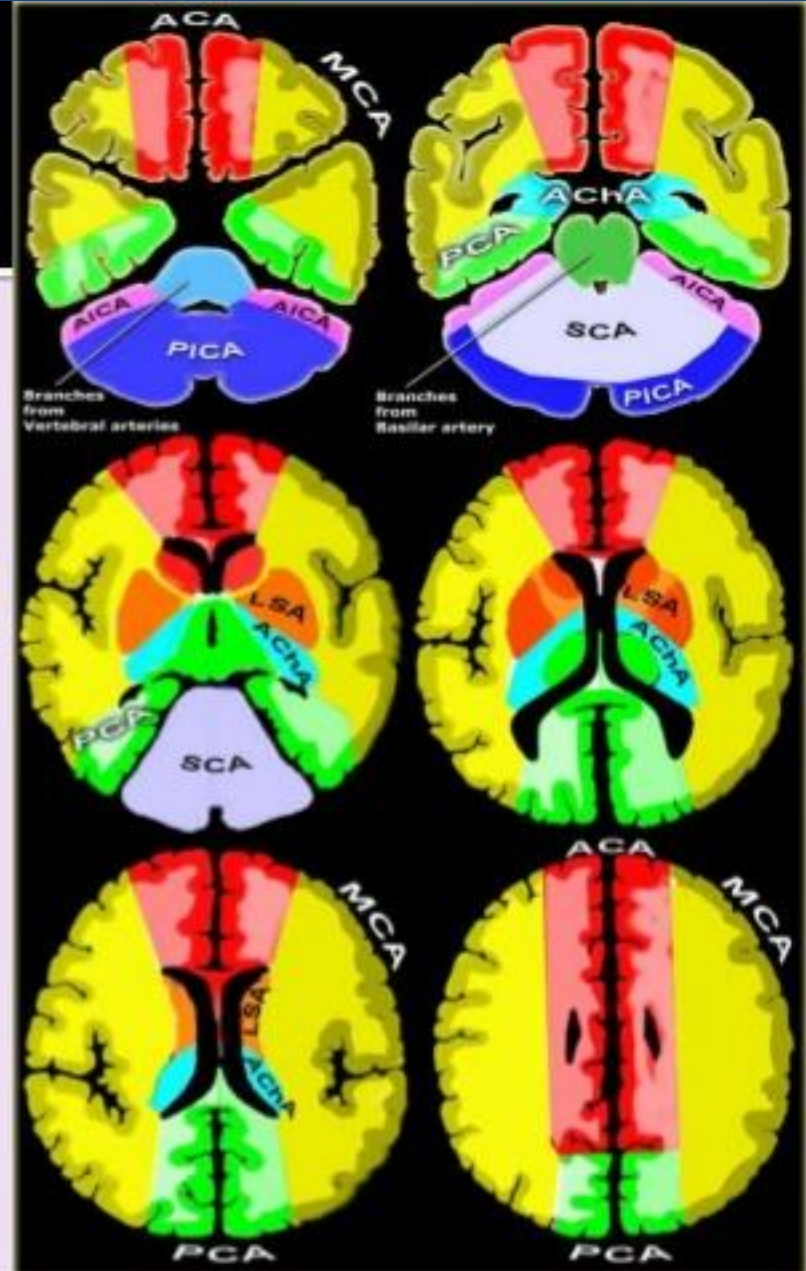
# Οπίσθια κάτω παρεγκεφαλιδική αρτηρία( PICA)

- ▣ Μεγαλύτερος κλάδος της σπονδυλικής αρτηρίας
- ▣ Απουσία στο 20%
- ▣ Έκφυση συνήθως πάνω από το foramen magnum στο 60 %

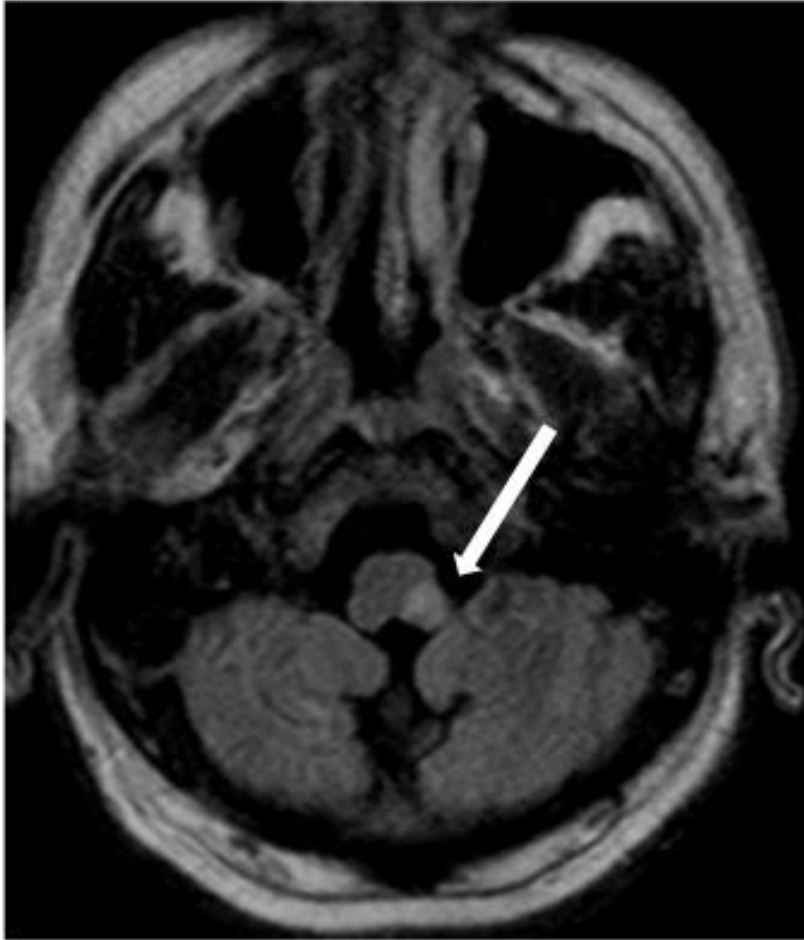
# PICA territory

## Supplies

- Choroid plexus of 4<sup>th</sup> ventricle.
- Posterolateral medulla.
- Cerebellar tonsil.
- Inferior vermis.
- Posteroinferior cerebellar hemisphere.

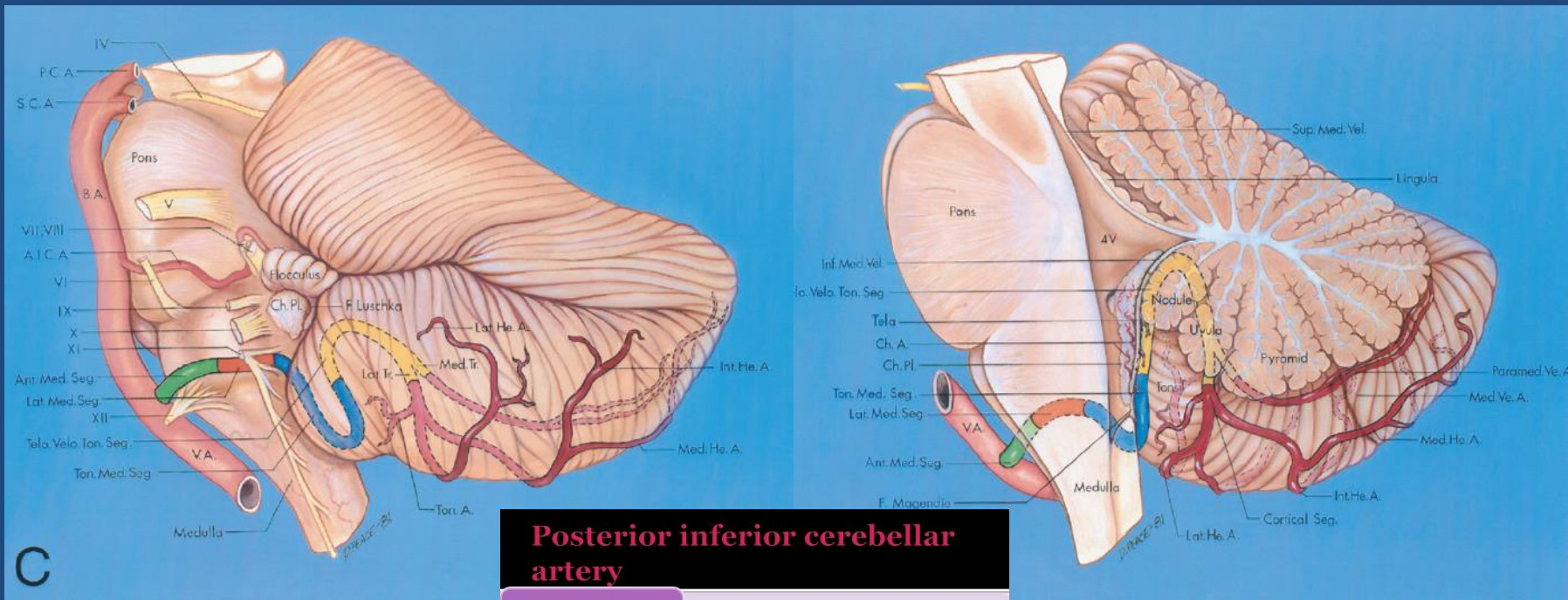






**FLAIR image showing  
ischemic infarct in left  
medulla.**

**Lateral Medullary  
Syndrome**



## Posterior inferior cerebellar artery

Anterior medullary segment	• Front of medulla
Lateral medullary segment	• Along side of medulla caudally to level of CN 9-11
Tonsilomedullary segment	• Around inferior half of cerebellar tonsil
Telovelotonsillar segment	• Cleft btw tela chorioidae and inferior medullary velum rostrally and superior pole of tonsil caudally
Cortical / hemispheric segment	

Lateral posterior choroidal artery

Medial posterior choroidal artery

Posterior thalamoperforating arteries

Superior cerebellar artery

Basilar artery with pontine perforating arteries

Anterior medullary segment, PICA

Caudal loop, lateral medullary segment, PICA

Posterior cerebral artery and splenic branch

Superior hemispheric branches (SCA)

Superior vermian artery

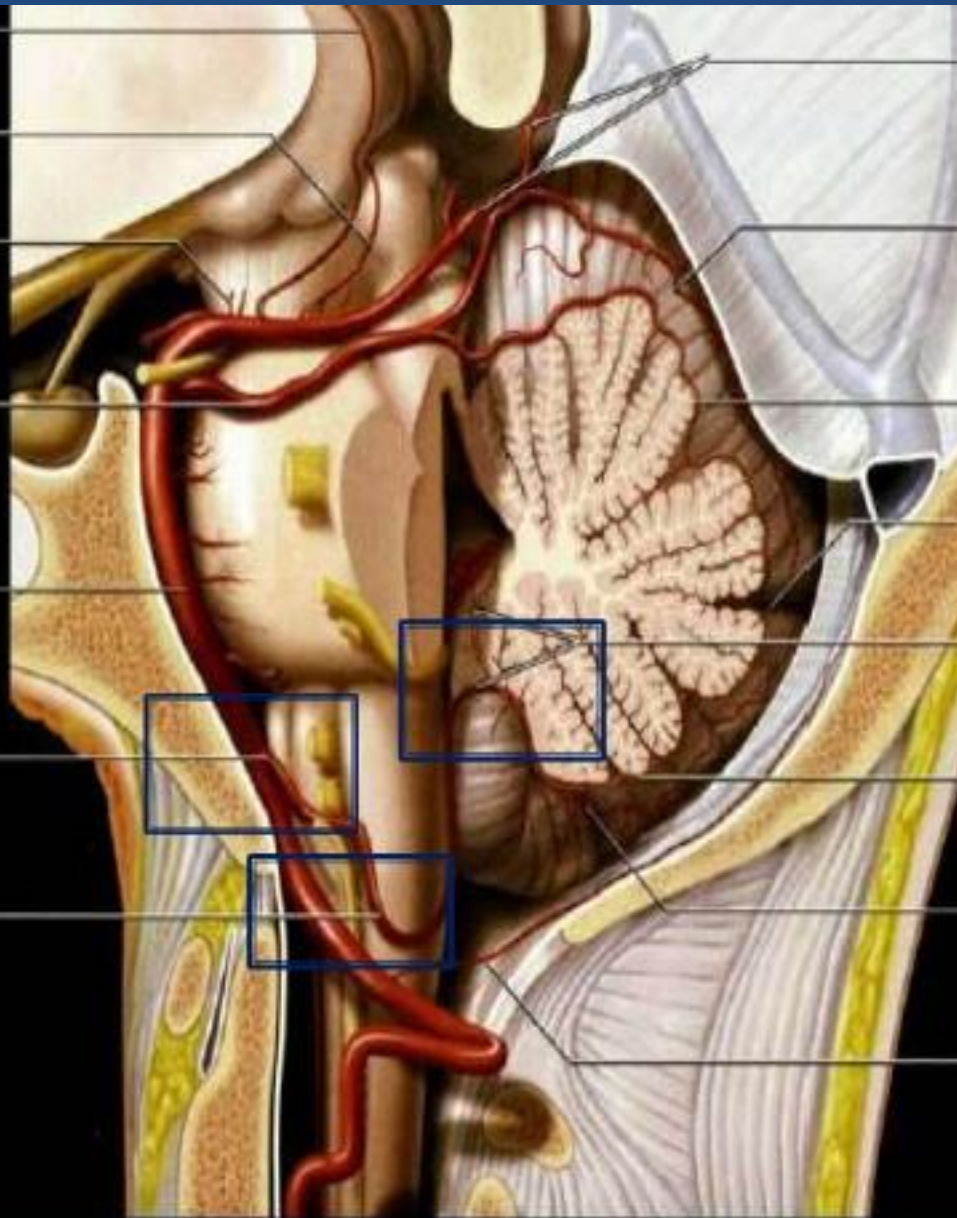
Great horizontal fissure, cerebellum

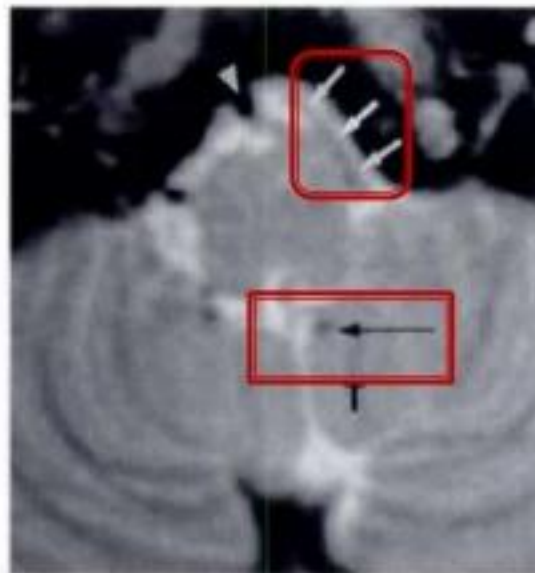
Supratonsillar segment, PICA, with choroidal branches

Inferior vermian artery (PICA)

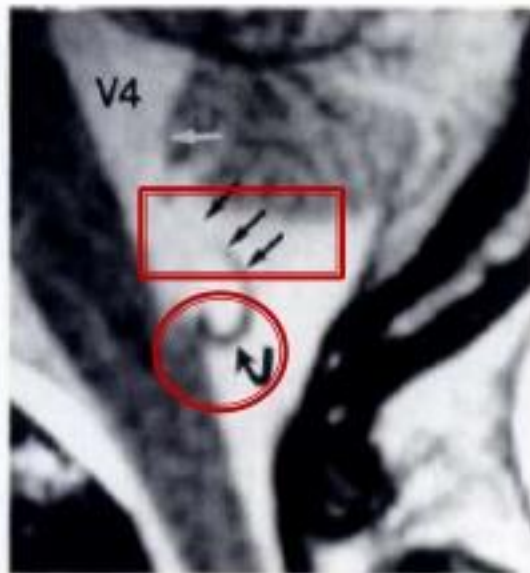
Inferior hemispheric branches (PICA)

Posterior meningeal artery





A



B



C



D

Anterior medullary segment  
 Posterior medullary segment  
 Lateral medullary segment

Fig. 3.—Normal anatomy of posterior inferior cerebellar artery.

A, Axial T2-weighted (2400/80, one excitation) MR image shows left vertebral artery (arrowhead) and anterior medullary segment (white arrows) and posterior medullary segment (black arrow) of left posterior inferior cerebellar artery. Posterior medullary segment ascends ventral to tonsil (T).

B, Sagittal fast spin-echo T2-weighted (2000/85, two excitations, echo-train length of 8) MR image shows caudal loop of posterior inferior cerebellar artery (lateral medullary segment) (curved arrow) and posterior medullary segment (straight black arrows). Posterior medullary segment terminates near inferior medullary velum (white arrow) of fourth ventricle (V4).

C, Coronal T2-weighted (2000/80, one excitation) MR image shows caudal loop (arrow) of left posterior inferior cerebellar artery.

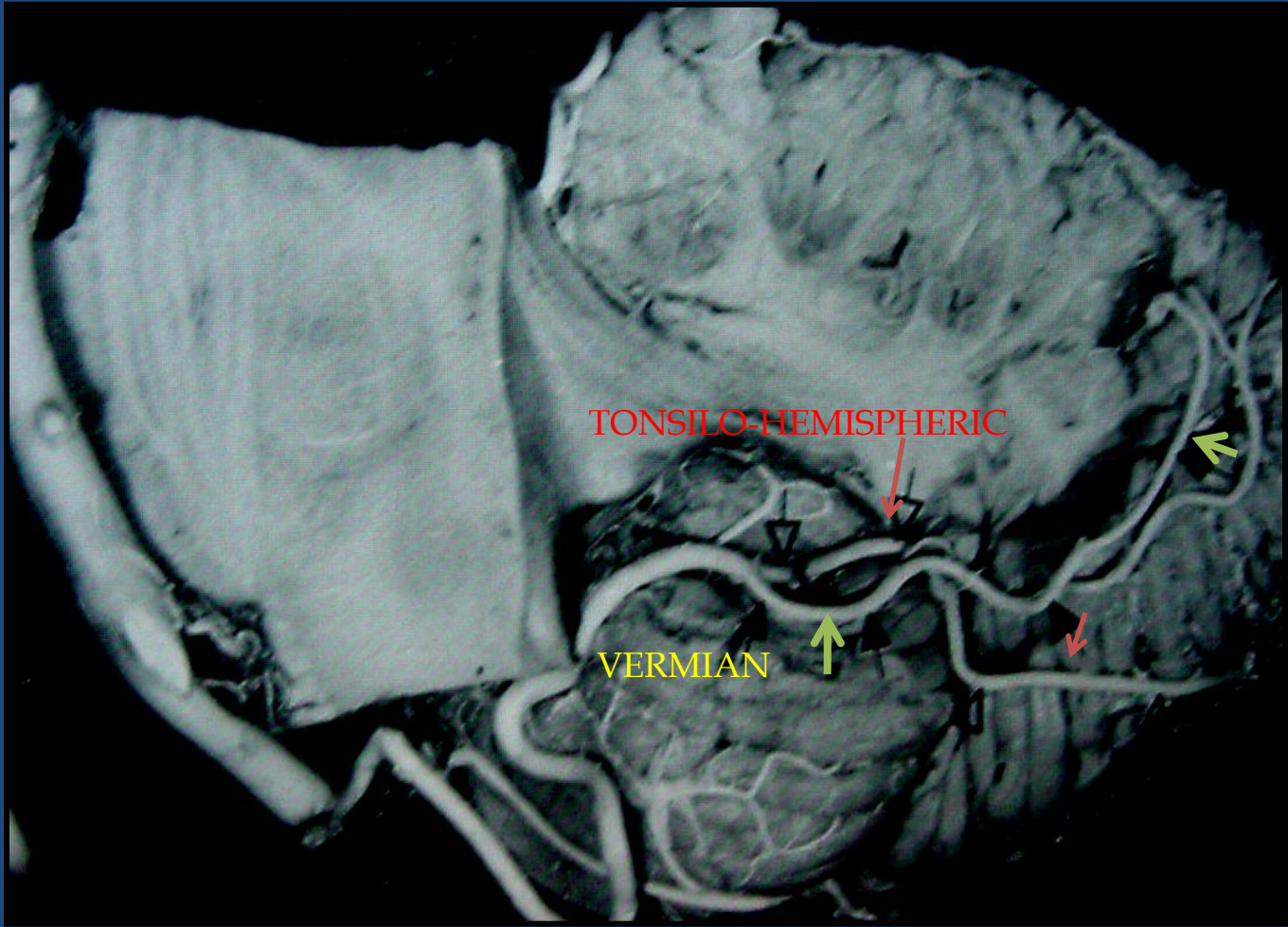
D, Sagittal T1-weighted (600/15, one excitation) MR image in a 4-year-old boy with cerebellar arteriovenous malformation shows cranial loop (supratonsillar segment) (curved arrow) coursing over superior pole of tonsil (T). Despite variation in location of apex of cranial loop, anatomic position of measured choroid point is constant. Supratonsillar segment bifurcates distal to apex of cranial loop into tonsillohemispheric and vermian (straight arrows) branches. Note parenchymal hemorrhage (H) and enlarged draining vein (V).

