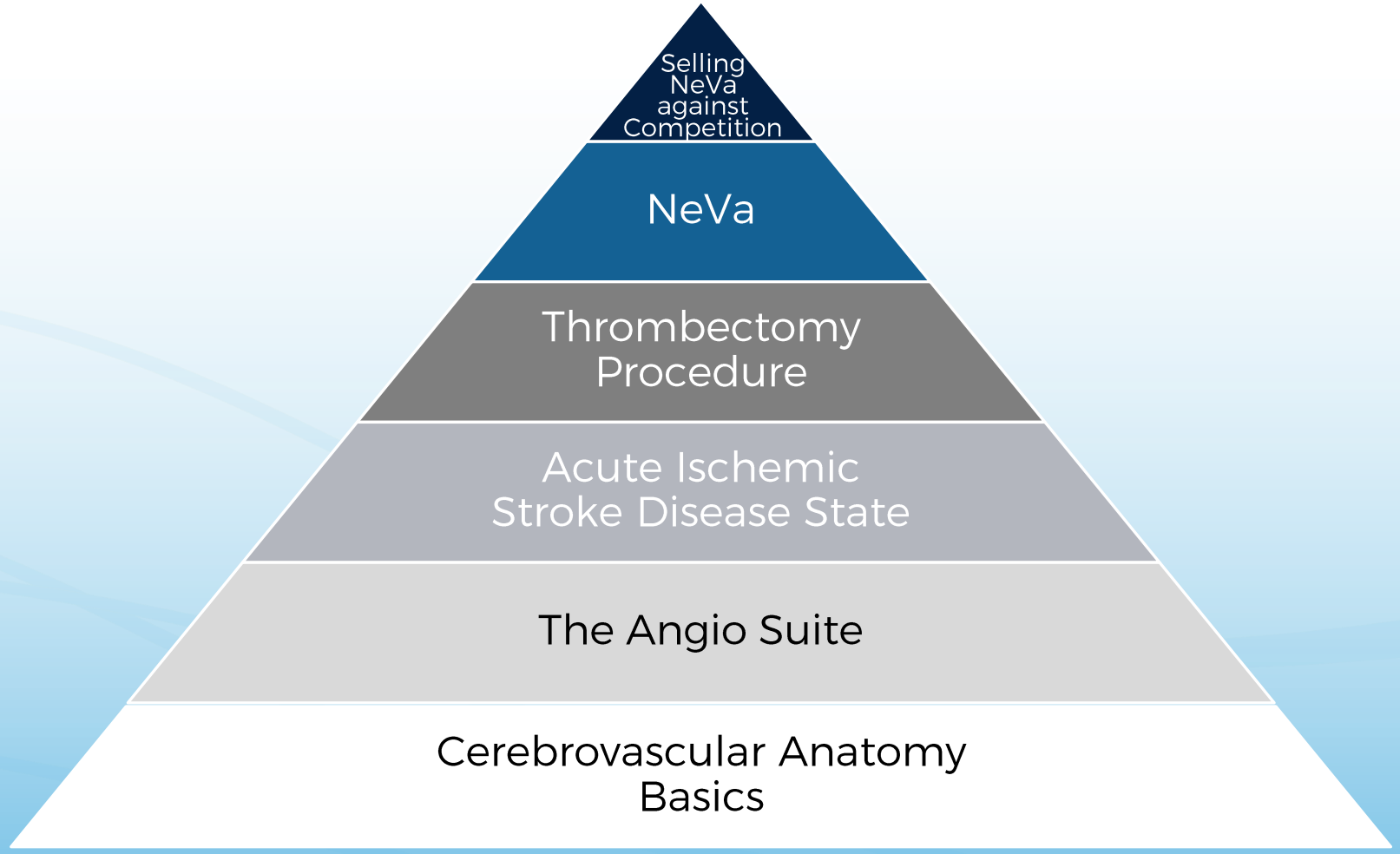
VESALIO TRAINING PROGRAM



- Designed to give confidence & credibility in front of physicians
- 6 modules of 1-2 hours
- To attend in order (from 1 to 6)
- To be completed in a period of 2-3 weeks
- Attendance is necessary for all new sales team members

MODULE 1: ANATOMY

Cerebrovascular Anatomy Basics

LEARNING GOAL

- Retain key information on main cranial arteries for stroke thrombectomy
  - CCA
  - VA
  - ICA
  - BA
  - **MCA**
  - **ACA**
  - **PCA**
  - Acom
  - Pcom

  - Full name?
  - How many are there?
  - Are they part of anterior or posterior circulation?
  - Are they partially or fully intra-cranial? (or not at all?)
  - Where do they branch out from, what do they branch out into? (i.e. what comes before and after?)
  - Which parts of the brain do they irrigate?
  - What is their diameter and which NeVa could you recommend?

ANATOMY

1.1 DIRECTIONAL TERMINOLOGY & ACCESS SITES

- Anatomical position and directional terminology
- Access Sites
- Femoral Access

1.2 CEREBRAL ARTERIAL CIRCULATION

- Anterior Circulation
- Posterior Circulation
- Names & position of main arteries
- Recognizing these in AP & Lateral imaging
- The Circle of Willis

1.3. SIZE INFORMATION

- Size of Cerebral Arteries

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