# PICA SEGMENTS

- ▣ ANTERIOR MEDULLARY
- ▣ LATERAL MEDULLARY
- ▣ MEDIAL TONSILLAR (POSTERIOR MEDULLARY)
- ▣ SUPRATONSILLAR

# PICA BRANCHES

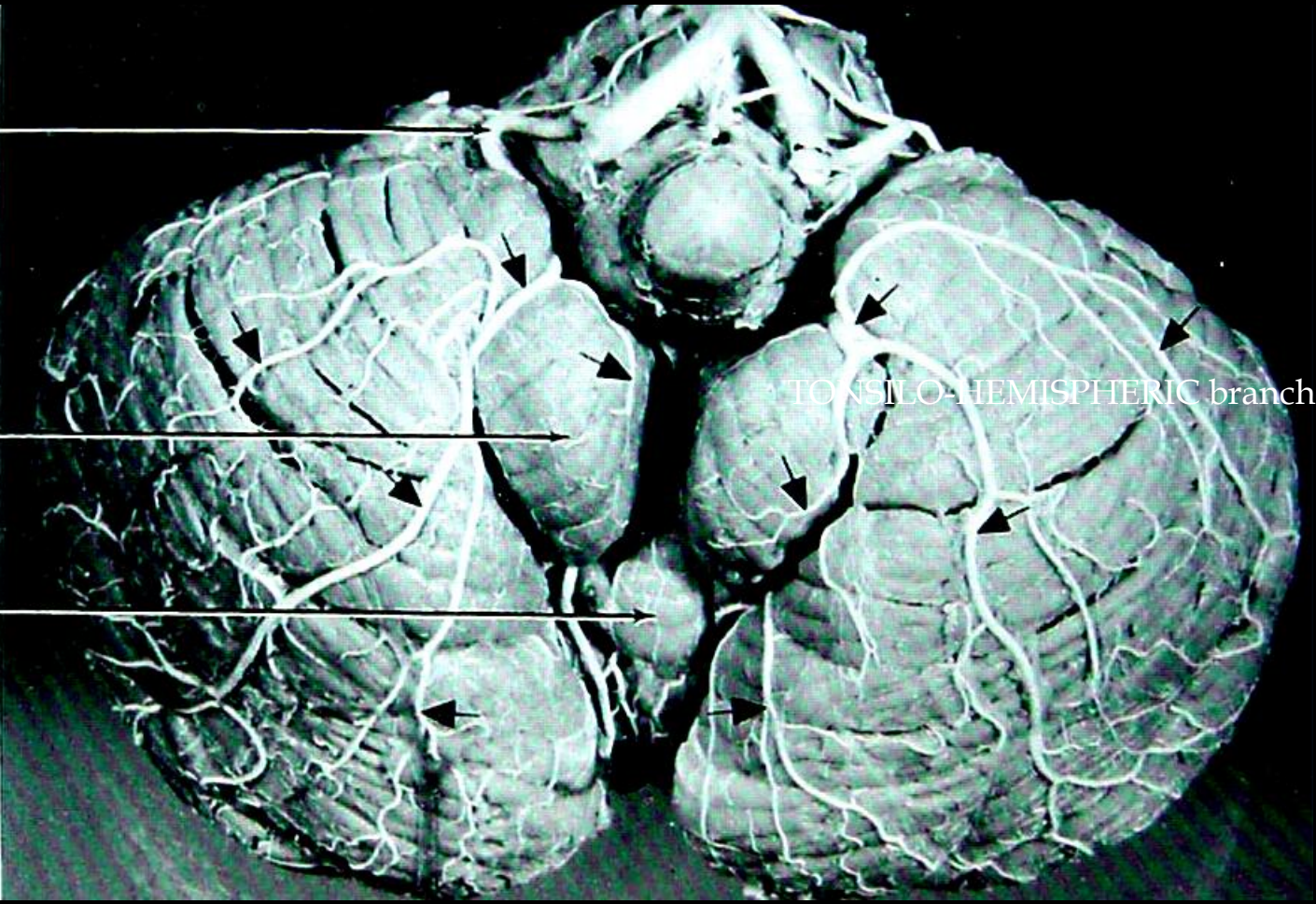
- ▣ PERFORATING not routinely visible on angiography
- ▣ TERMINAL
  - TONSILOHEMISPHERIC (LATERAL TRUNK )
  - VERMIAN (MEDIAL TRUNK)
- ▣ MENINGEAL



Anterior medullary  
segment right PICA

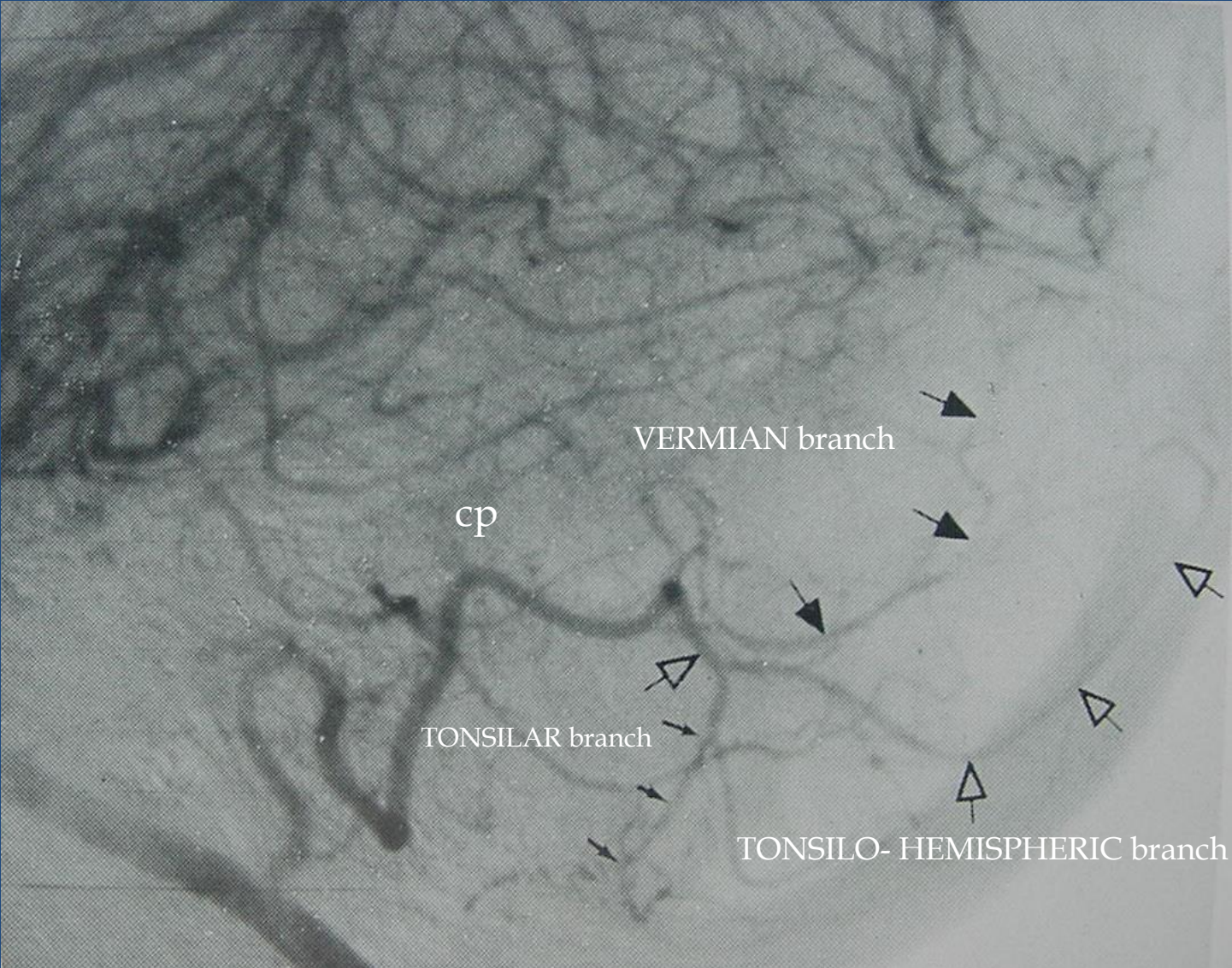
Tonsil

Pyramid of  
vermis

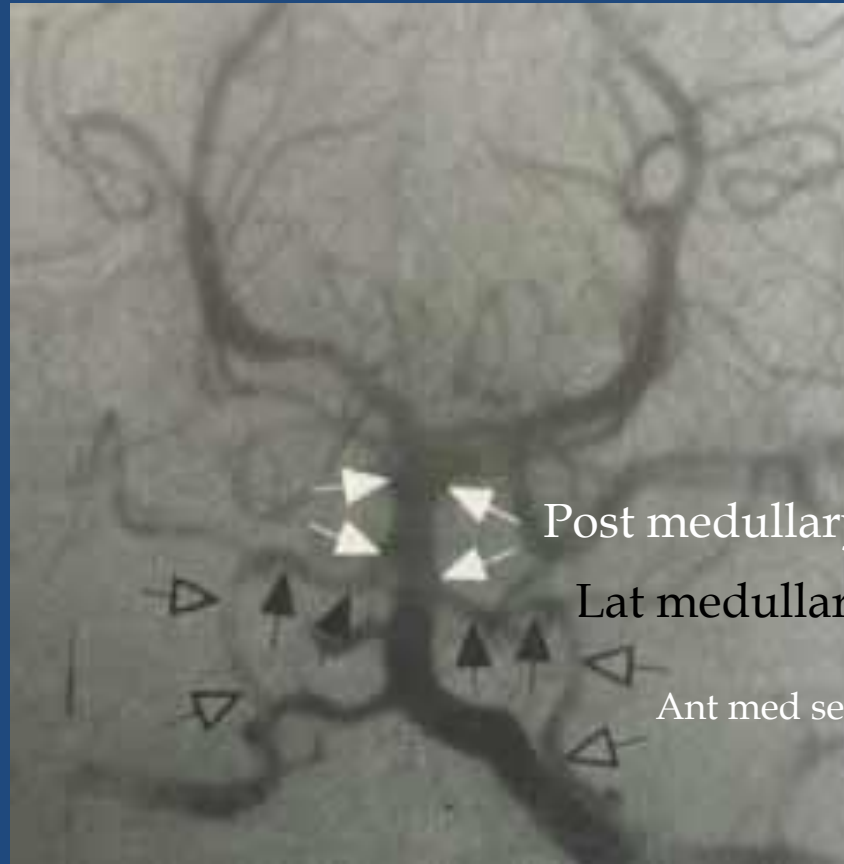


TONSILO-HEMISPHERIC branches





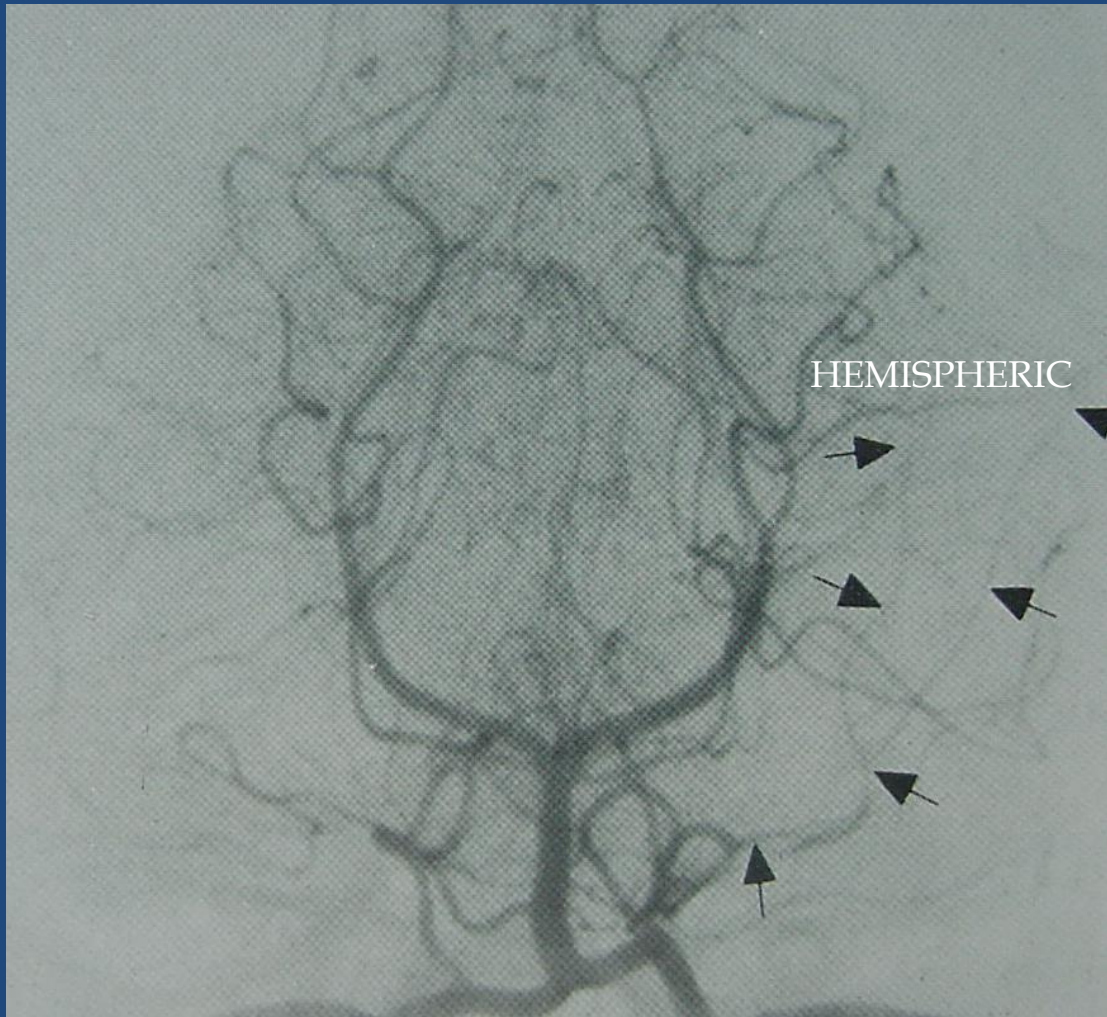
# Towne



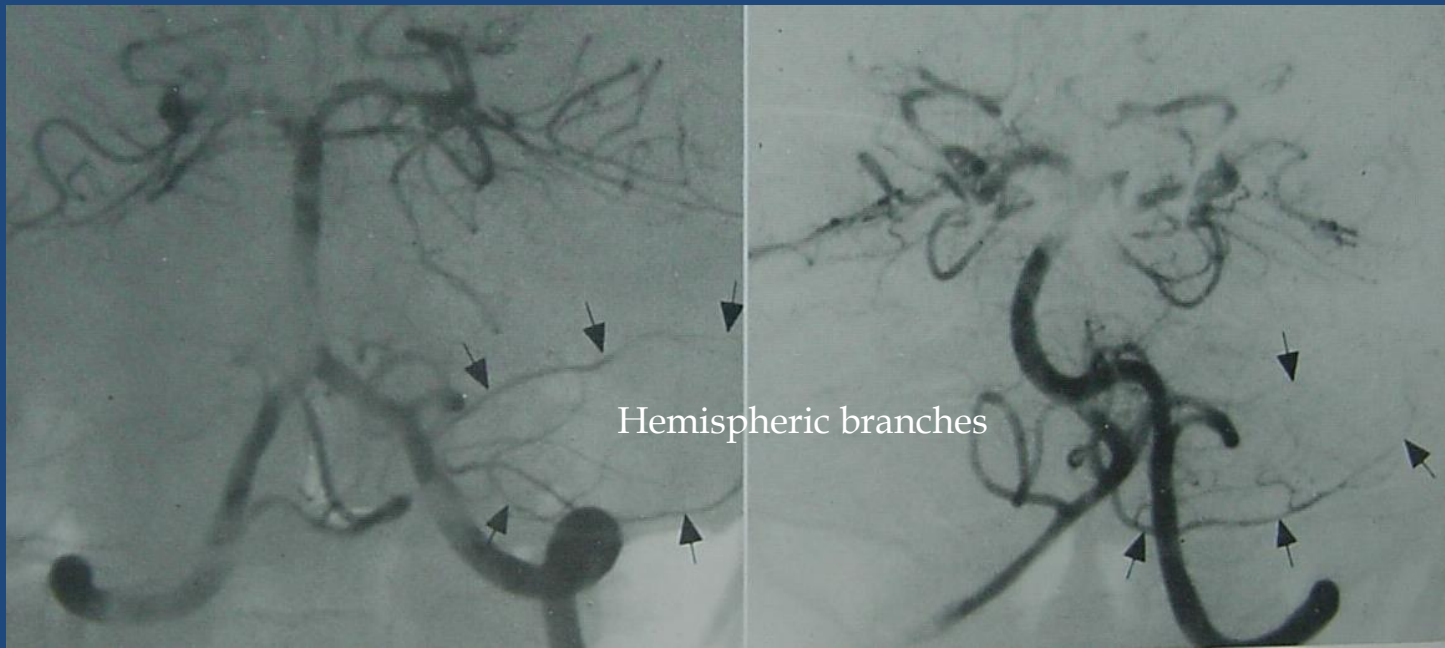
Post medullary seg

Lat medullary seg

Ant med seg

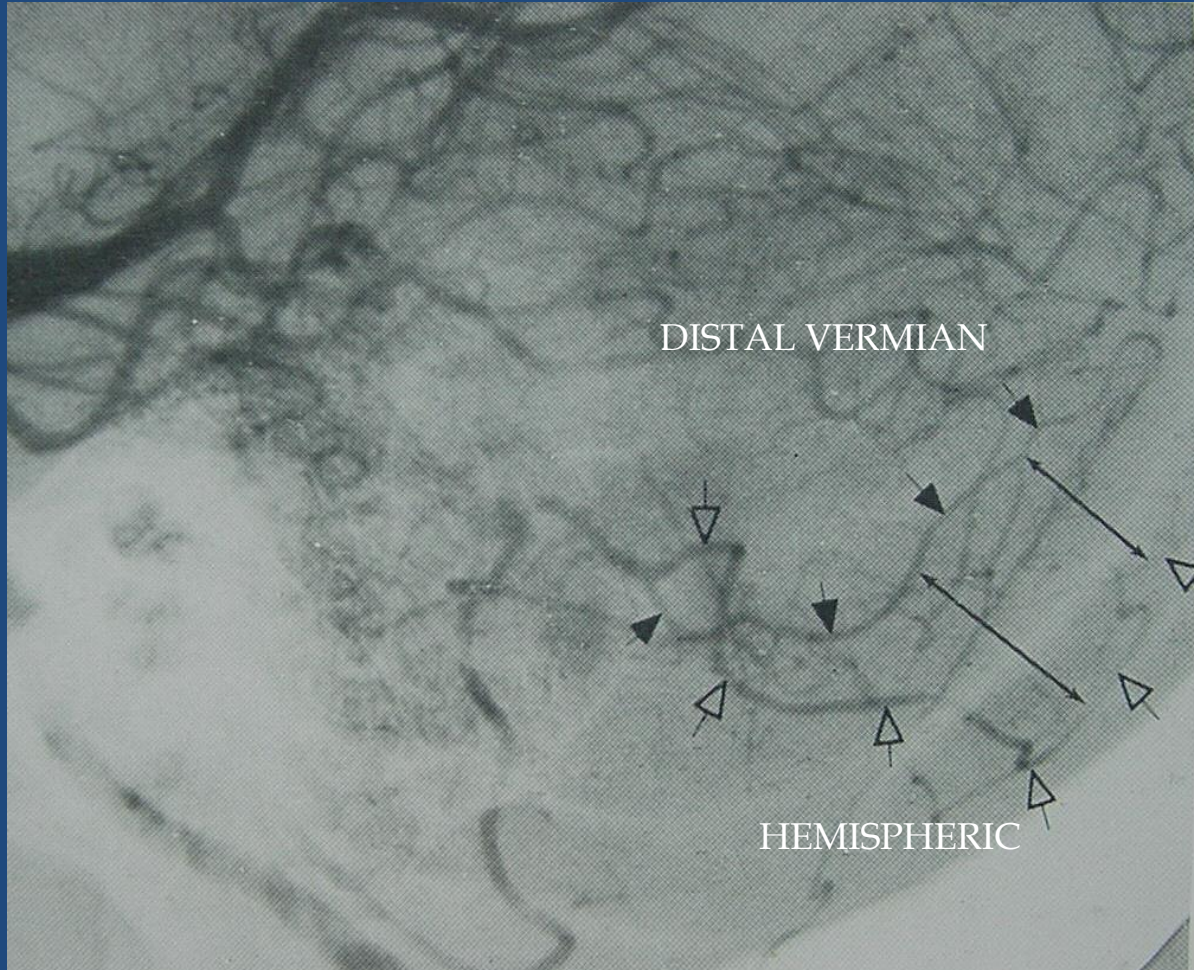


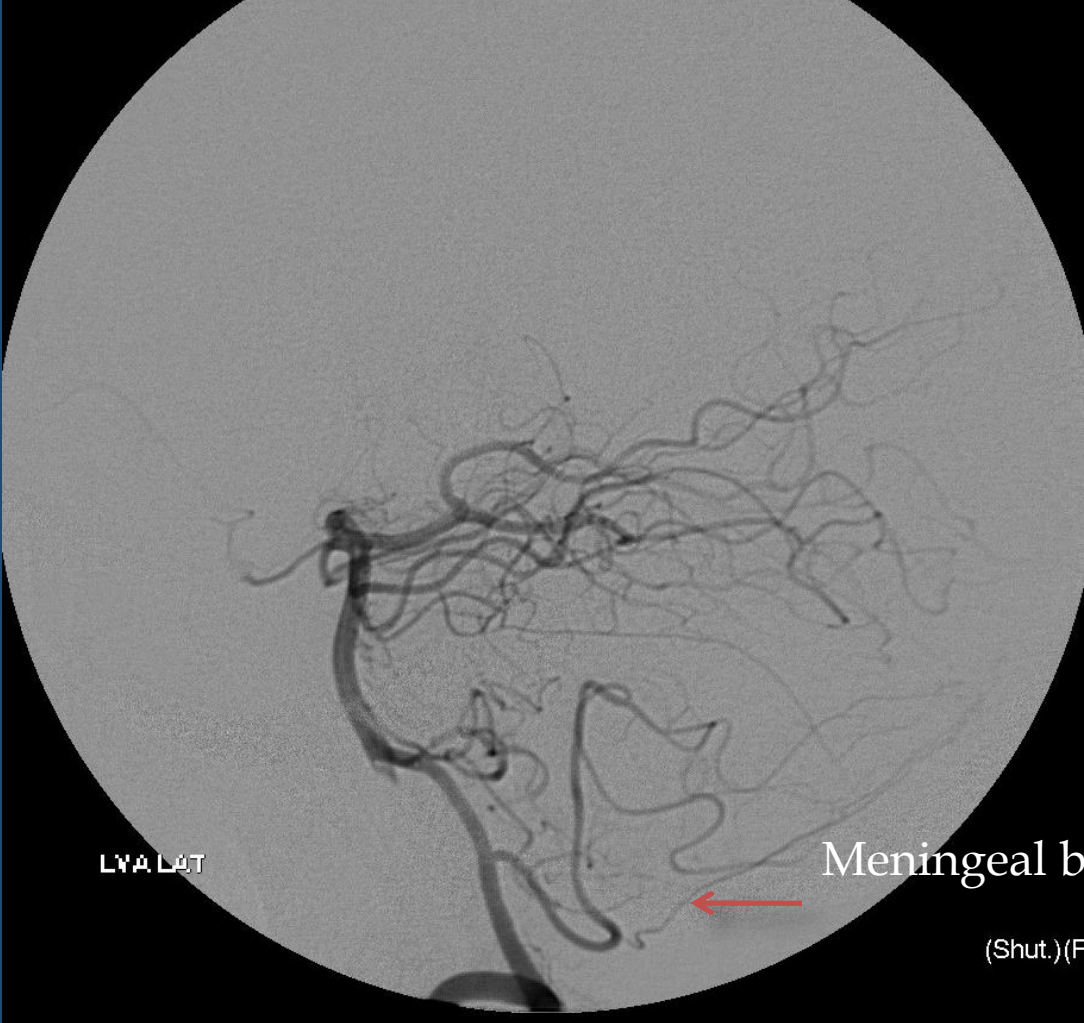
TW



AP

# Lateral view





LYA.LAT

Meningeal branch

(Shut.)(F

# Medulla perforators from PICA

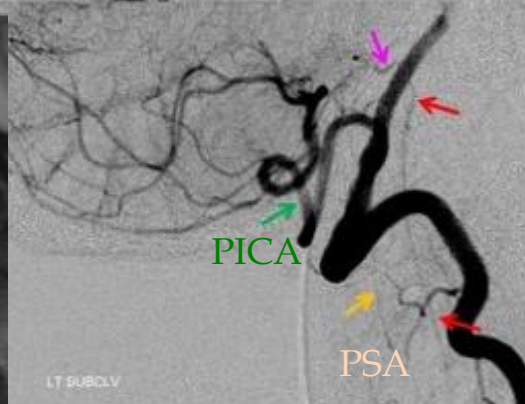
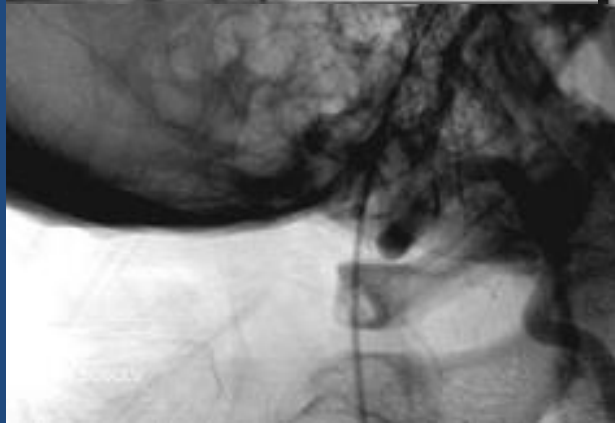
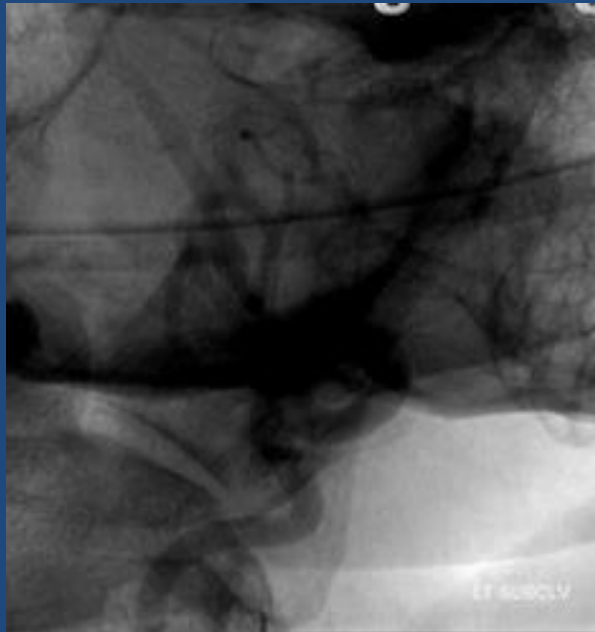
- No perforators if PICA extradural
- The closer to BA trunk-more perforators
- Distal take off PICA always supplies medulla

# EXTRADURAL PICA ORIGIN





# Extradural PICA



ASA

# Choroid point

Most important PICA landmark for neurointerventionalists

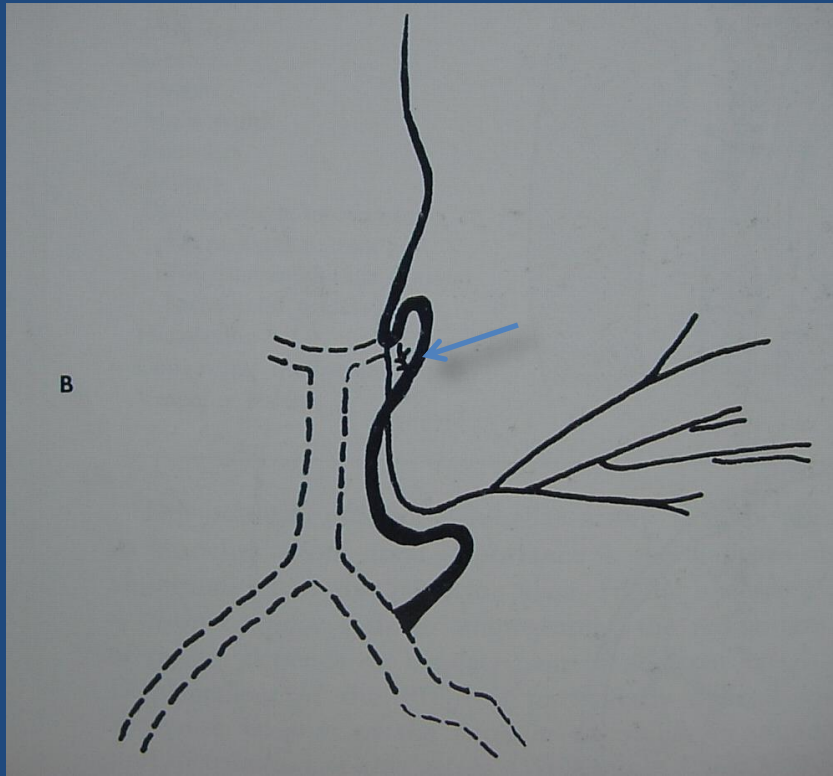
No brainstem perforators distal to choroid point



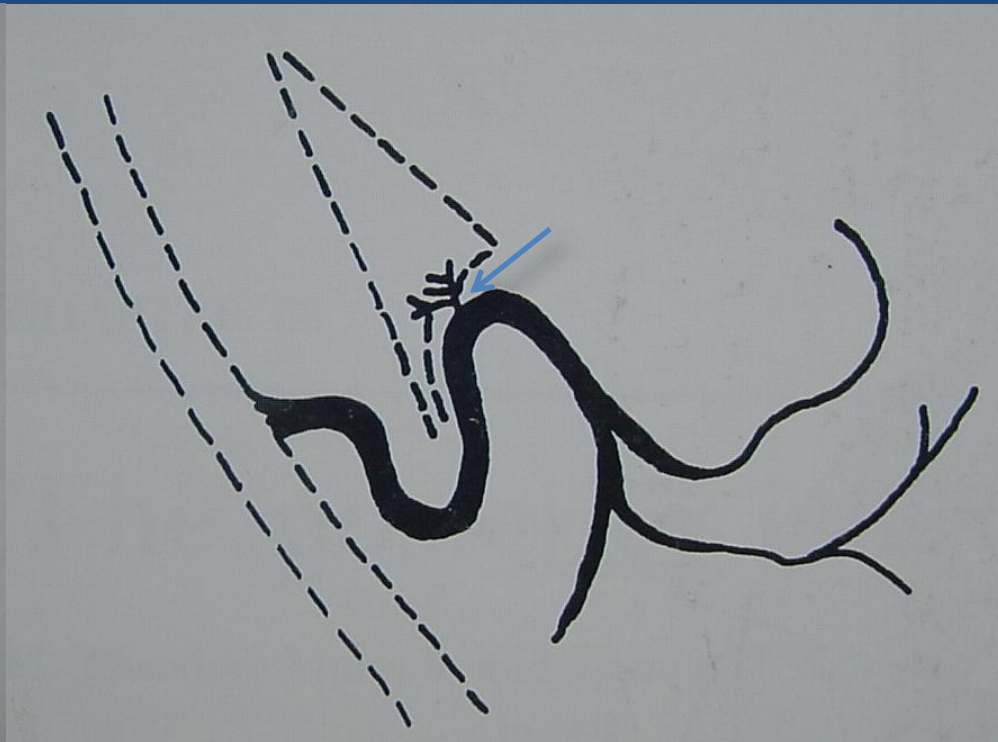
**Choroid point**

**Caudal loop**

# CHOROID POINT- JUNCTION POSTERIOR MEDULLARY AND SUPRATONSILLAR SEGMENT

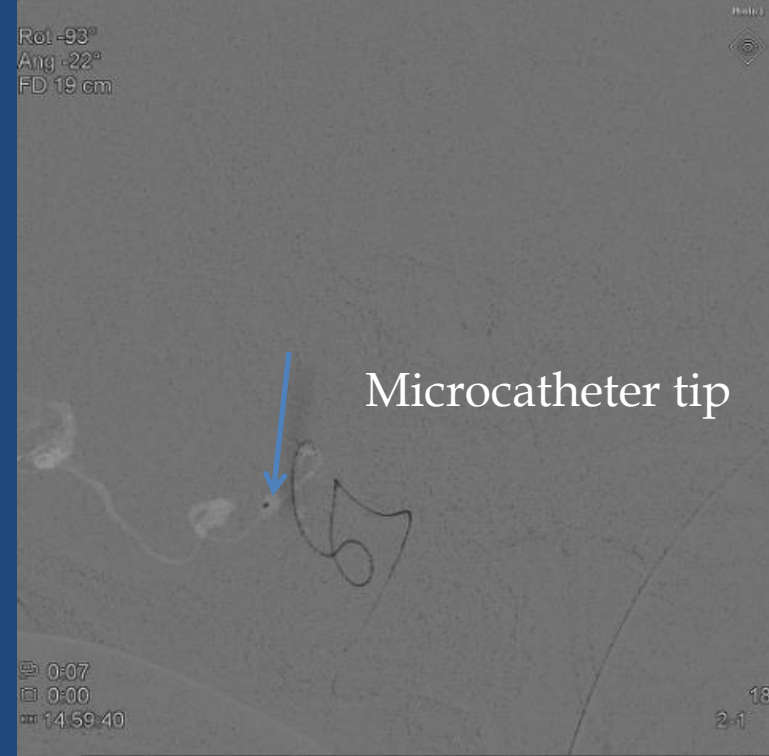
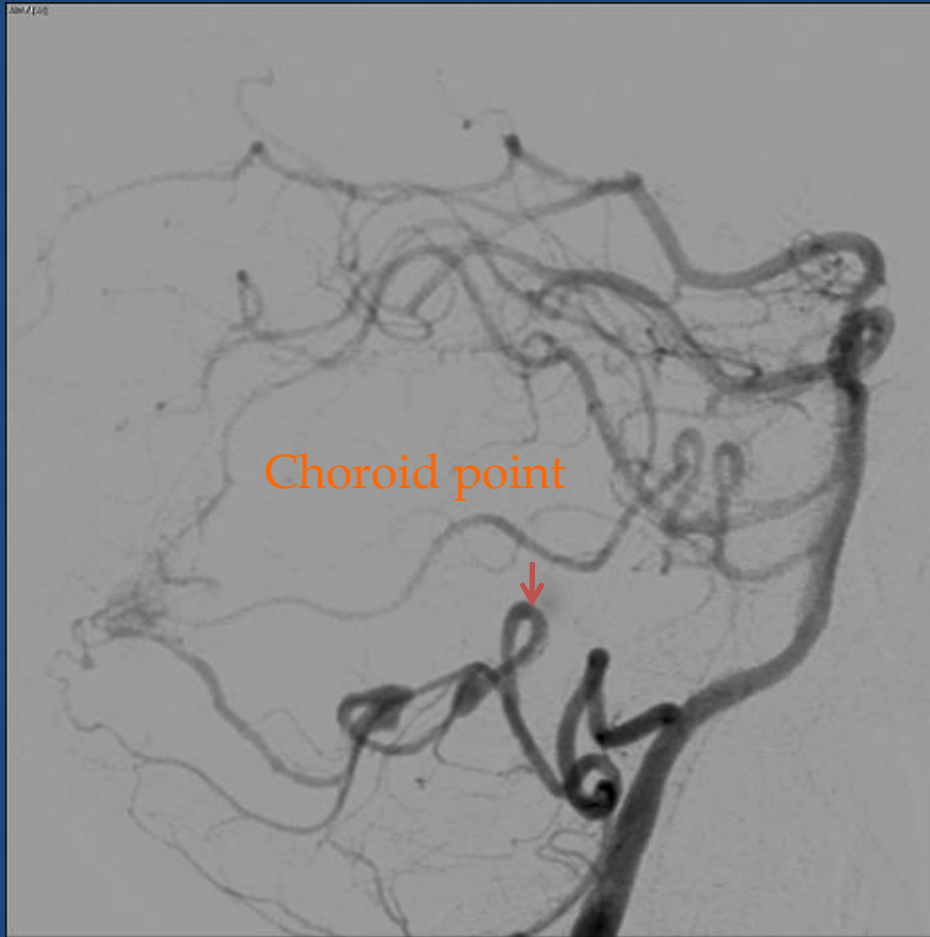


TOWNE



LATERAL

# RUPTURED CEREBELLAR AVM

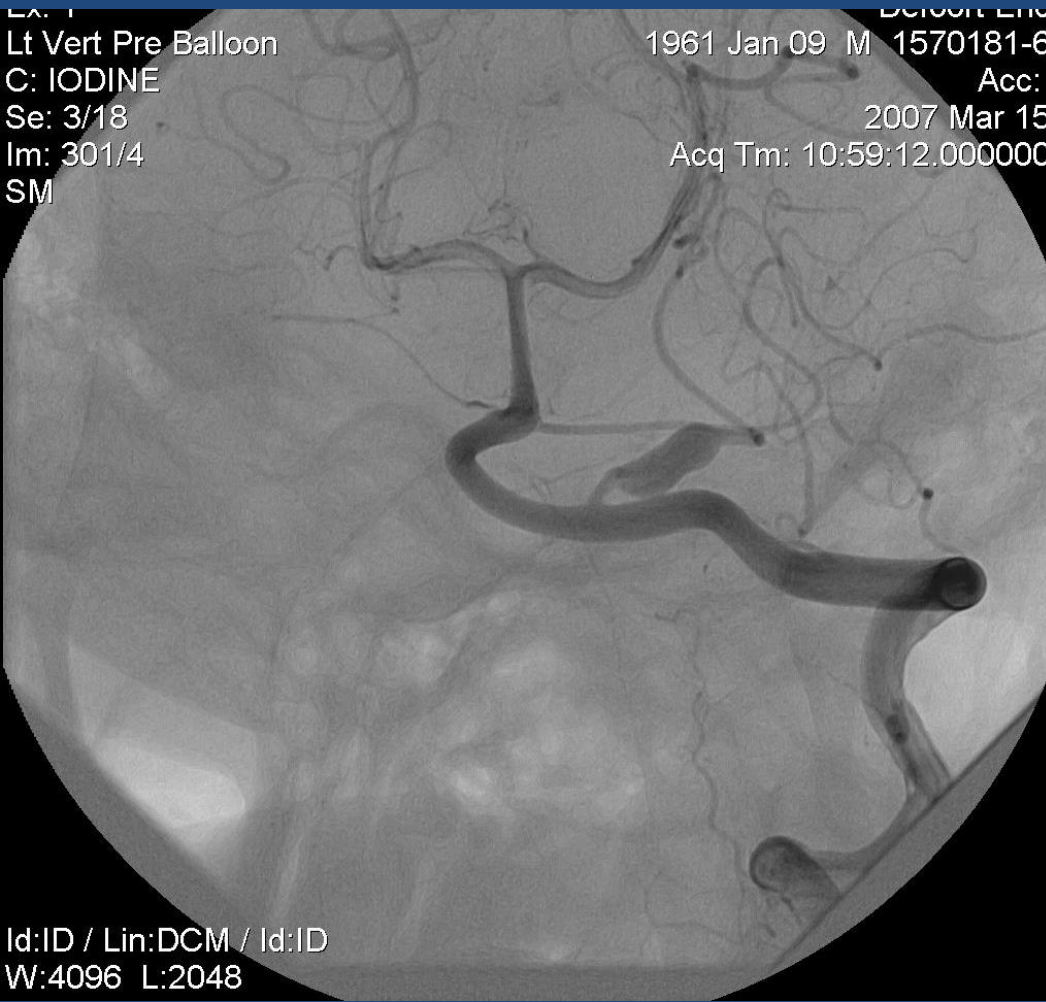


EX: 1  
Lt Vert Pre Balloon  
C: IODINE  
Se: 3/18  
Im: 301/4  
SM

1961 Jan 09 M 1570181-6  
2007 Mar 15  
Acq Tm: 10:59:12.000000

BSR03166  
Ex: 1  
Acc: Lt Vert Pre Balloon  
C: IODINE  
Se: 3/18  
Im: 302/4  
SM

Health Sciences C  
Defoort  
1961 Jan 09 M 15701  
2007 Ma  
Acq Tm: 10:59:12.00



Id:ID / Lin:DCM / Id:ID  
W:4096 L:2048

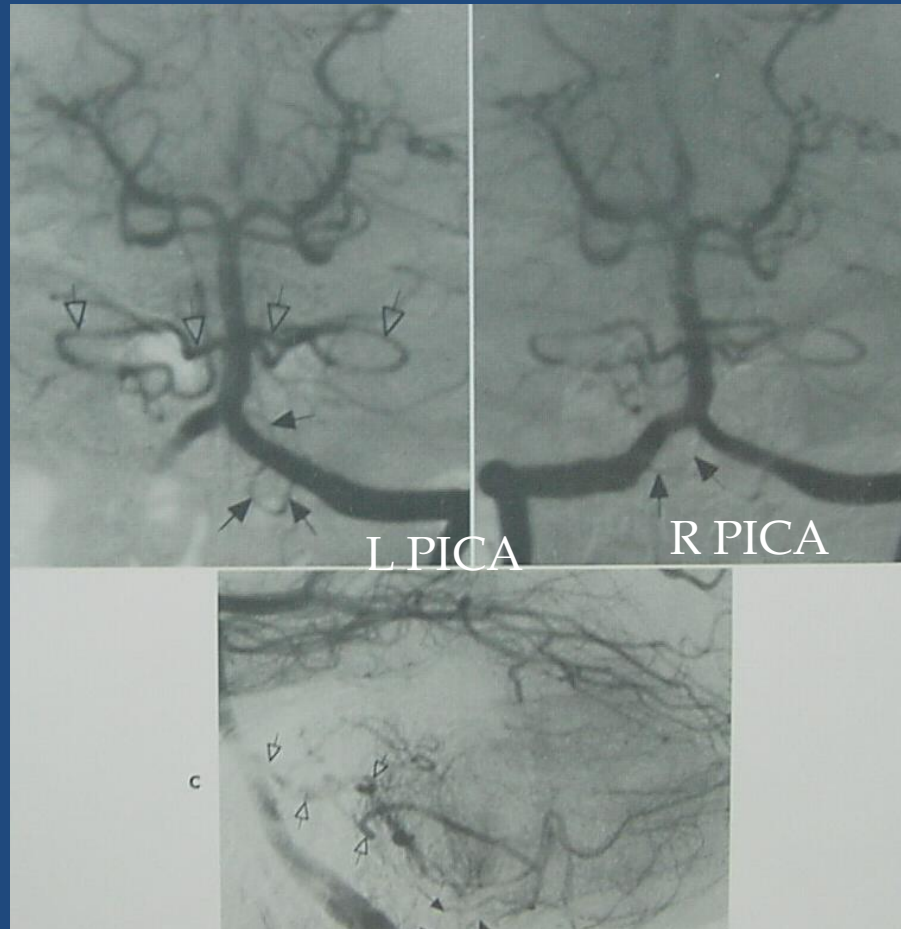
Id:ID / Lin:DCM / Id:ID  
W:4096 L:2048

# EXTRADURAL PICA ORIGIN



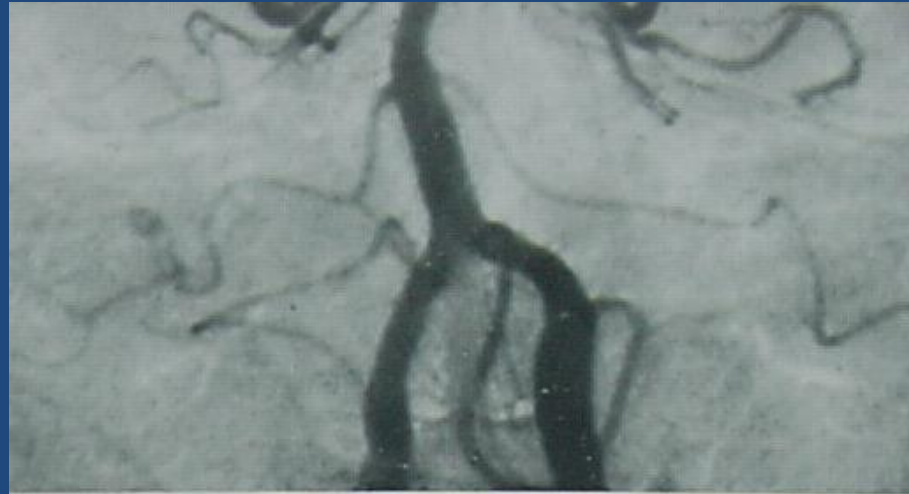
PICA ORIGIN C2

# PICA bilateral hypoplasia





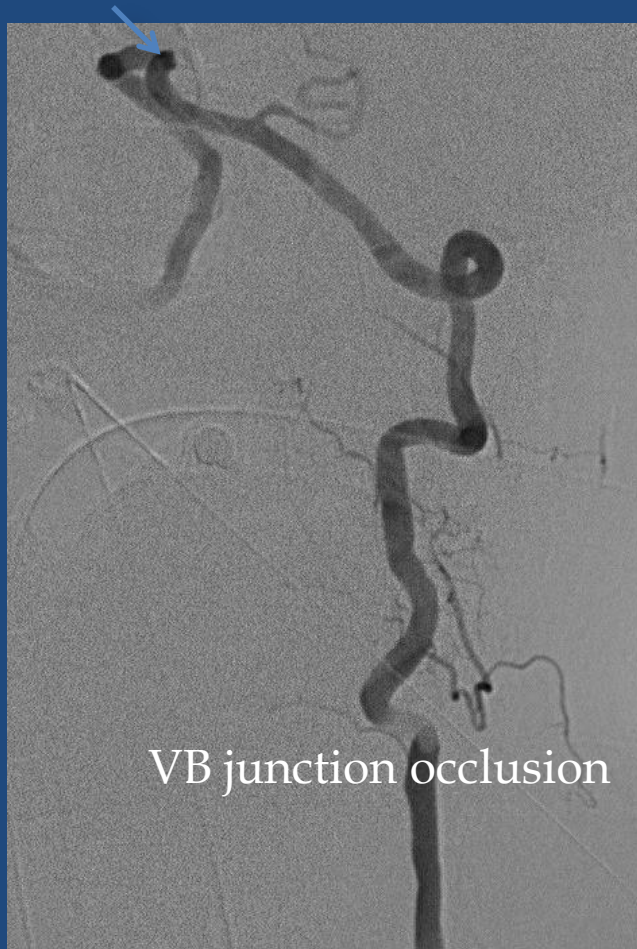
AICA PICA BILAT.

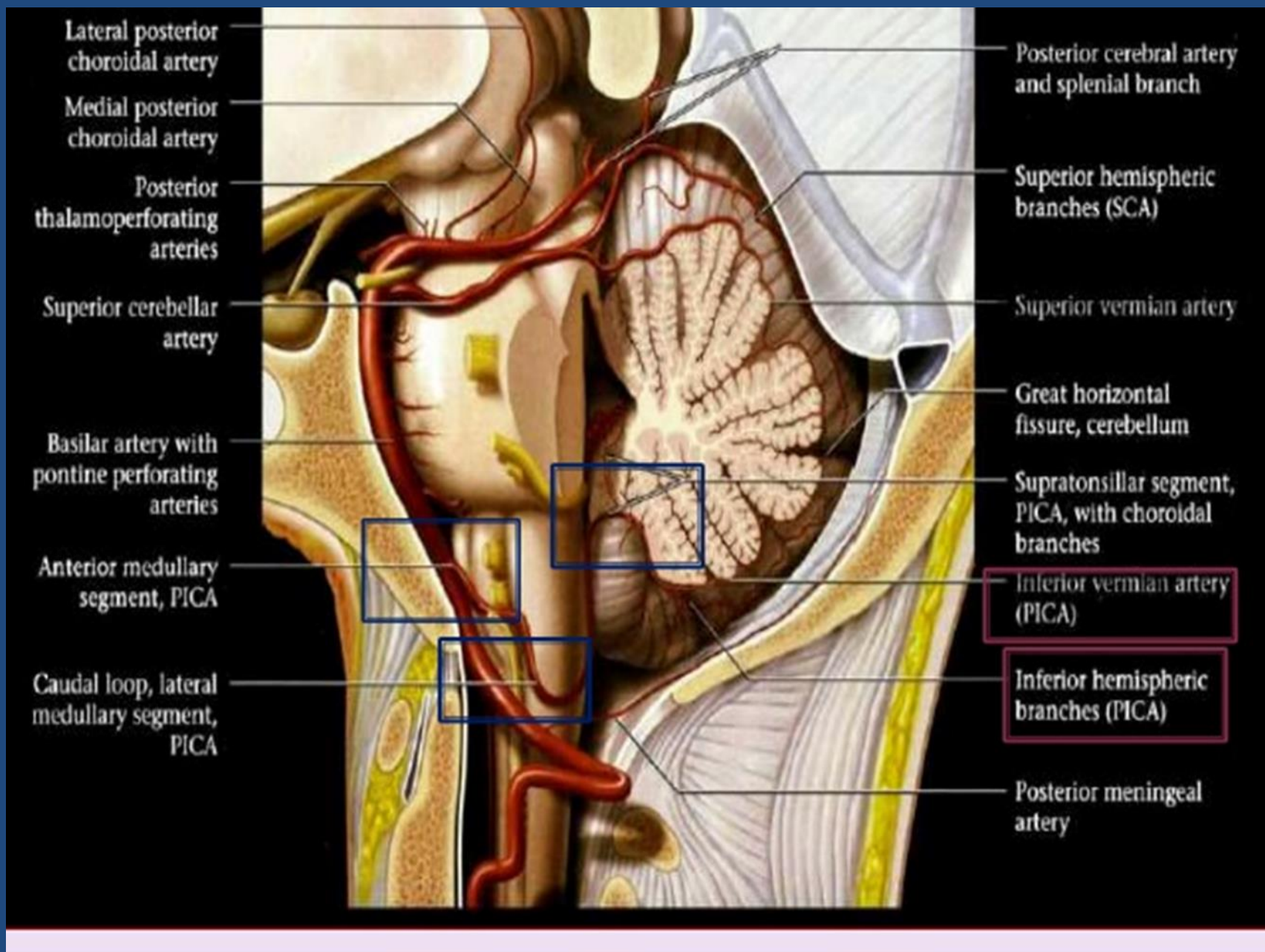


Aica Pica variant hypoplastic r vert



# Απόφραξη σπονδυλοβασικής συμβολής

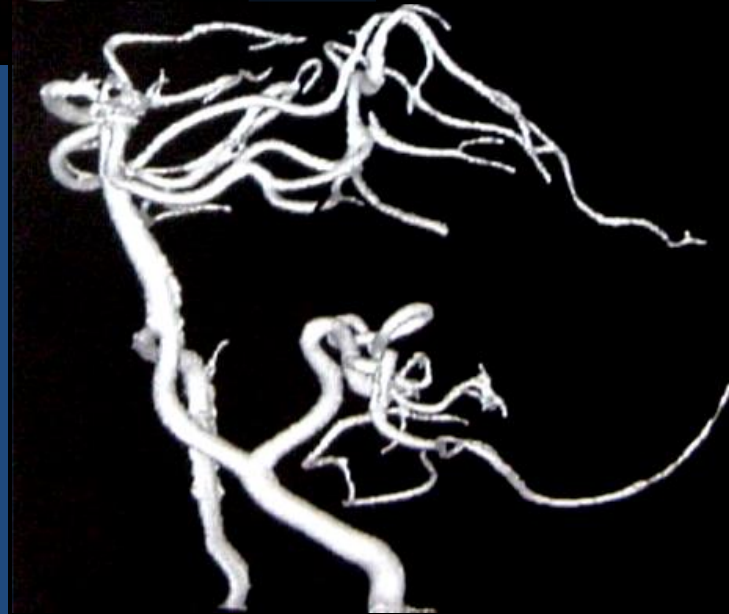




# Bihemispheric PICA



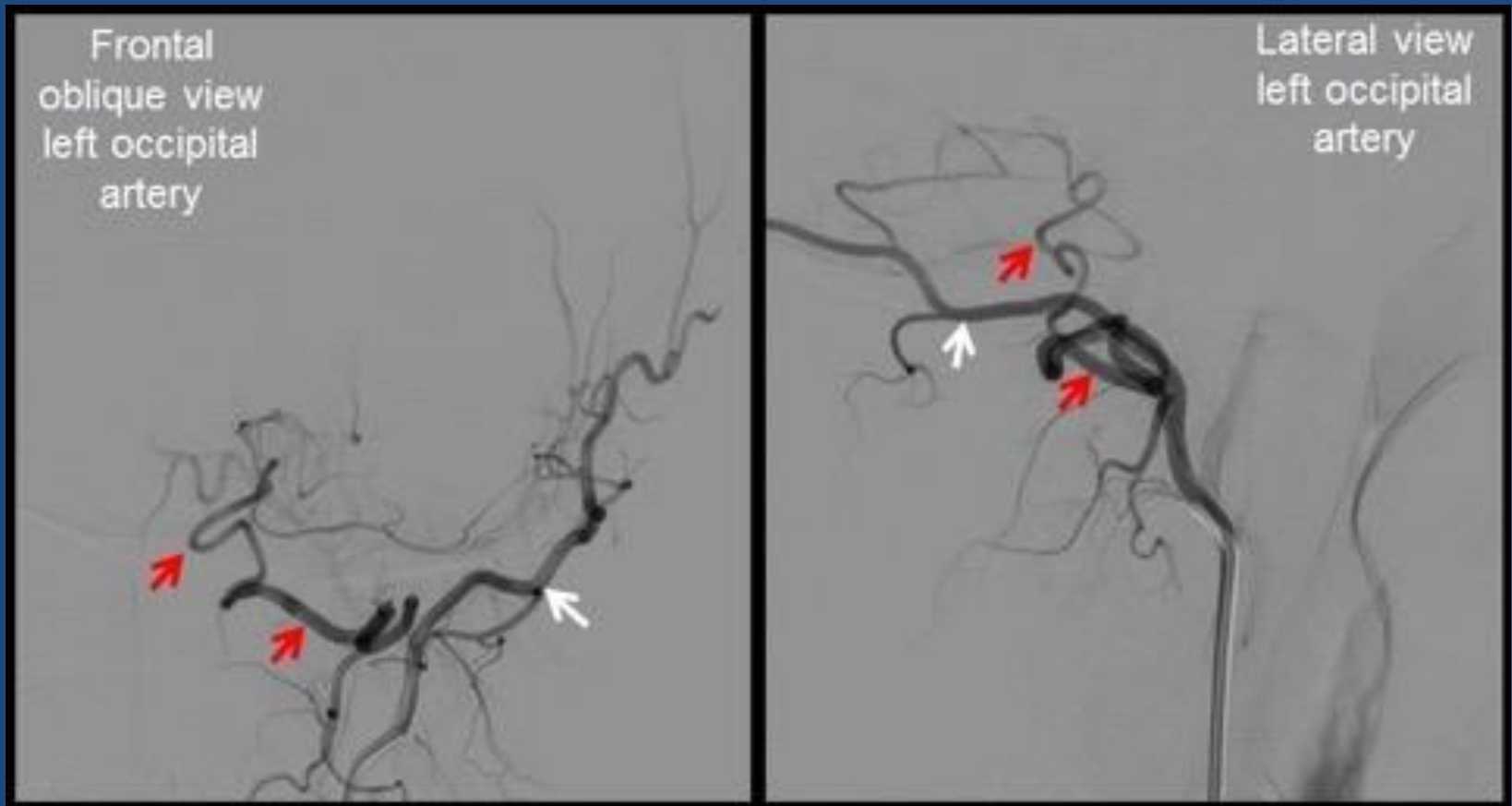
PICA across midline



# Bifid PICA ORIGIN



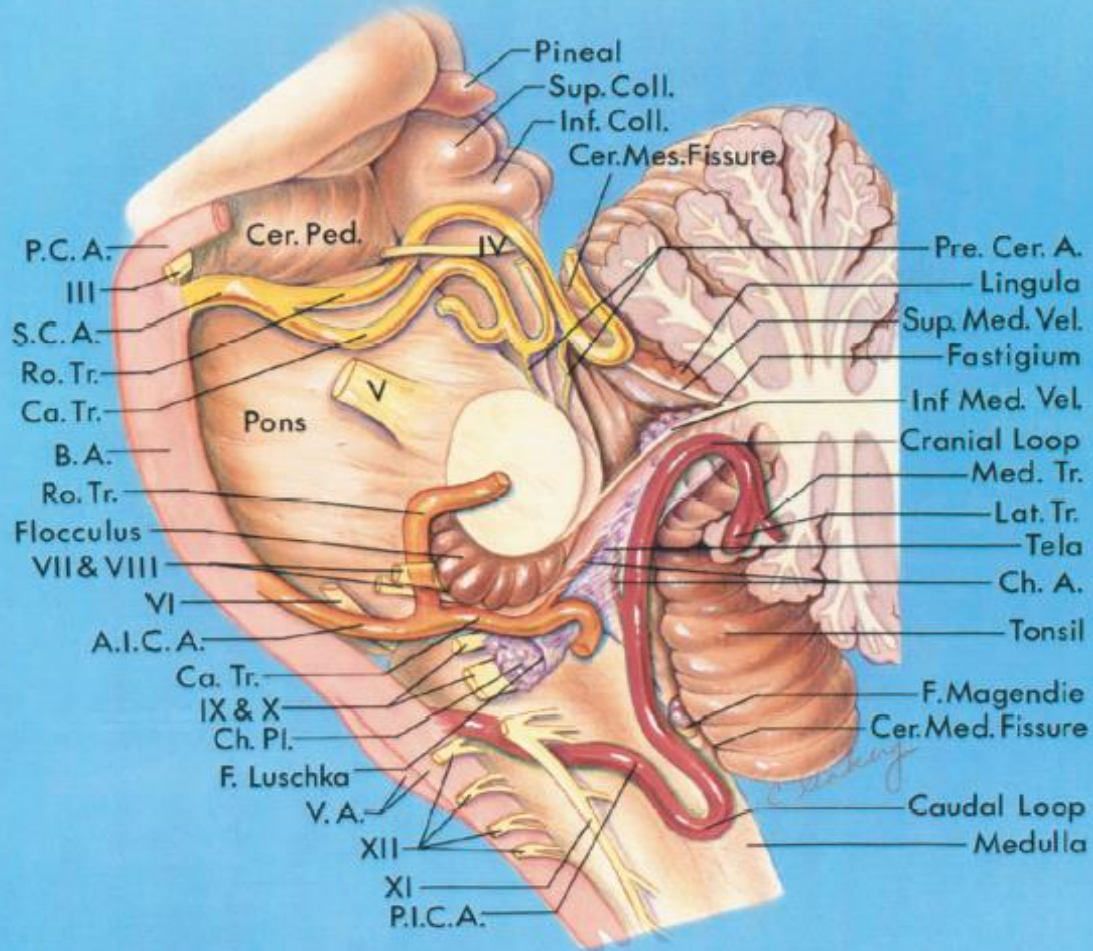
# Occipital artery PICA origin



# Πρόσθια κάτω παρεγκεφαλιδική αρτηρία (AICA)

- ▣ SINGLE VESSEL -72%
- ▣ DUPLICATED- 26%
- ▣ TRIPLICATED-2%
- ▣ ORIGIN LOWER BA

# B





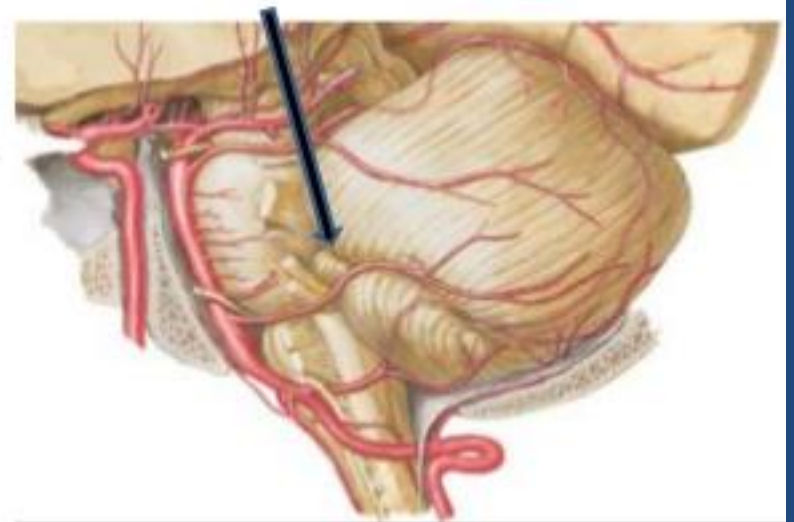
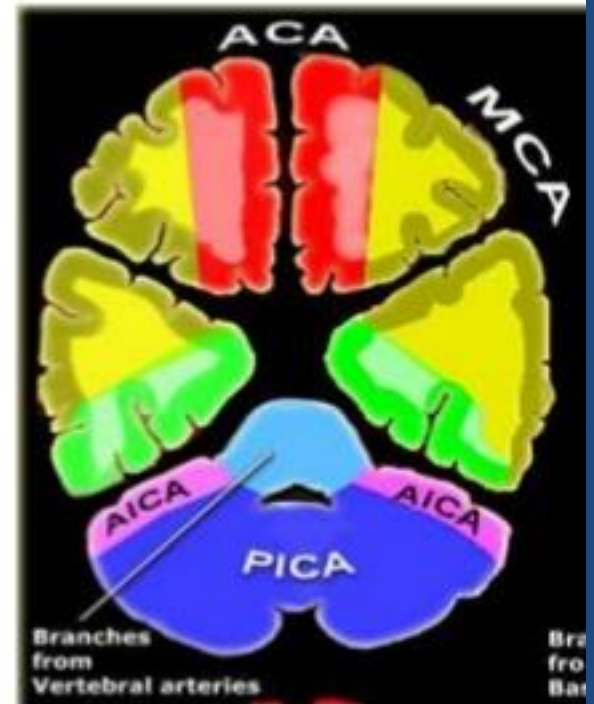
# AICA BRANCHES

- ▣ Perforators
- ▣ Internal auditory(labyrinthine) artery
- ▣ 2 major branches in the CPA
  - Lateral rostral branch(horizontal fissure between superior and inferior semilunar lobule)
  - Medial caudal branch (biventral lobule)

# Branches

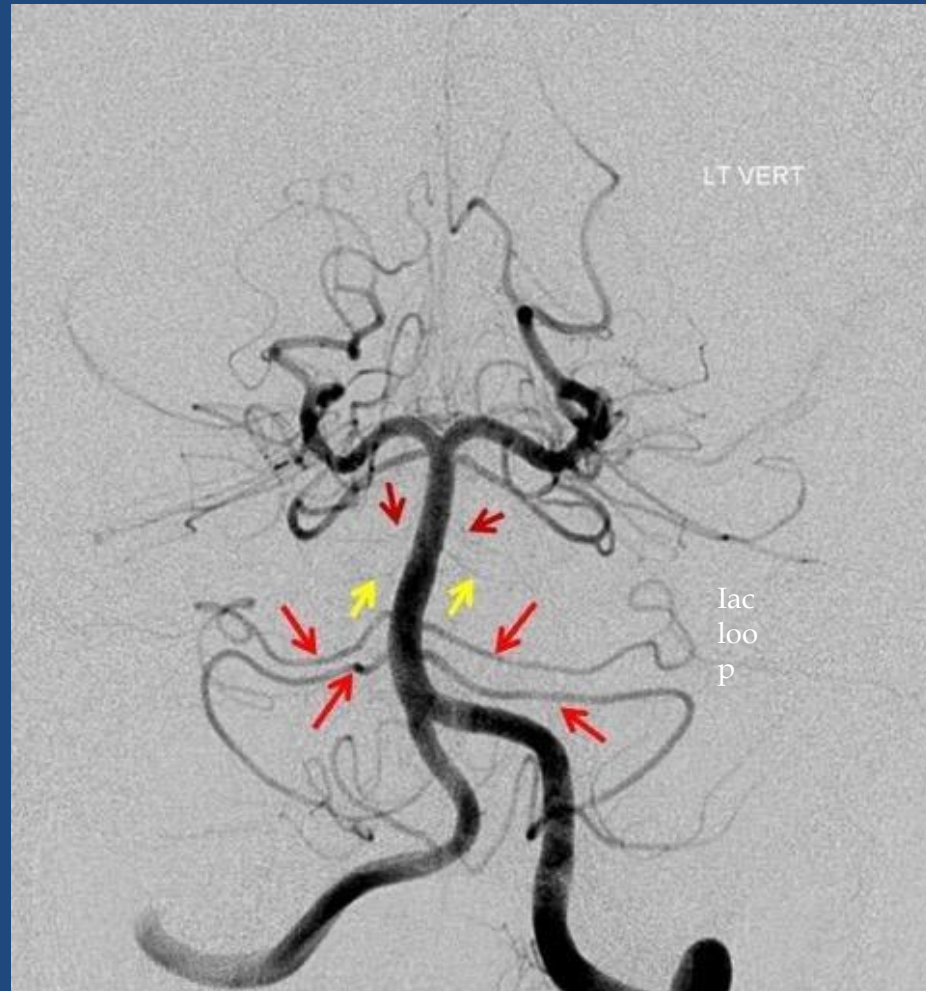
## 1. AICA – Anterior Inferior Cerebellar Artery

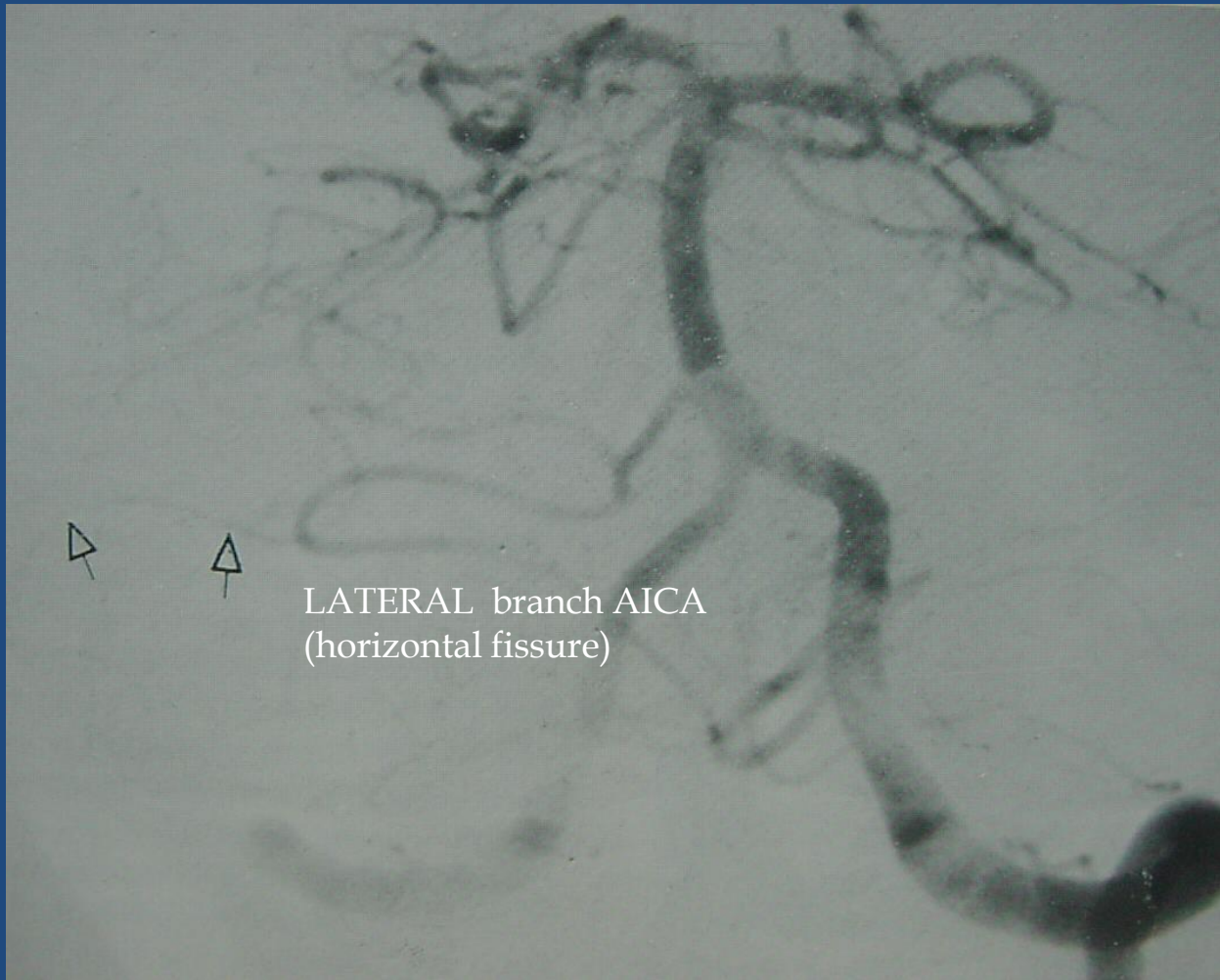
- 1<sup>st</sup> major branch.
- Posterior laterally in cerebellopontine angle cistern.
- Supplies-
  - Inferolateral pons
  - Middle cerebellar peduncle
  - Flocculus
  - Anterolateral cerebellar hemisphere





# Duplicate AICA's





LATERAL branch AICA  
(horizontal fissure)

# AICA SUPPLY

- No supply to posteromedial medulla even in the setting of AICA  
PICA variant

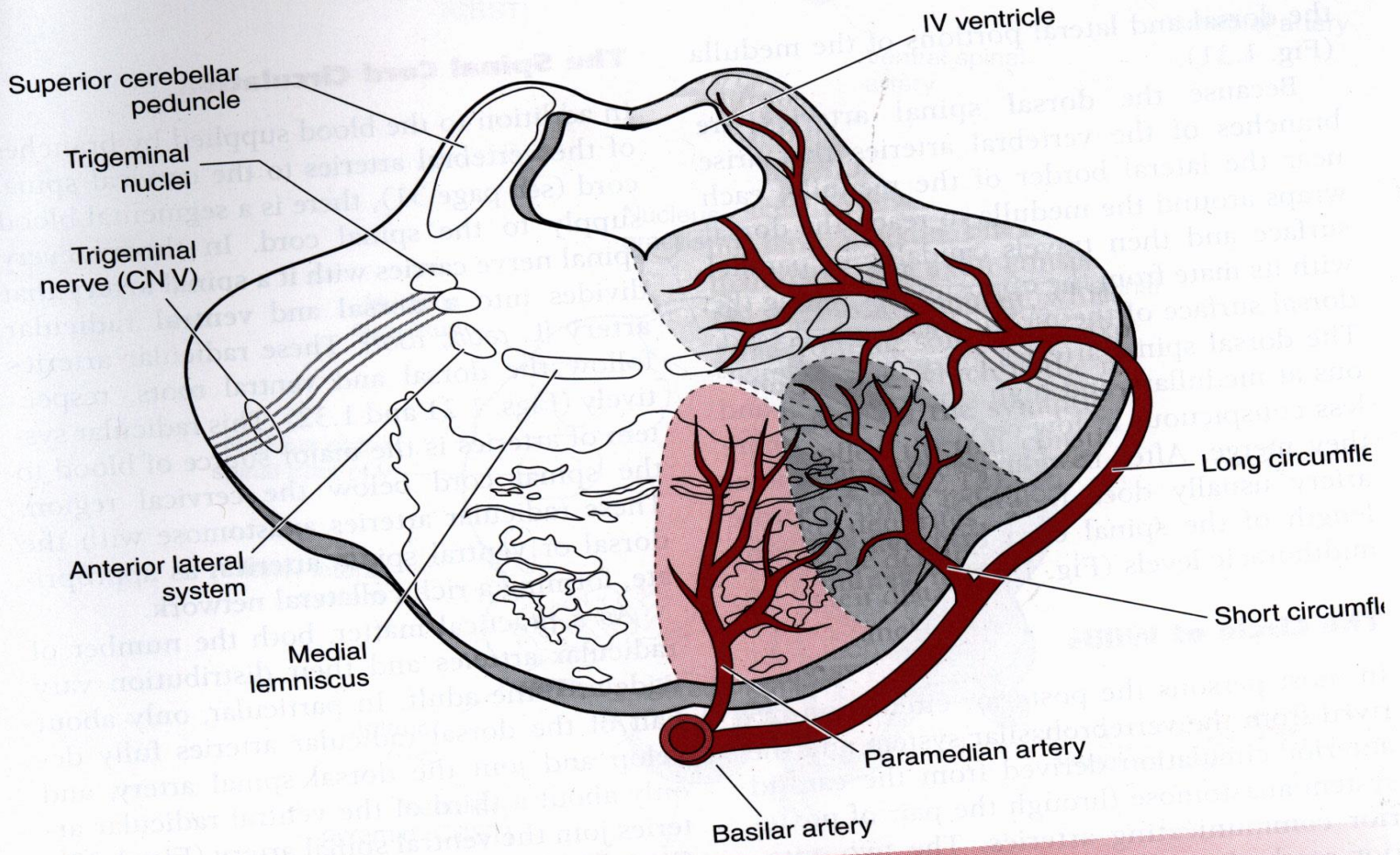
# Βασική αρτηρία

- ▣ Fusion of bilateral longitudinal neural arteries by the 6<sup>th</sup> gestational week

# Βασική αρτηρία

- Μήκος 15-40 χιλ (ΜΟ: 32χιλ)
- Διάμετρος ~4χιλ
  - Πρόσθιες κάτω παρεγκεφαλιδικές (IACA)
  - Άνω παρεγκεφαλιδικές (SCA)
- Διατιτρώντες (κυρίως γεφυρικοί) κλάδοι
  - Περίπου 17 ζεύγη
  - Μέσοι κλάδοι
    - Κάθετοι → αιμάτωση πρόσθιας μέσης γραμμής
  - Βραχείς – μακρείς περισπώμενοι κλάδοι
    - Πλάγια επιφάνεια γέφυρας



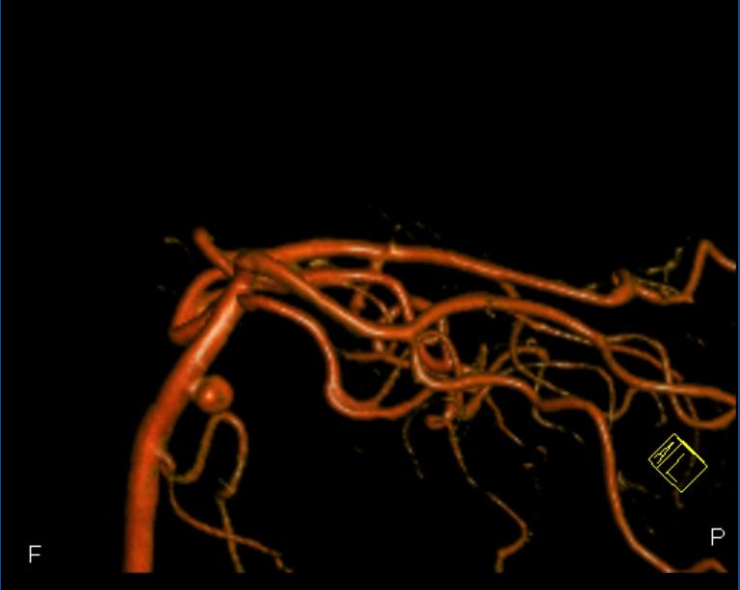




BA perforators

12/30/1955  
051Y  
IM:1

09:44:19

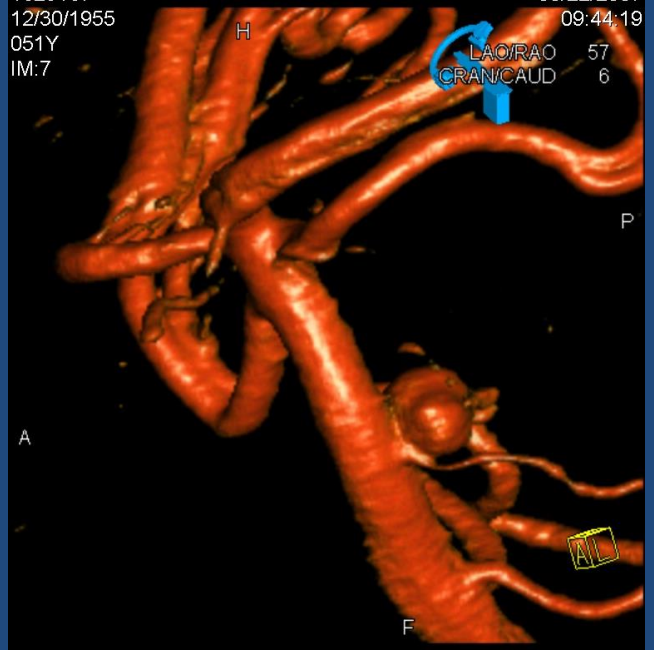


08/22/2007  
W 249 : L 125

<VRT Collection>  
ARTERIOGRAM

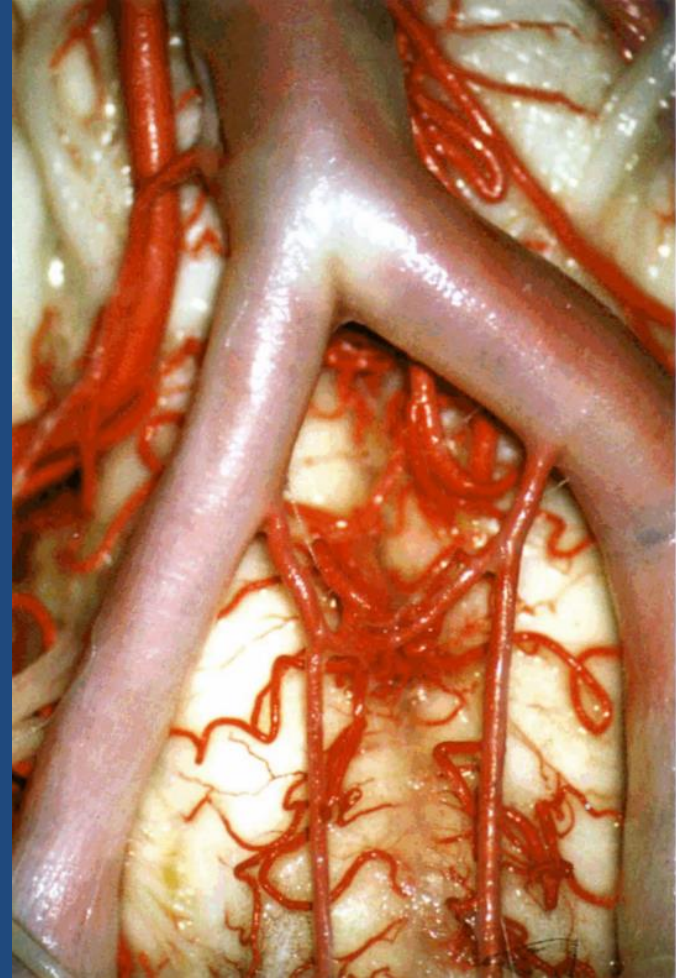
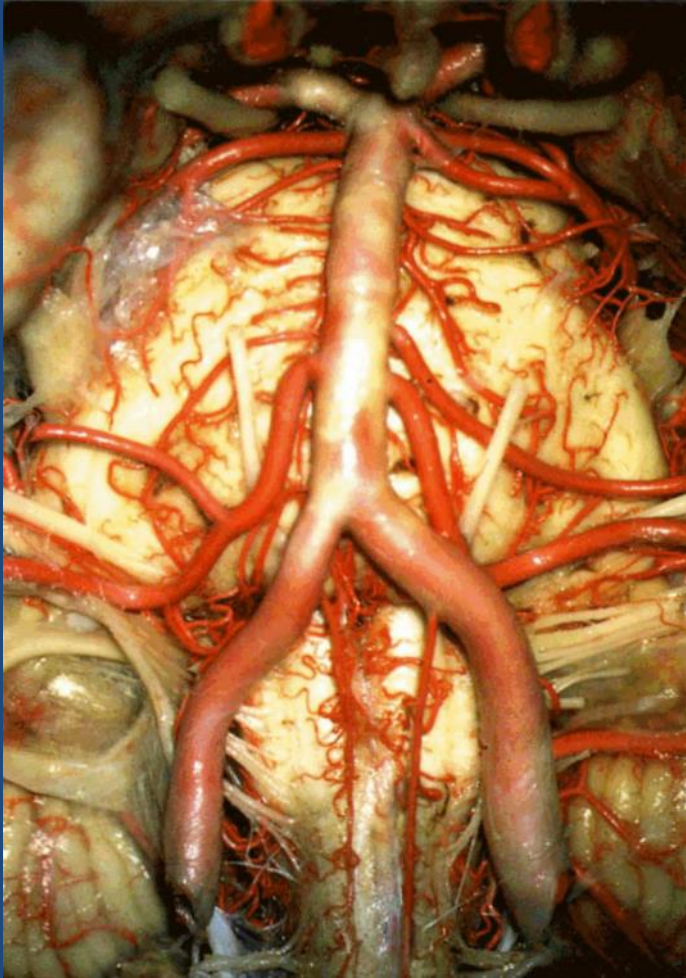
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08/22/2007  
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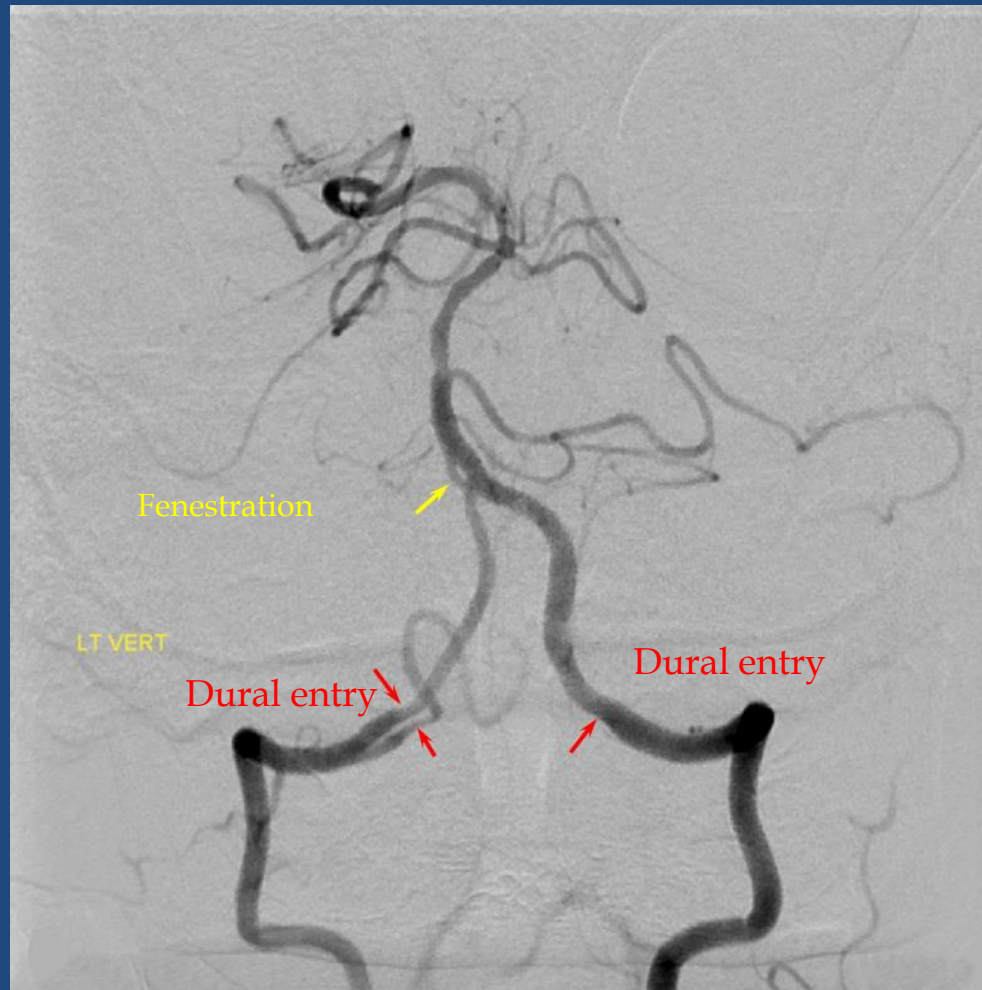


08/22/2007  
W 249 : L 125

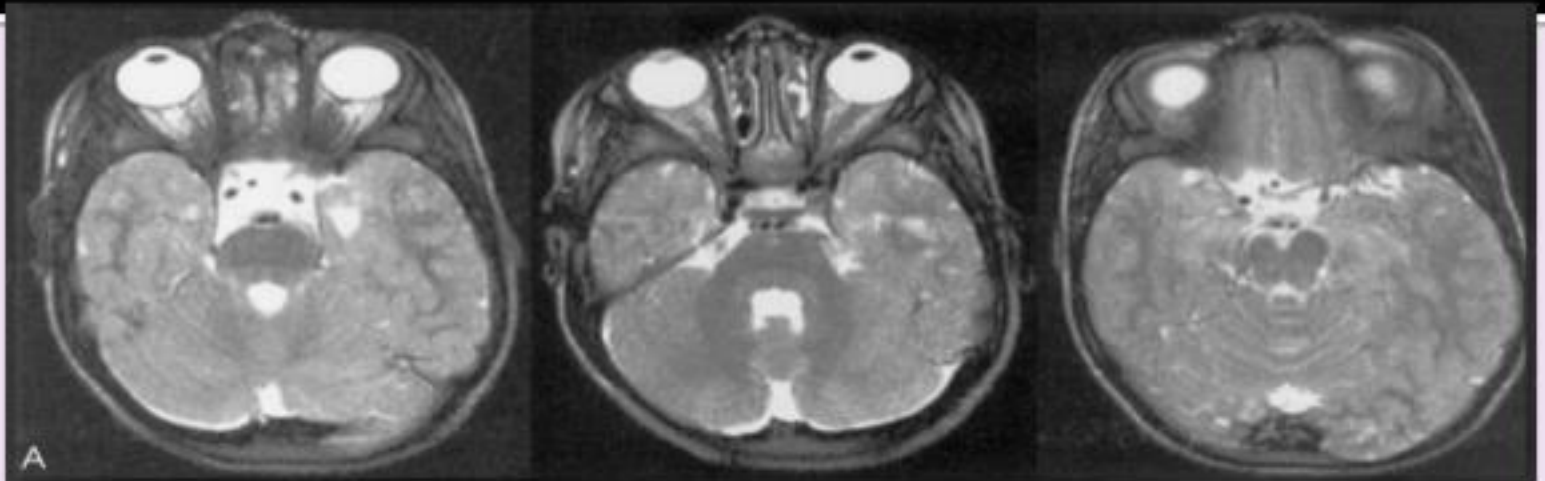
<VRT Collection>  
ARTERIOGRAM



# Ba fenestration 1-5%



# Variants - Nonfused basilar





LT VERT

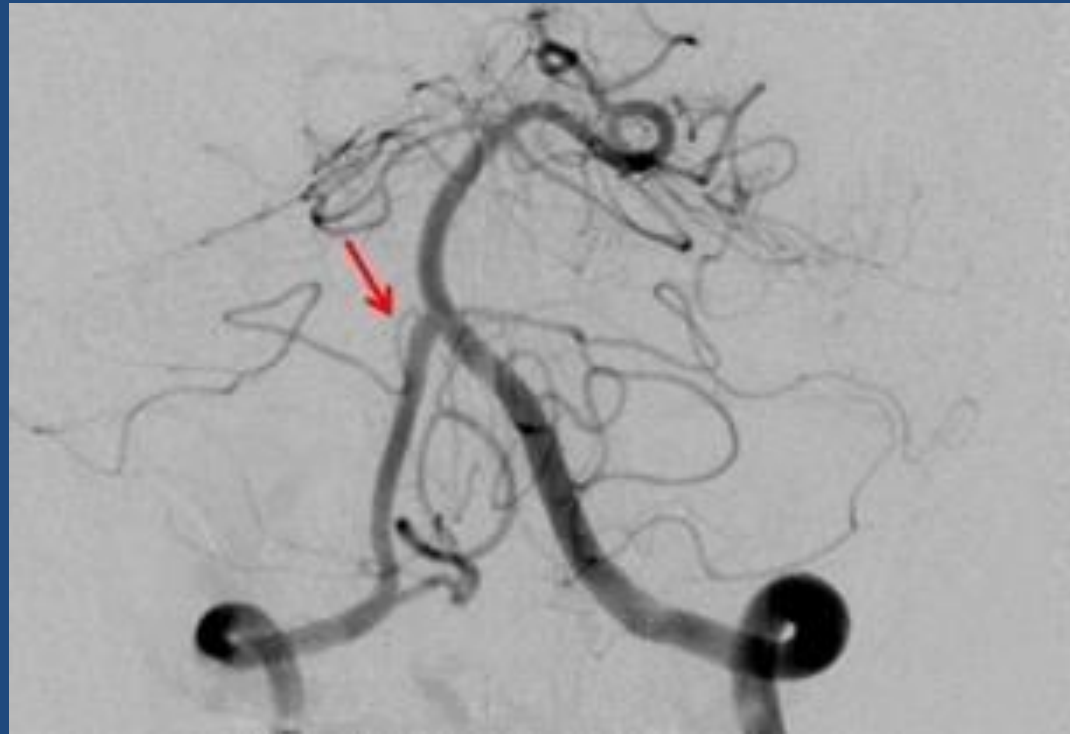


LT VERT



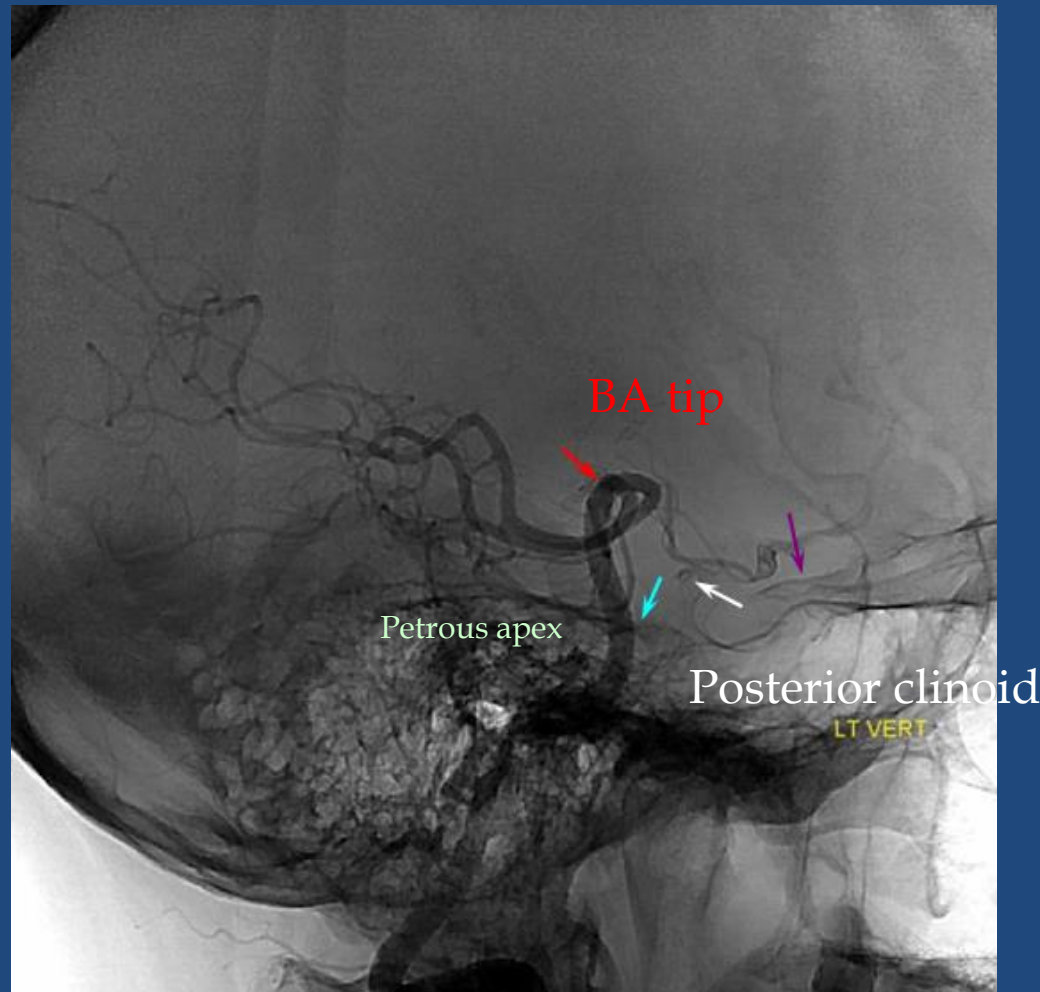
LT VERT

# AICA ORIGIN VA -high VB- junction



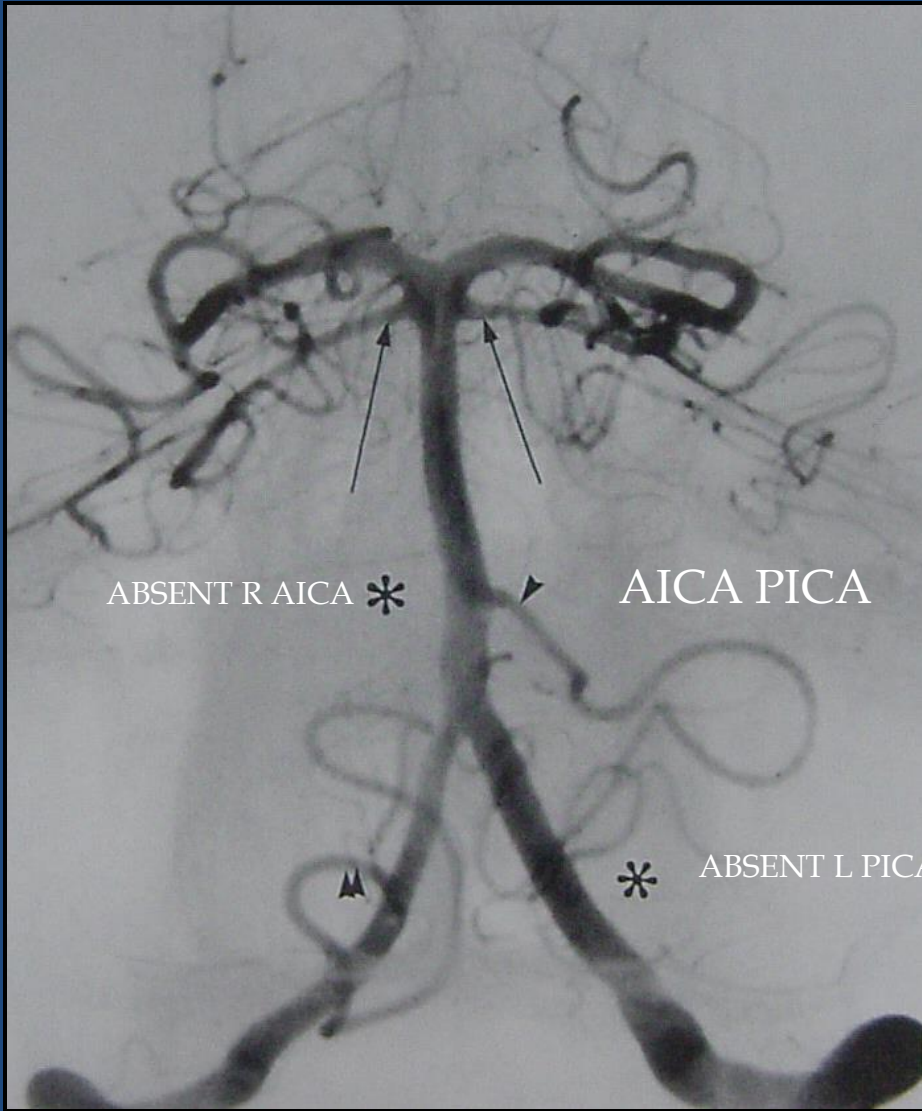


# High riding BA



# SUPERIOR CEREBELLAR ARTERY

- ▣ ABSENCE -RARE
- ▣ SINGLE TRUNK 86%
- ▣ DUPLICATE TRUNK- 14%
- ▣ BILATERAL DUPLICATE SCA's- 2%
- ▣ TRIPLICATED SCA's -RARE



Symmetric SCA's

Asymmetric  
AICA  
PICA

# SCA

## SEGMENTS

- ▣ ANTERIOR PONTO MESENCEPHALIC
- ▣ LATERAL PONTO MESENCEPHALIC (ambient)  
(parallel PCA)
- ▣ CEREBELLO MESENCEPHALIC (Quadrigeminal)
- ▣ CORTICAL

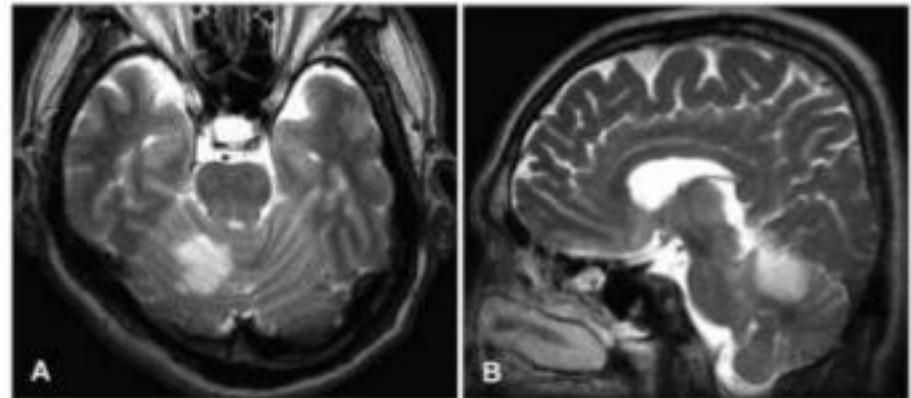
# SCA

## BRANCHES

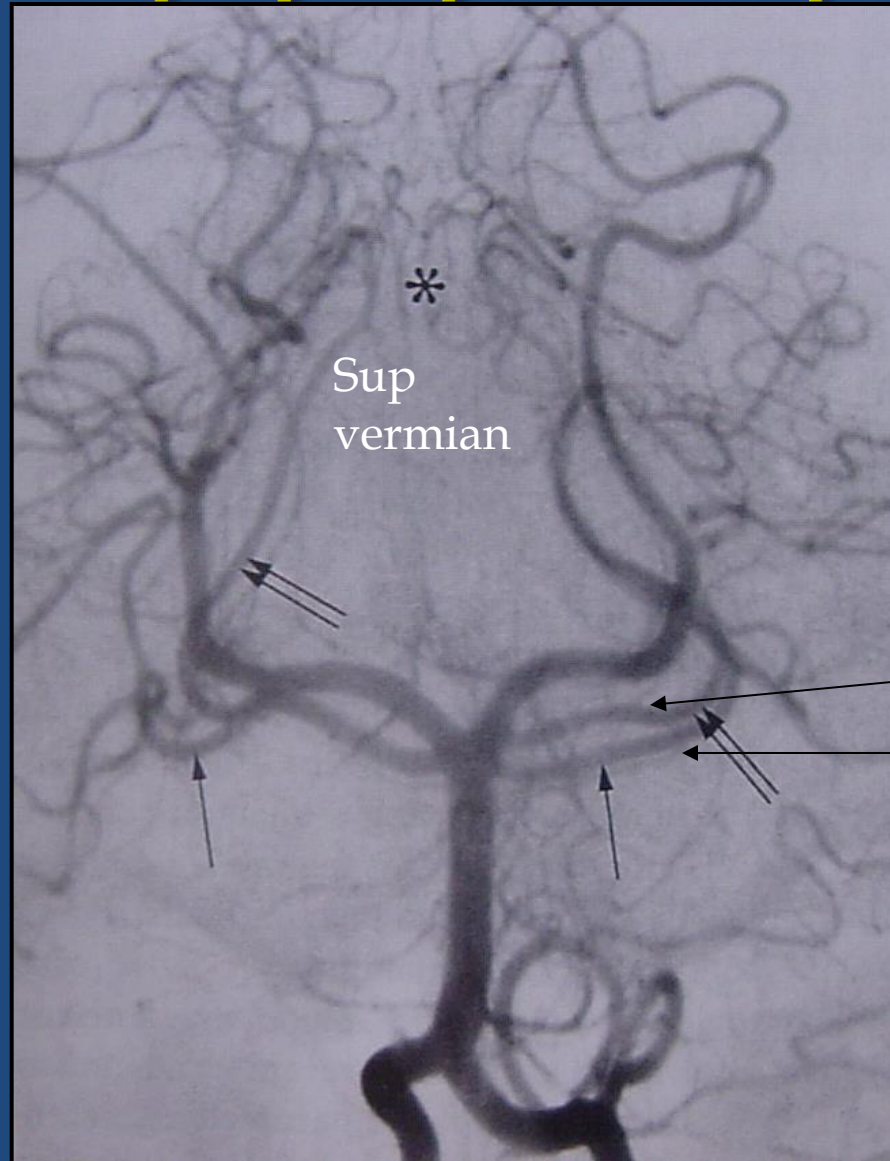
- ▣ PERFORATORS
- ▣ PRE-CEREBELLAR deep cerebellar nuclei, inferior colliculi
- ▣ CORTICAL
  - HEMISPHERIC
  - VERMIAN
  - MARGINAL BRANCH
- ▣ Internal auditory artery, if not from AICA,BA

## SCA- Superior Cerebellar Artery –

- Arises from BA apex.
- Supplies –
  - Superior surface of vermis n cerebellar hemisphere.
  - Deep cerebellar white matter.
  - Dentate nucleus.

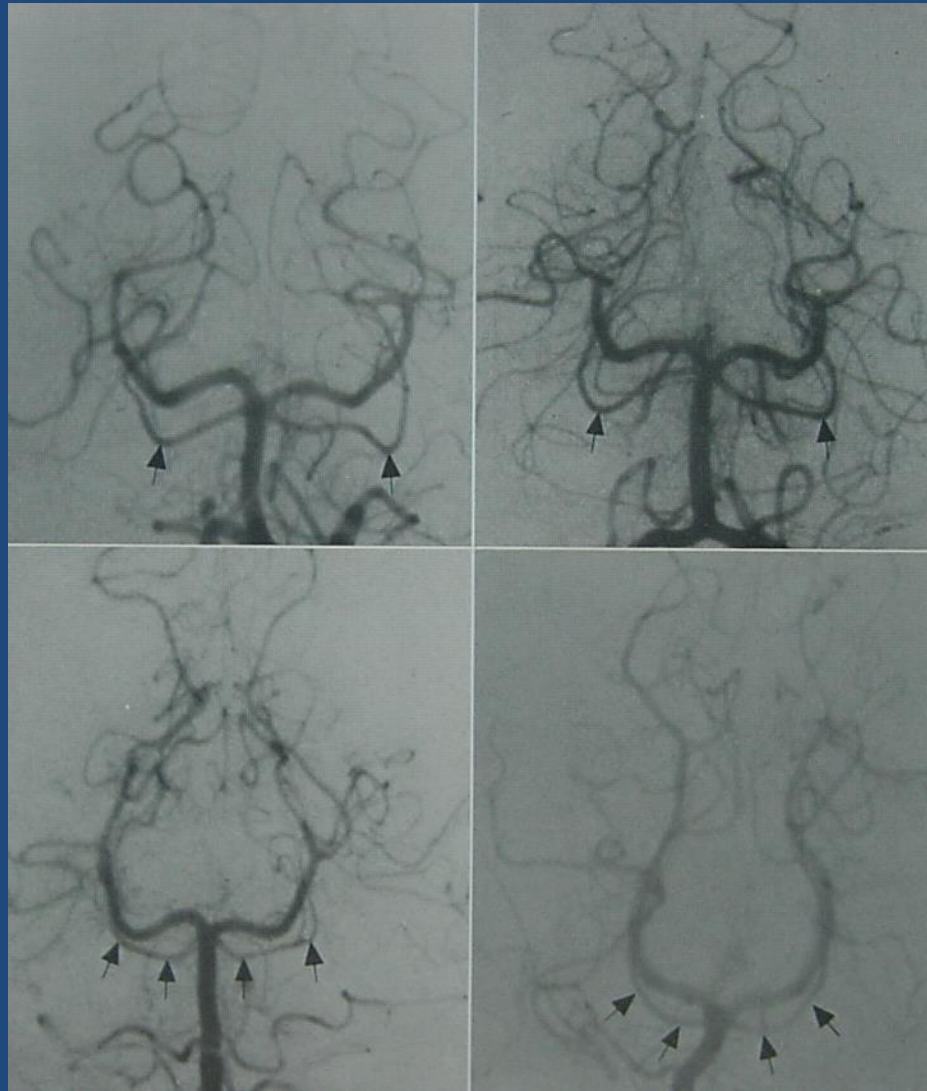


# Άνω παρεγκεφαλιδική αρτηρία



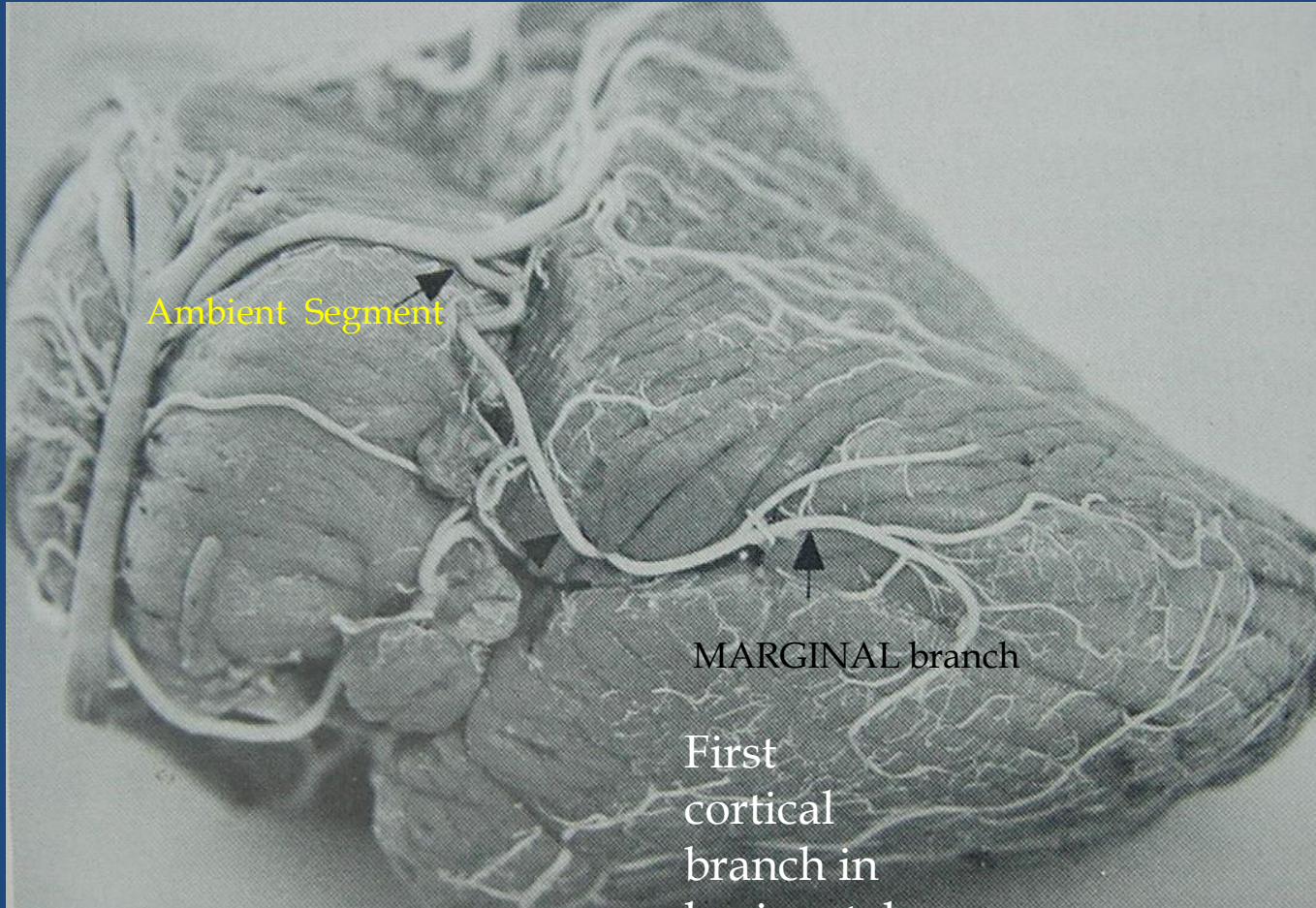
SCA  
-VERMIAN  
-HEMISPHERIC  
Duplicated SCA

TOWNE's view



ANTERIOR PONTINE SEGMENT- VARIATIONS





Ambient Segment

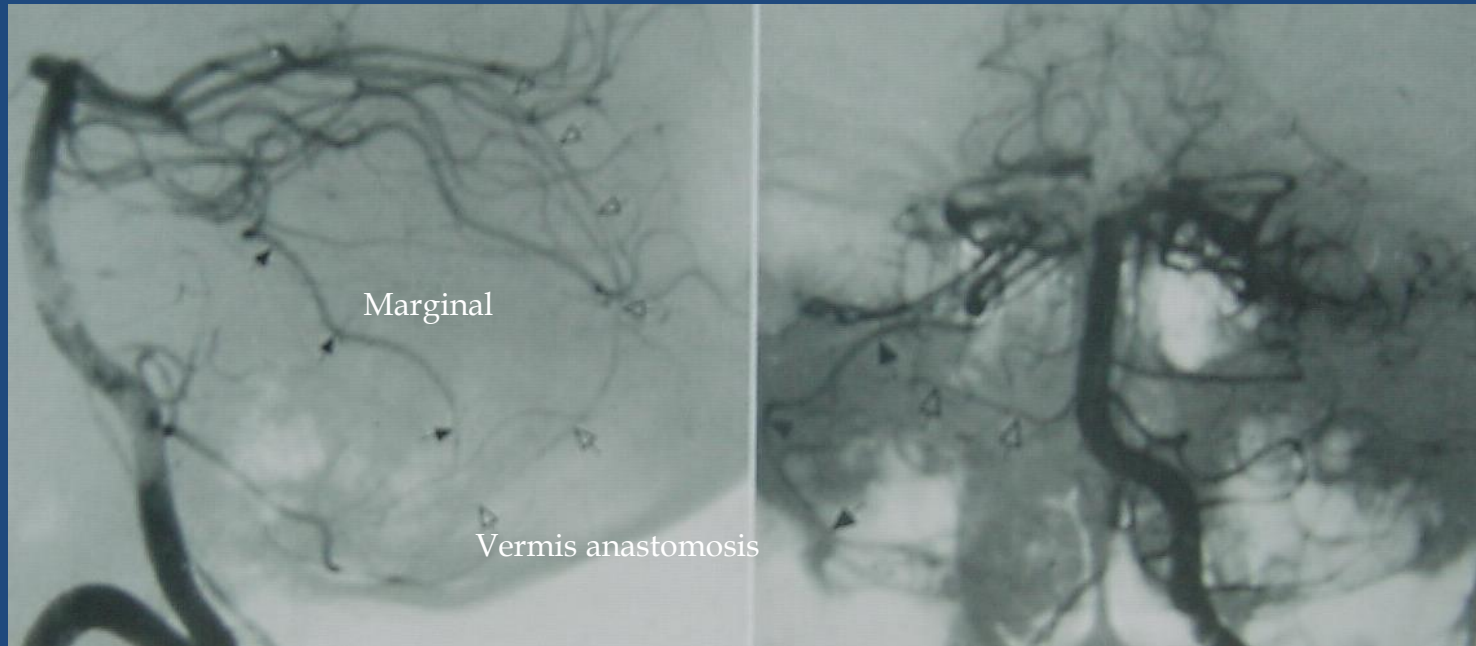
MARGINAL branch

First  
cortical  
branch in  
horizontal  
fissure



MARGINAL branch  
(HORIZONTAL FISSURE)

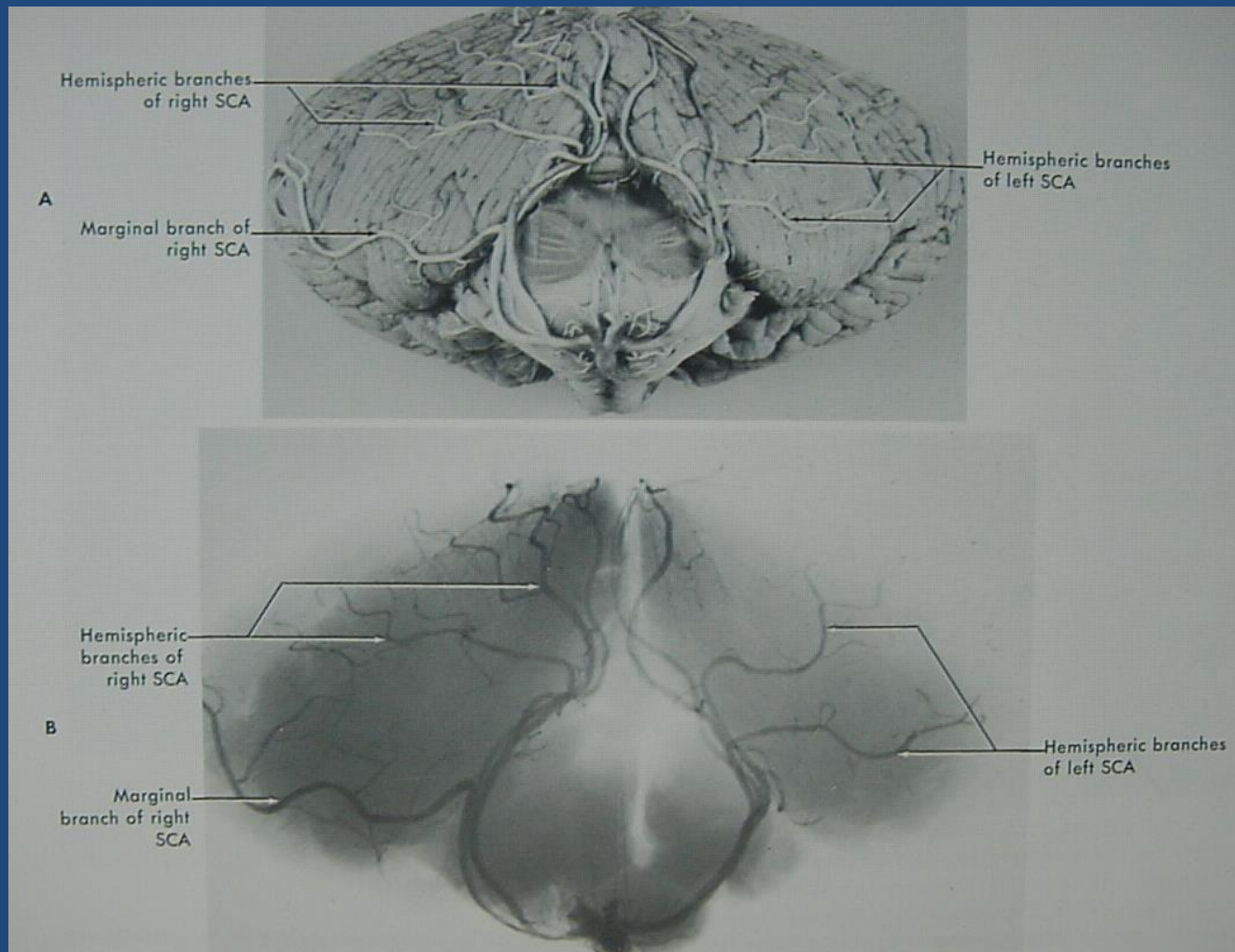
# Inferior cerebellar supply SCA



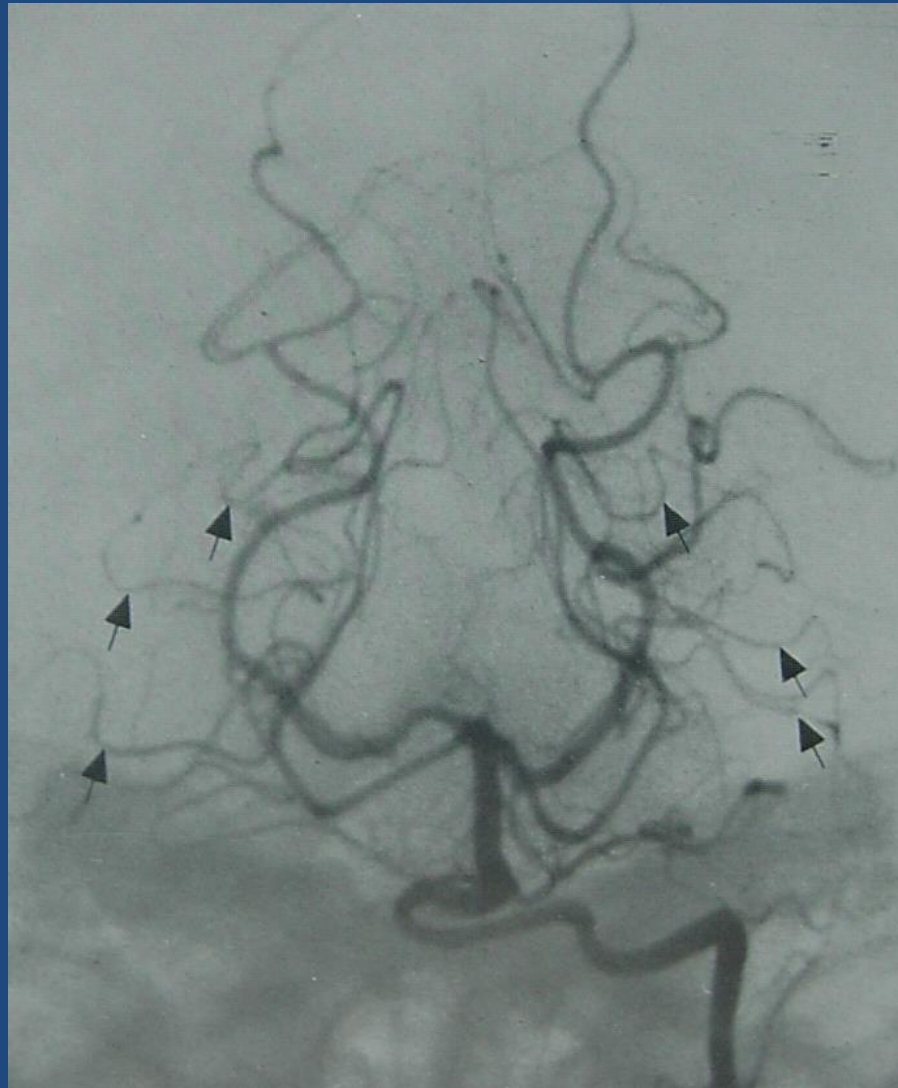
LARGE MARGINAL BRANCH

RT VERT HYPOPLASIA/ ABSENT P.I.C.A / SMALL AICA

# Simulated TOWNE's view

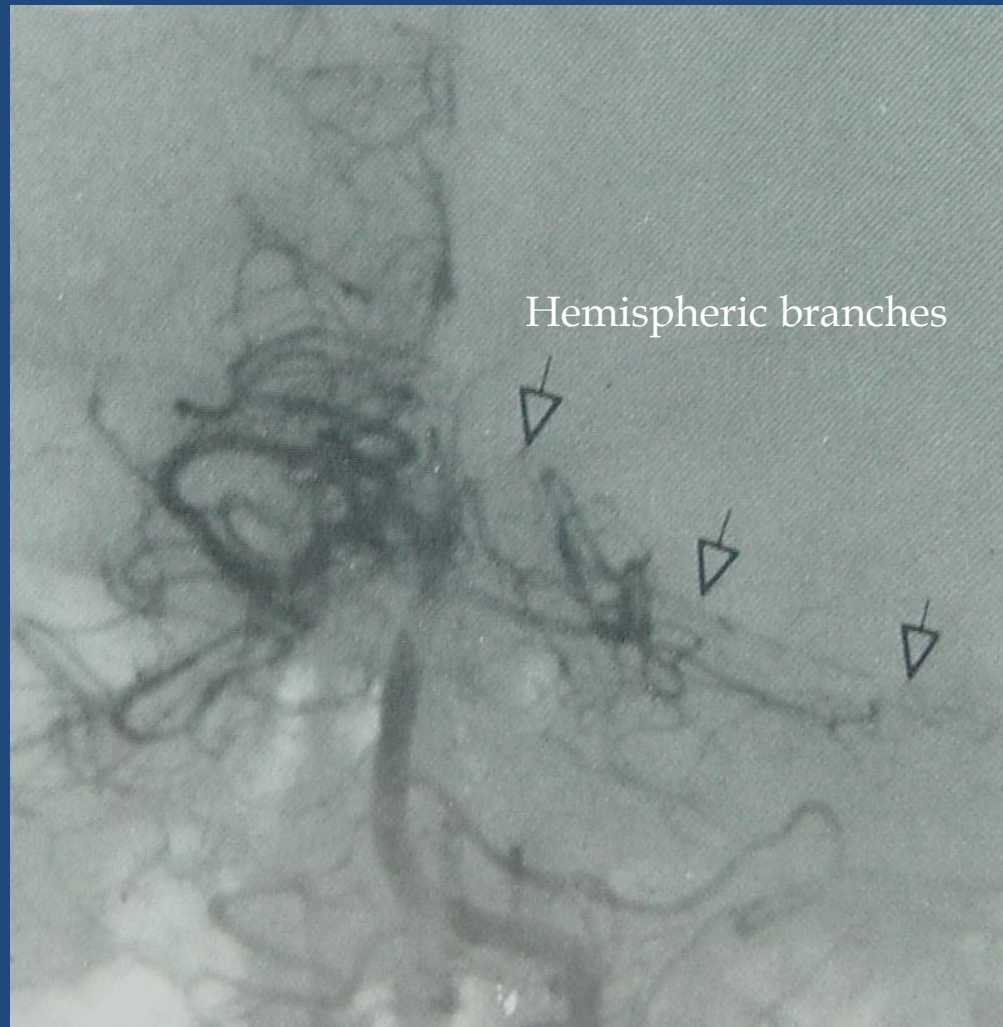


# Towne view



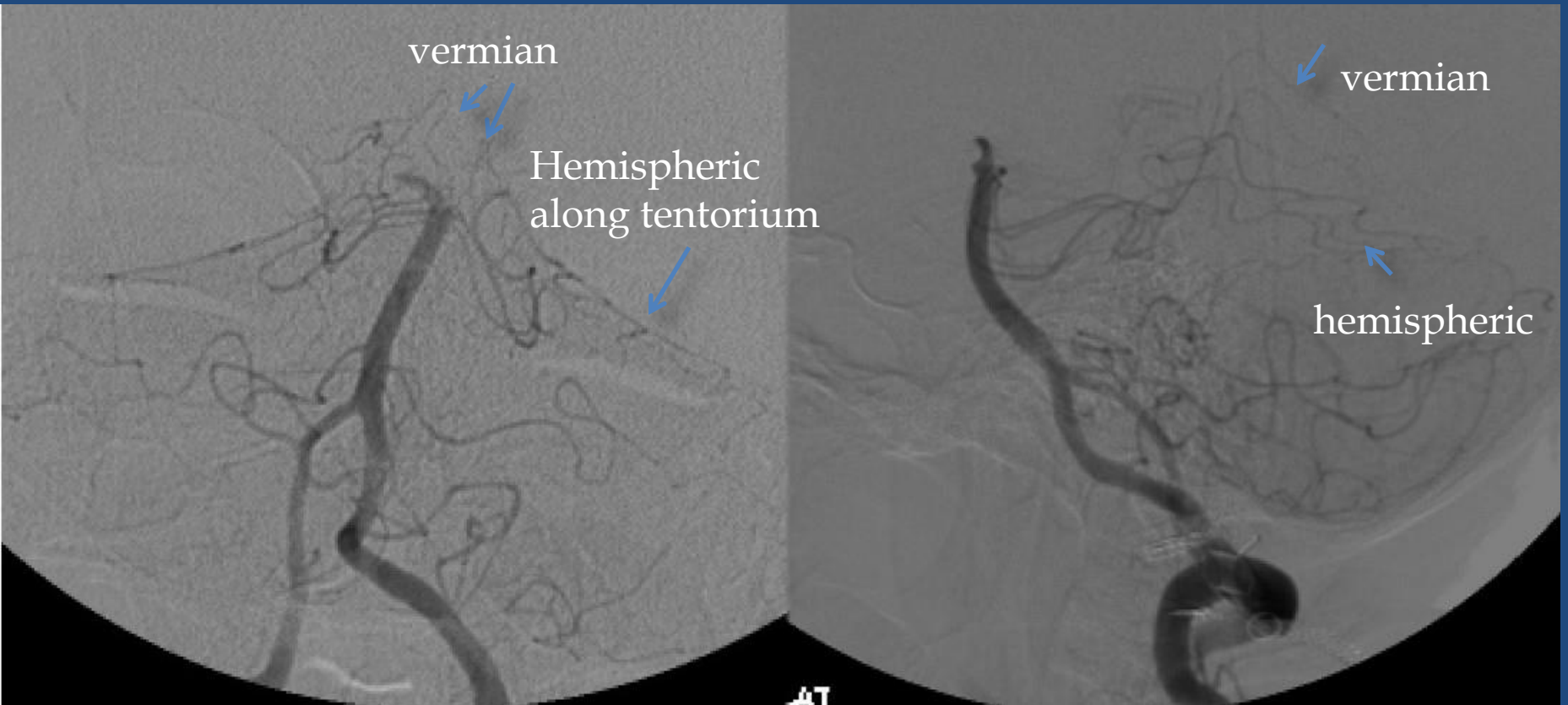
Hemispheric branches

# AP VIEW

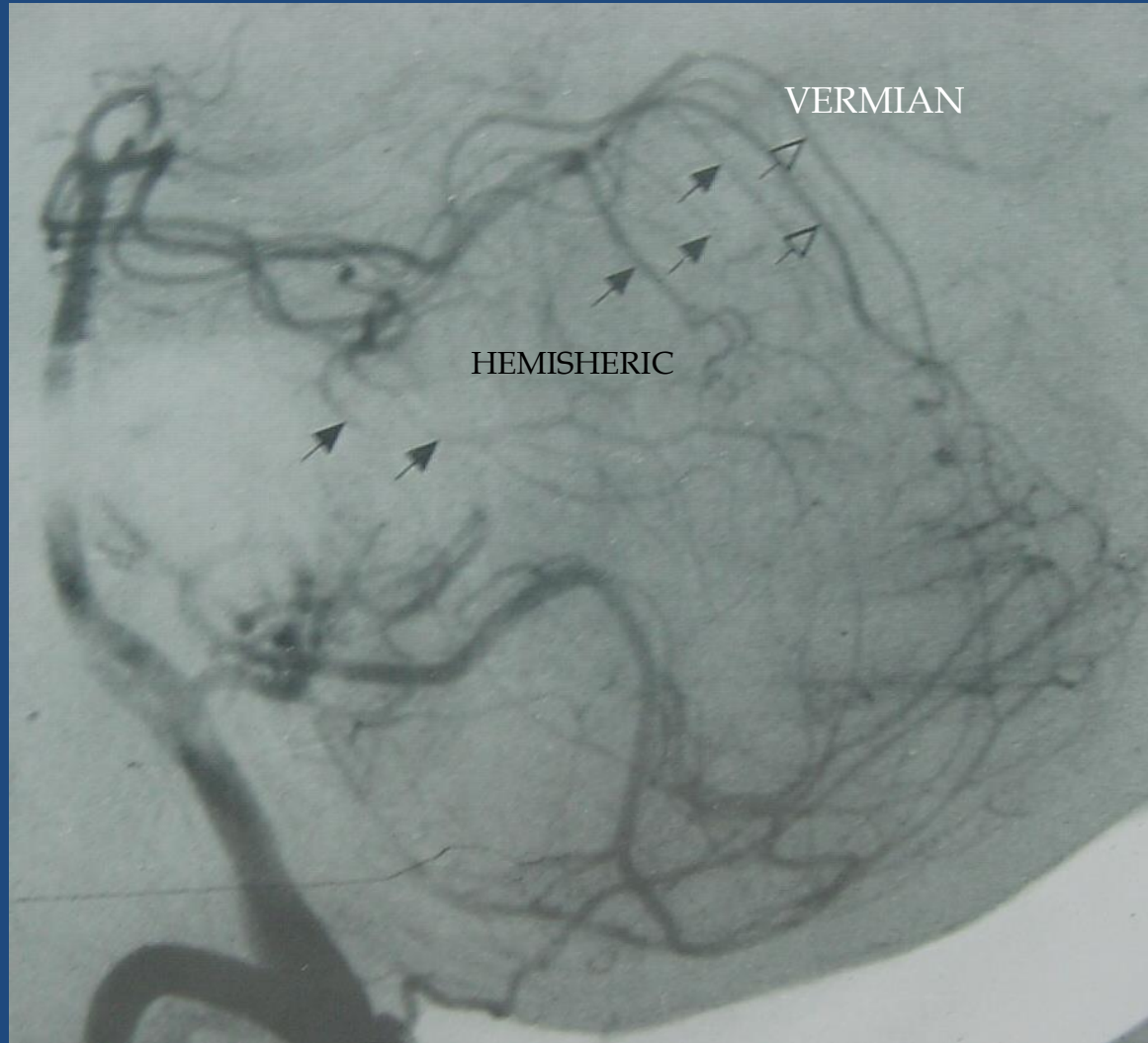


Absent L PCA

# BA tip occlusion AP VIEW



# Stepladder pattern- top stairs vermian branches

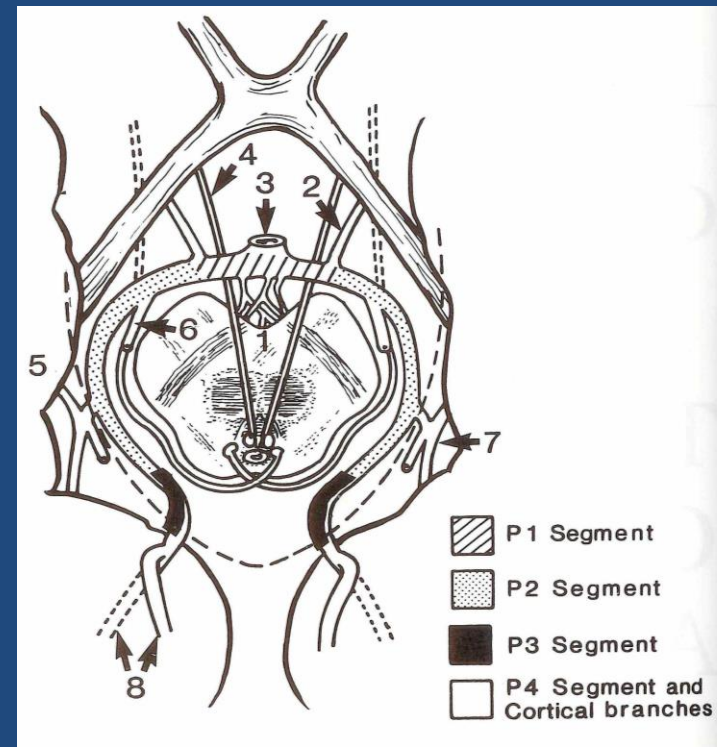


Lateral projection SCA branches



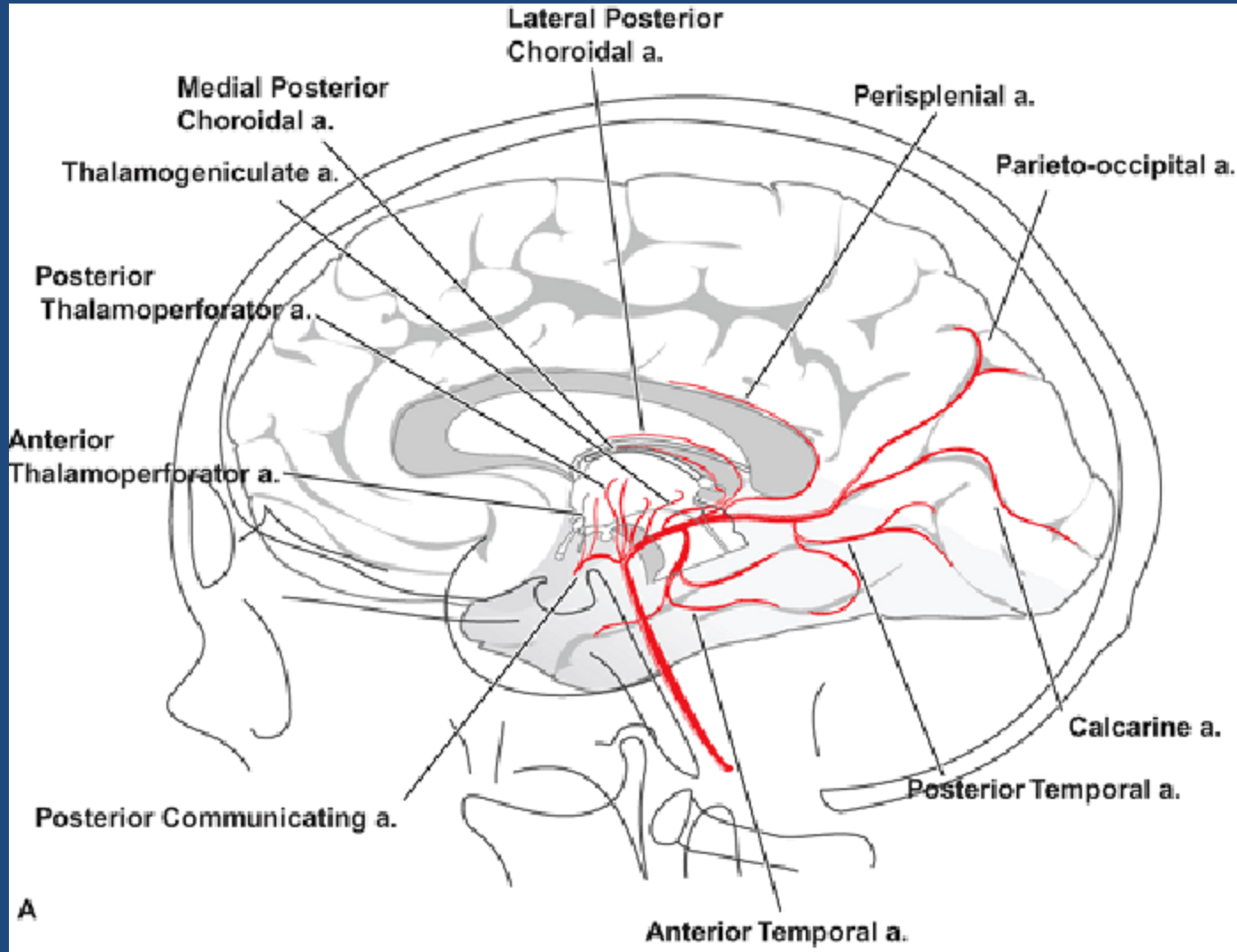
# Posterior cerebral artery Segments

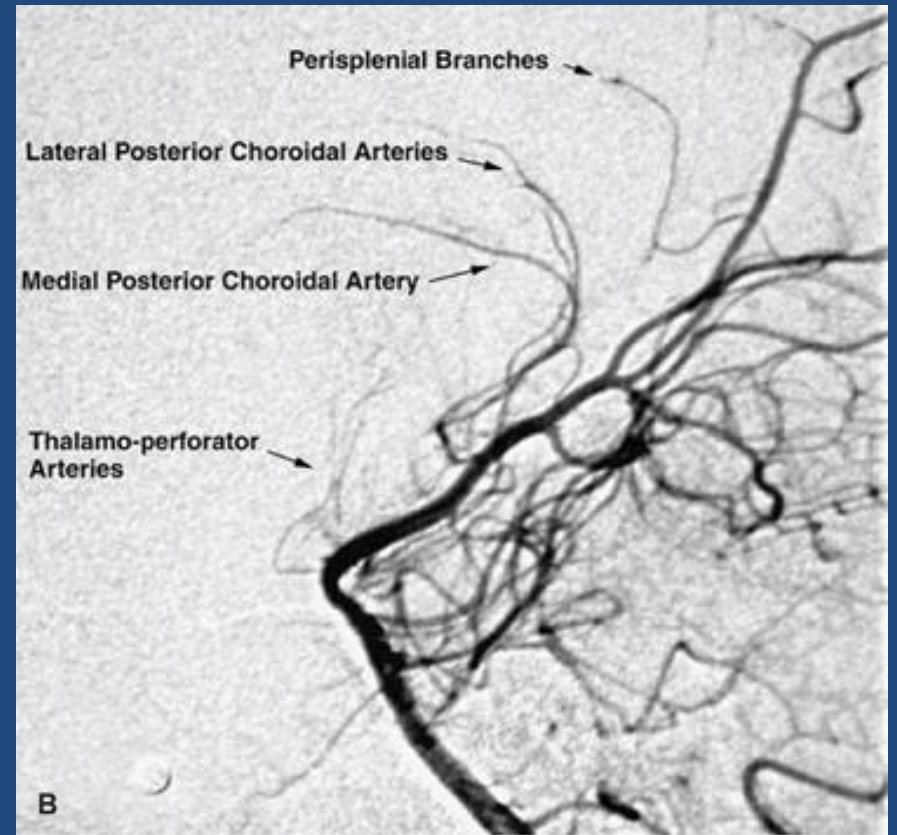
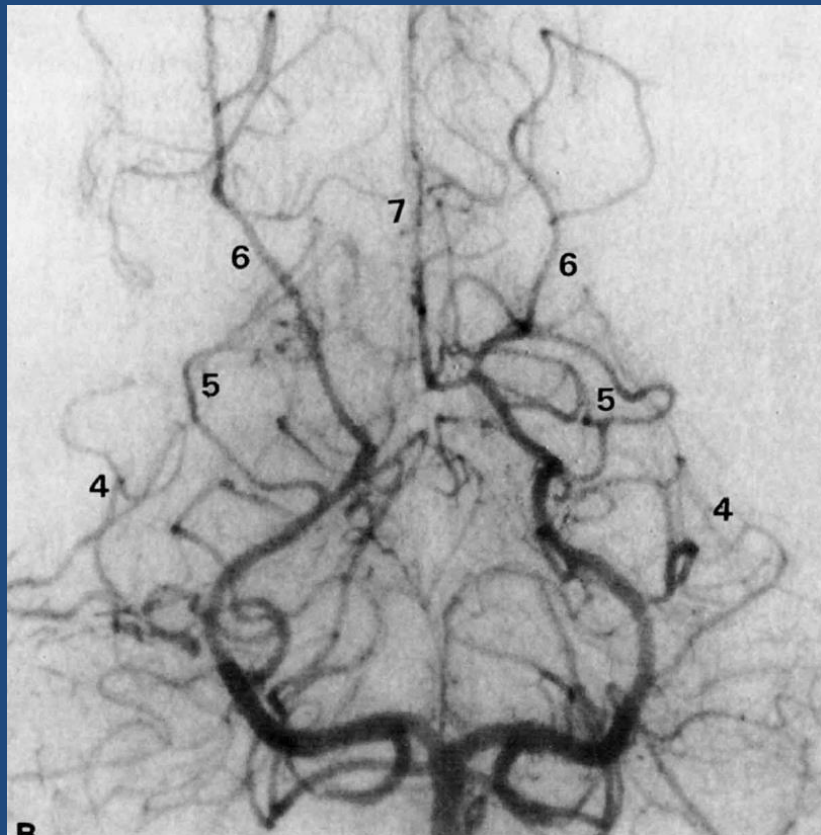
1. P1: BA-PcoA
2. P2: PcoA- posterior midbrain
3. P3: Pulvinar -anterior end of calcarine fissure
4. P4 and cortical branches

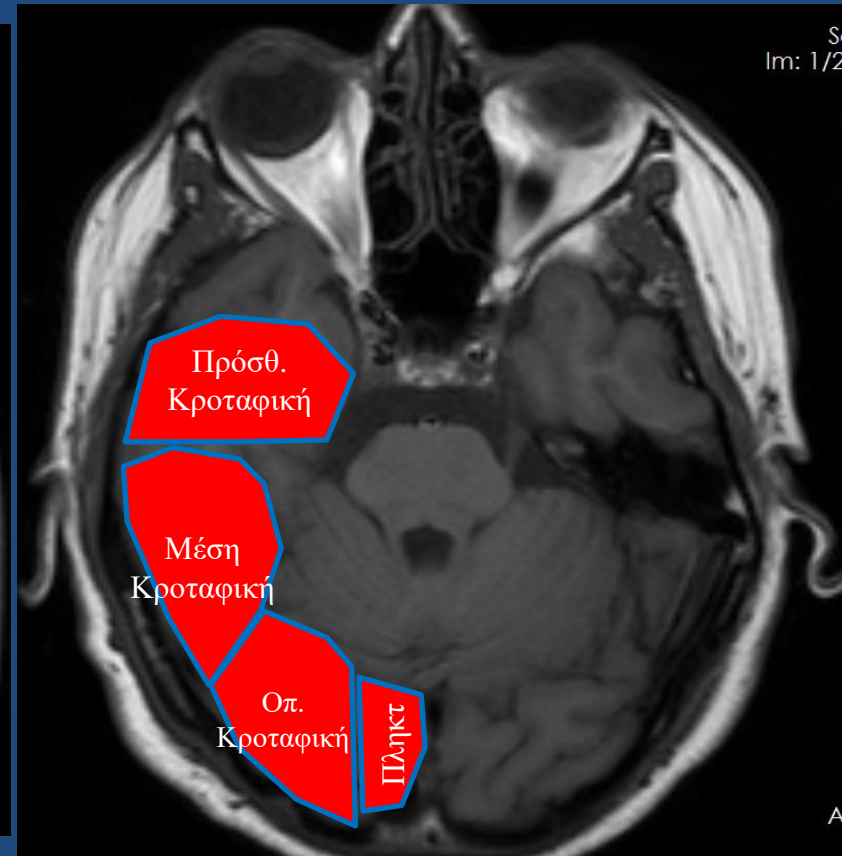
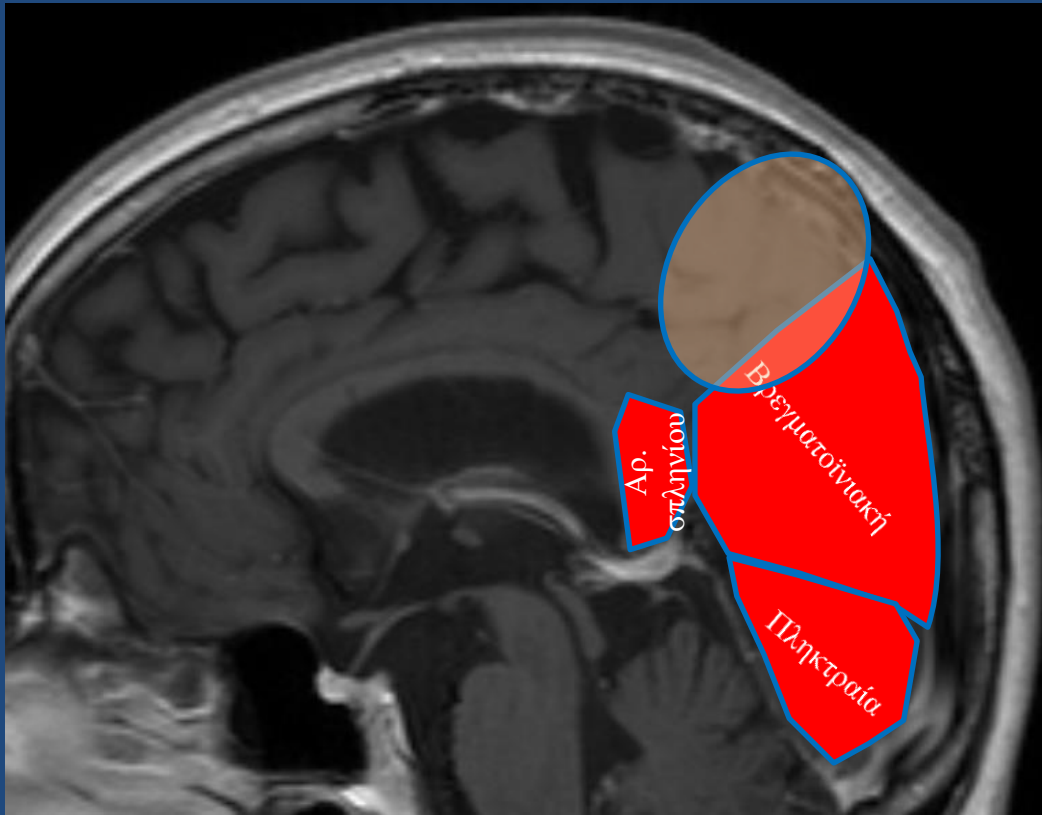


# Οπίσθια Εγκεφαλική Αρτηρία

- ▣ Εμβρυολογική προέλευση από Έσω καρωτίδα
- ▣ Τμηματική ανατομία
  - P1 Μέχρι την οπίσθια αναστομωτική
  - P2 Μέχρι το τετράδυμο πέταλο
  - P3 μέχρι πρόσθια πληκτραία σχισμή
  - P4 Φλοιικοί κλάδοι
- ▣ Κλάδοι
  - Διατιραίνωντες
    - ▣ Θαλαμοραβδωτές - Θαλαμογονατώδεις
  - Ενδοκοιλιακοί
    - ▣ Οπίσθιες έσω-έξω χοριοειδείς
  - Φλοιικοί
    - ▣ Κροταφικοί - Σπληνική - Πληκτραία - Βρεγματοϊνιακή







# Basilar tip anatomical disposition

- ▣ Angiographic landmark: site of origin of SCA (P1(**caudal**) vs Basilar artery trunk (**cranial**))
- ▣ Symmetrical vs asymmetrical

# Thalamoperforating branches with bilateral supply



# Asymmetrical caudal fusion: mesencephalo-diencephalic perforators from most cranial P1





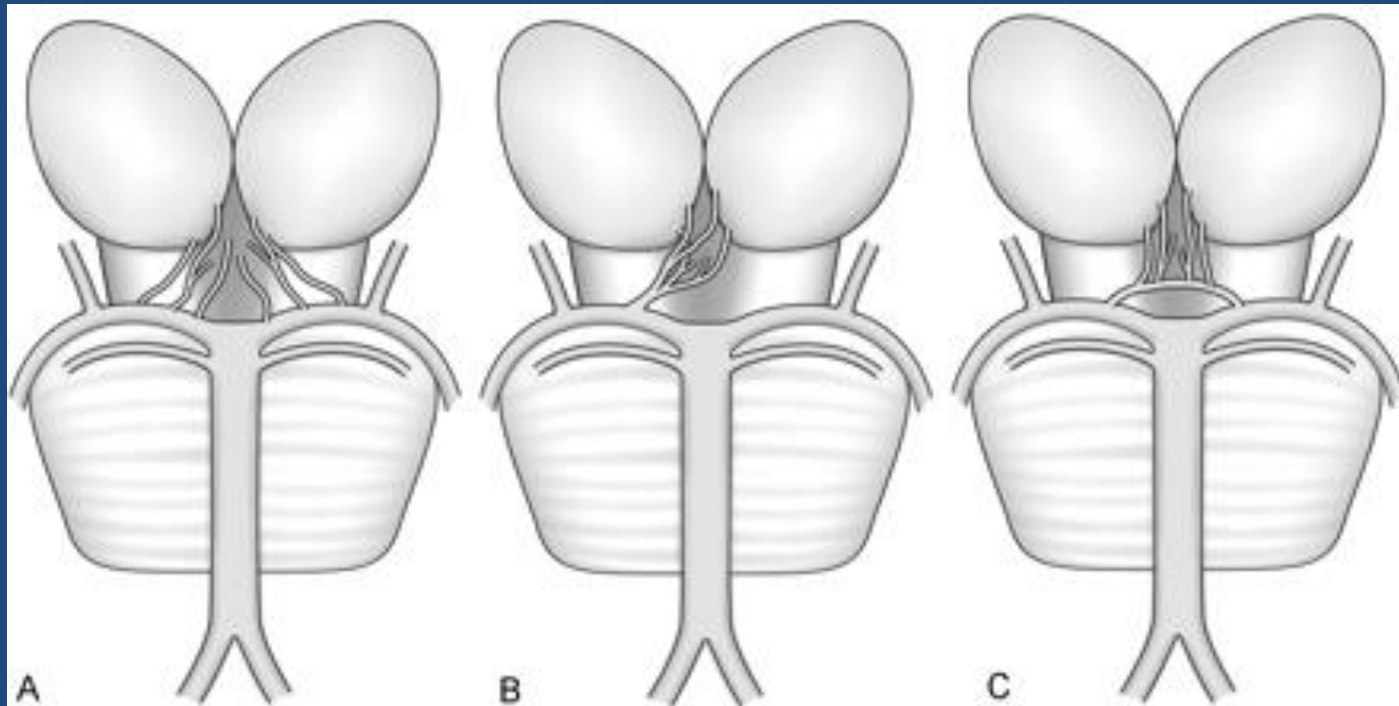
# Cranial fusion disposition

Bilateral perforator distribution from each P1 segment is more common

# Caudal fusion disposition

Less likely to have a common bilateral trunk for the perforators

# Variation of paramedian thalamic-mesencephalic arterial supply according to Percheron



# PCA Branches

1. Central or midbrain
2. Ventricular and choroid plexus
3. Cerebral

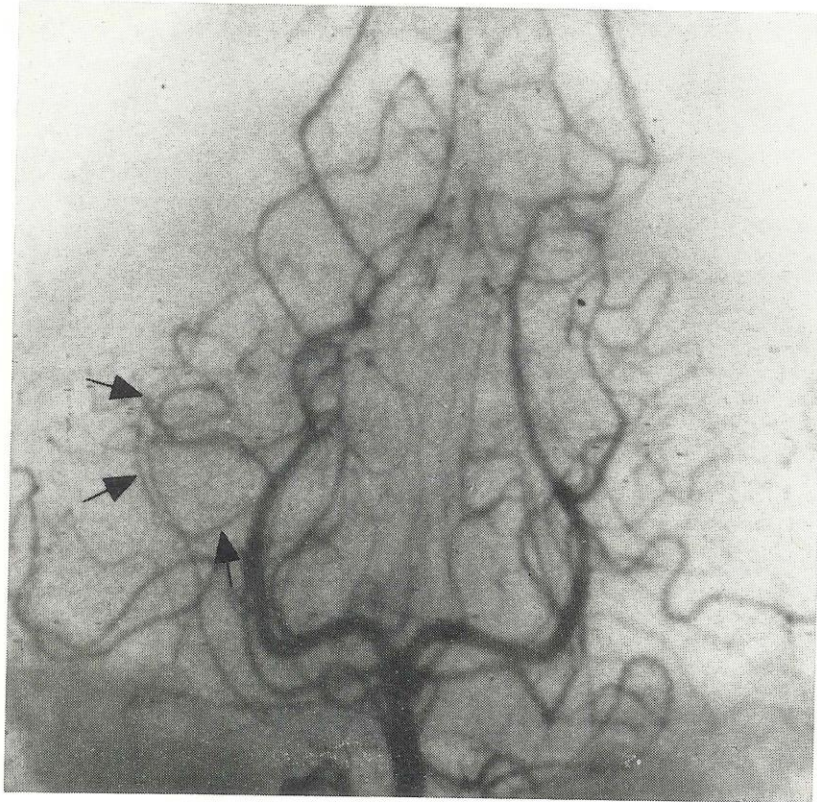
# Central or brainstem Branches

1. Direct perforating branches
  - ▣ Posterior thalamoperforating arteries arise on the posterior or superior aspect of P1 (the branch nearest to BA the largest in 56%)
  - ▣ Thalamogeniculate arteries arise on the P2 segment in the ambient cistern
  - ▣ Peduncular perforating branches on P2
2. Circumflex arteries
  - ▣ Short circumflex arteries on P2 or P1
  - ▣ Long circumflex arteries on P1 and P2

# Ventricular and Choroid plexus branches

1. Medial posterior choroidal arteries
2. Lateral posterior choroidal arteries

# Towne projection



**Fig. 65-39.** Lateral choroidal artery (arrows). Towne projection.

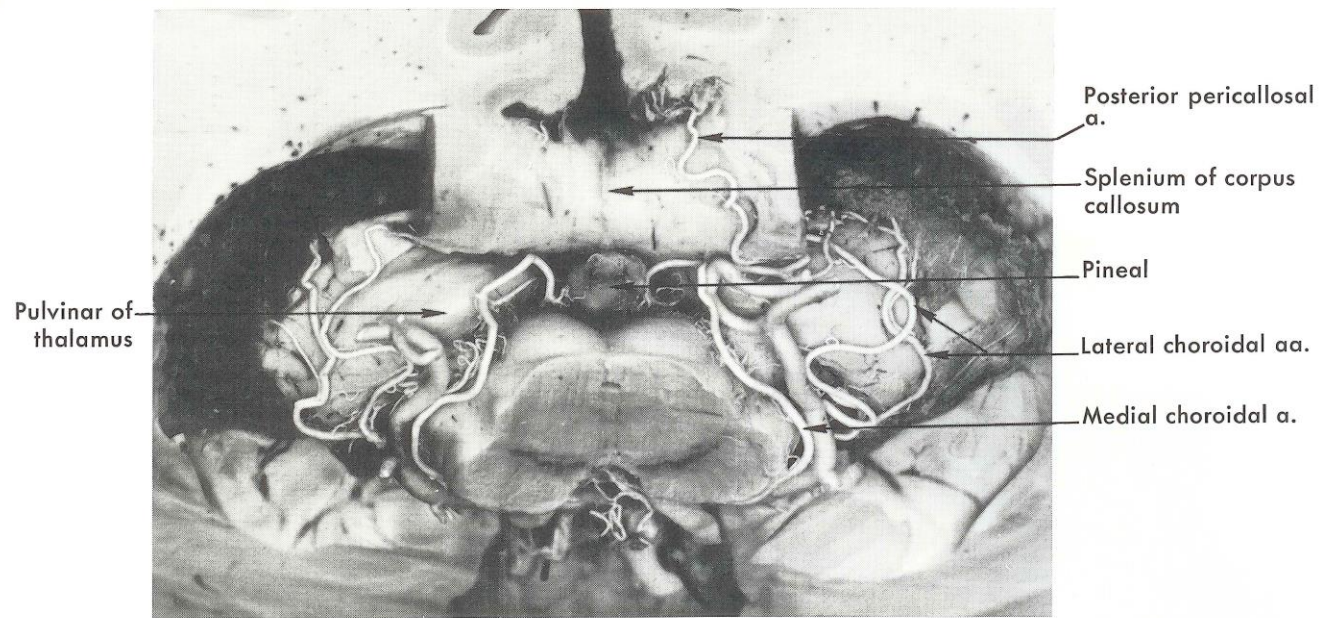


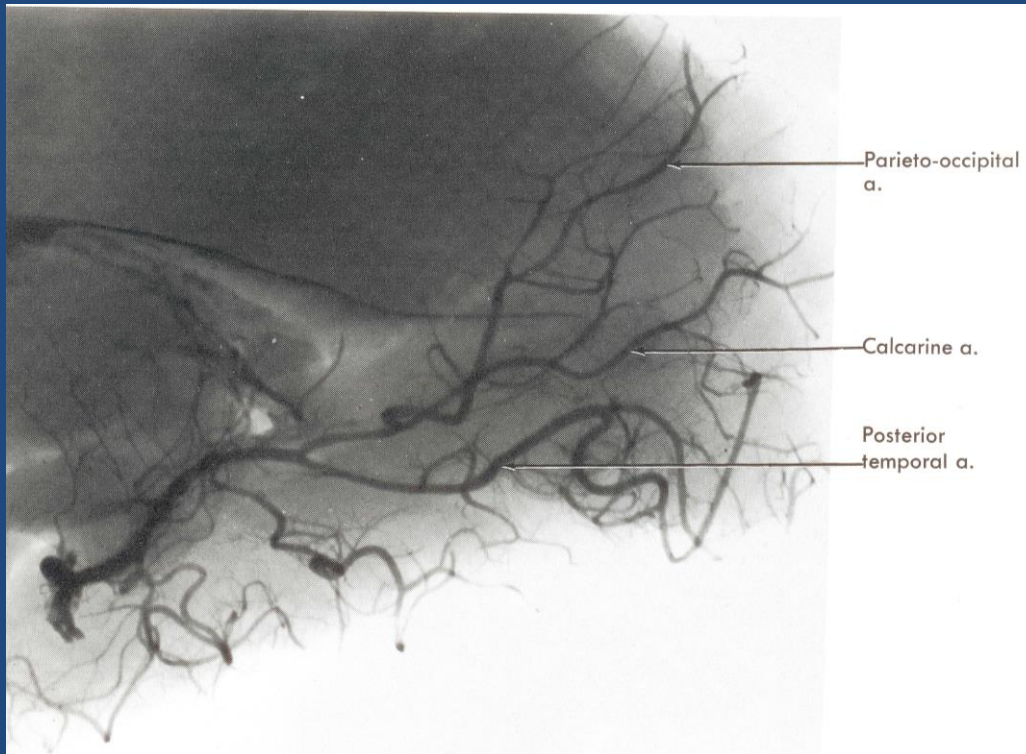
Fig. 65-29. Posterior choroidal and posterior pericallosal arteries as seen from behind.



# Cerebral branches

1. Inferior temporal group
  - ▣ Hippocampal
  - ▣ Anterior temporal
  - ▣ Middle temporal
  - ▣ Posterior temporal
2. Parietooccipital artery
3. Calcarine artery
4. Splenial artery

# Injected specimen



# Anatomic variations of the cerebral branches

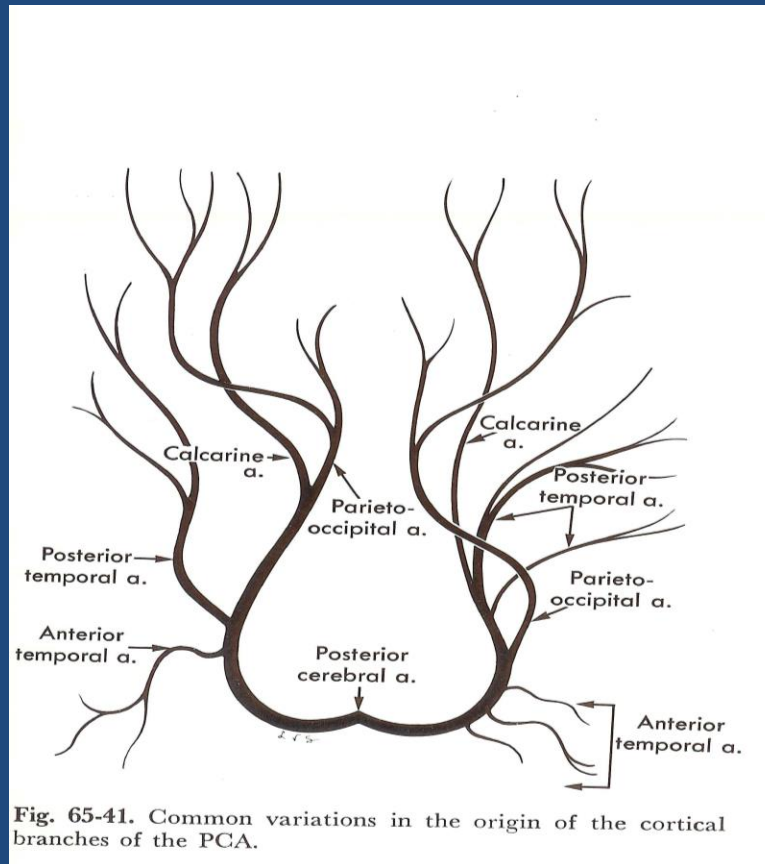
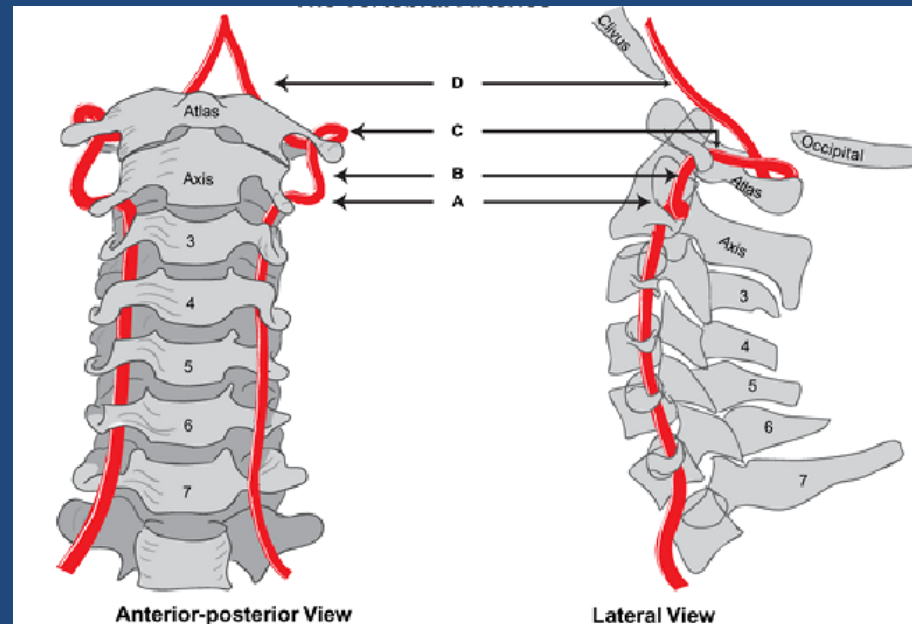


Fig. 65-41. Common variations in the origin of the cortical branches of the PCA.

# Σπονδυλική Αρτηρία

- ▣ Σχηματίζεται από τις επιμήκειες νευρικές αρτηρίες (μεταμερή αγγειακά στοιχεία A1-A7 σωματιών)
- ▣ Μετά την ανάπτυξή τους

- V1 → Extra-osseous
- V2 → Foraminal
- V3 → Extraspinal
- V4 → Intradural

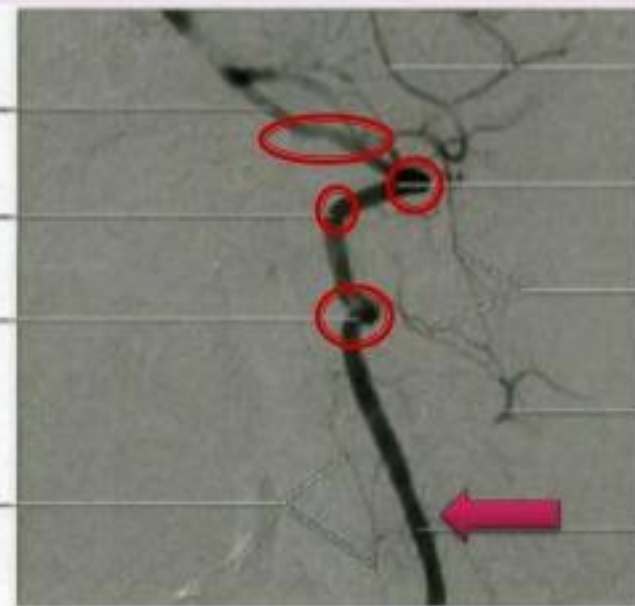


V4 (intradural) VA segment

VA in C1 transverse foramen

"L-shaped" bend through C2

Spinal rami



Posterior inferior cerebral artery

V3 (extraspinal) VA above C1 ring

Muscular branches of VA

Muscular branch of ECA

V2 (foraminal) VA segment

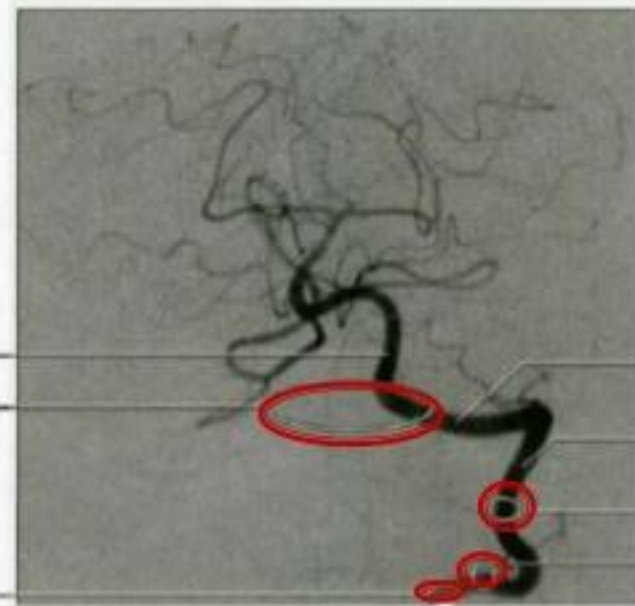
Lateral DSA

V1- extraosseous  
V2 -foraminal  
V3 - extraspinal  
V4 - intradural

V4 (intradural) VA segment

Foramen magnum

VA enters C2 transverse foramen



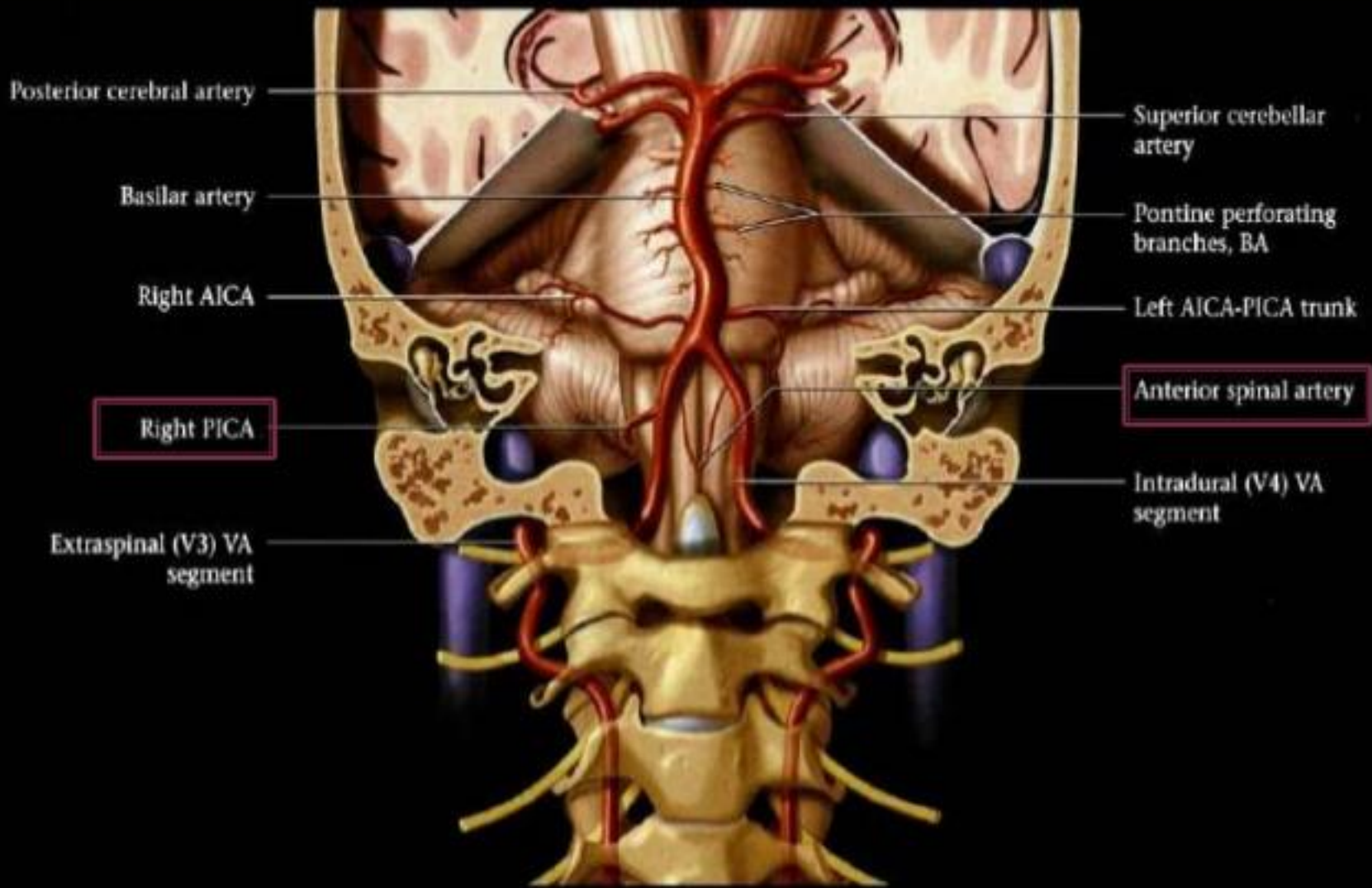
VA turns anteromedially to enter foramen magnum

V3 (extraspinal) VA above C1 ring

VA in C1 transverse foramen

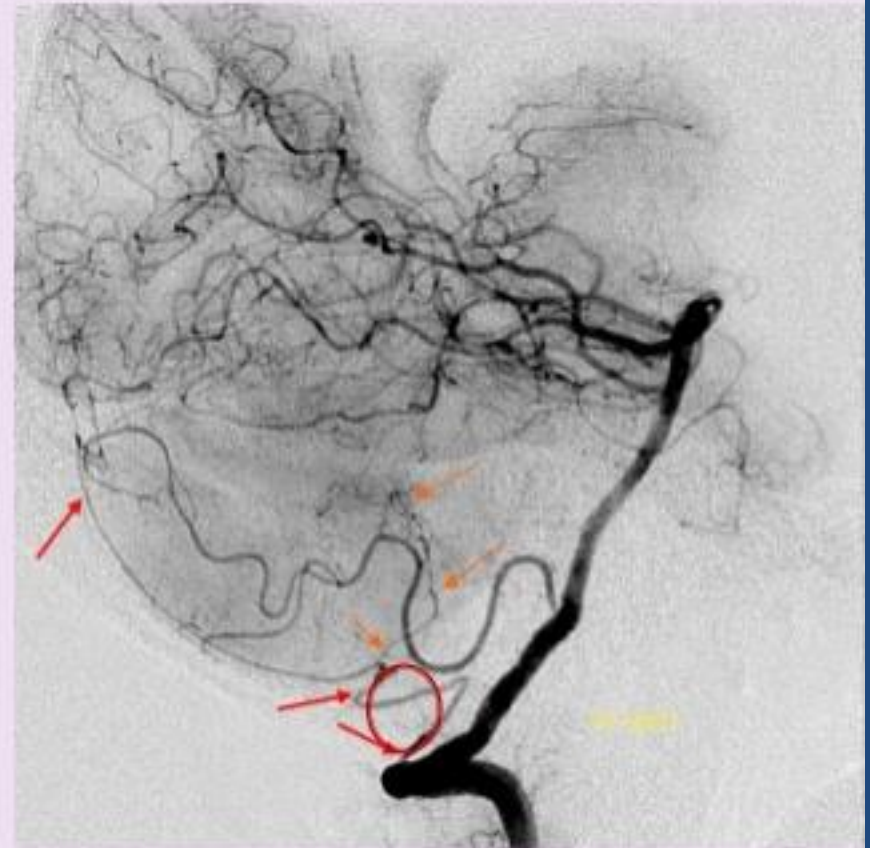
VA exits C2 transverse foramen

AP DSA



# Extracranial VA branches

1. V1-Small segmental spinal/ meningeal/ muscular branches.
2. V2- Anterior Meningeal artery , muscular branches.
3. V3 -Posterior Meningeal artery
  - Courses along posterior arch of atlas.
  - Supplies falx cerebri
  - Variant – origin from ECA / PICA.
  - Greatly enlarged with vascular malformations and neoplasms



Posterior meningeal artery

# Vertebral artery

From subclavian arteries  
Left VA dominant 50%

V1 Courses –Cephalad to enter transverse foramina at C6

Ascend directly to C2 (V2)

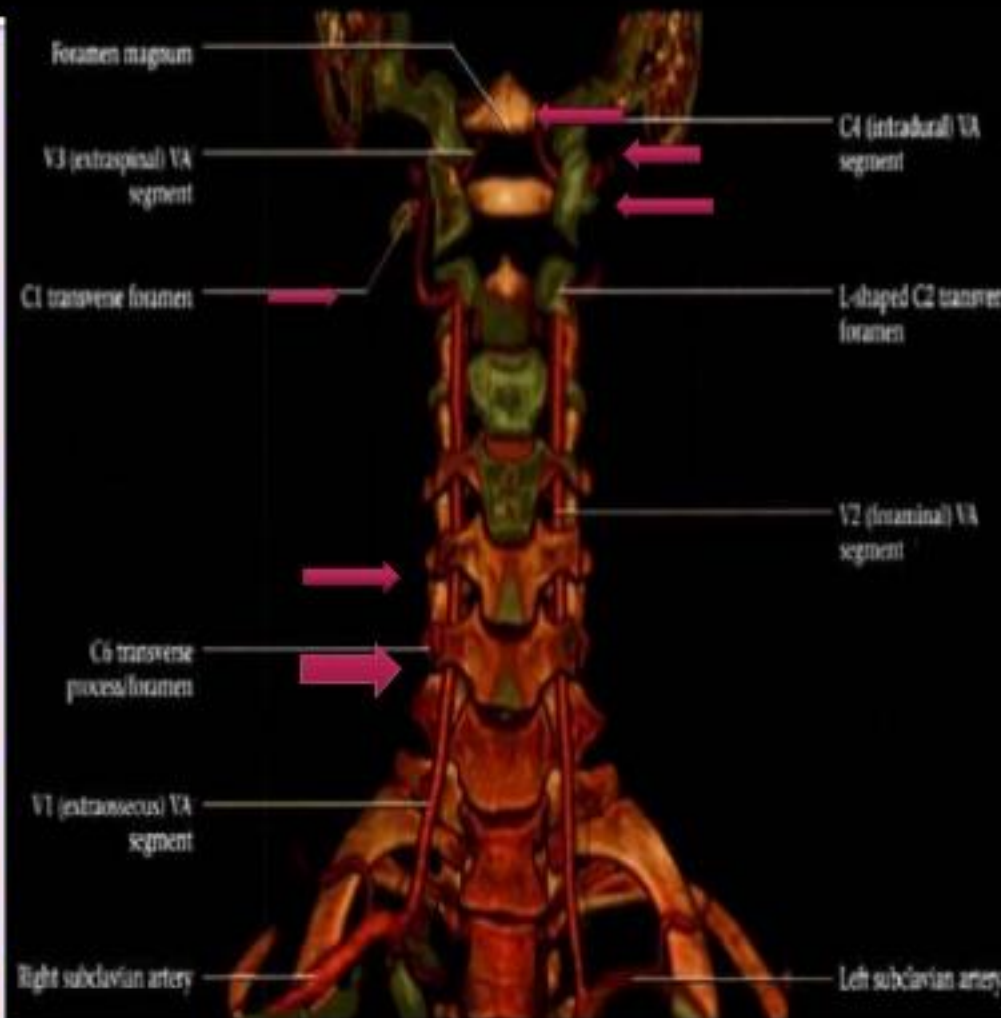
Turns laterally and superiorly thro C1 vertebral foramina

Looping posteriorly along atlas V3 extraspinal

Each VA passes superomedially thro foramen magnum

In Posterior fossa anterior to medulla (intradural )

VAs unite to form basilar artery





# Σπονδυλική Αρτηρία - Κλάδοι

- ▣ Μυϊκοί
- ▣ Νωτιαίοι
- ▣ Μηνιγγικοί
  - Οπίσθια μηνιγγική αρτηρία
- ▣ Ενδοκράνιοι κλάδοι
  - Οπίσθια νωτιαία
  - Πρόσθια νωτιαία
  - Οπίσθια κάτω παρεγκεφαλιδική



AP



LAT



LAT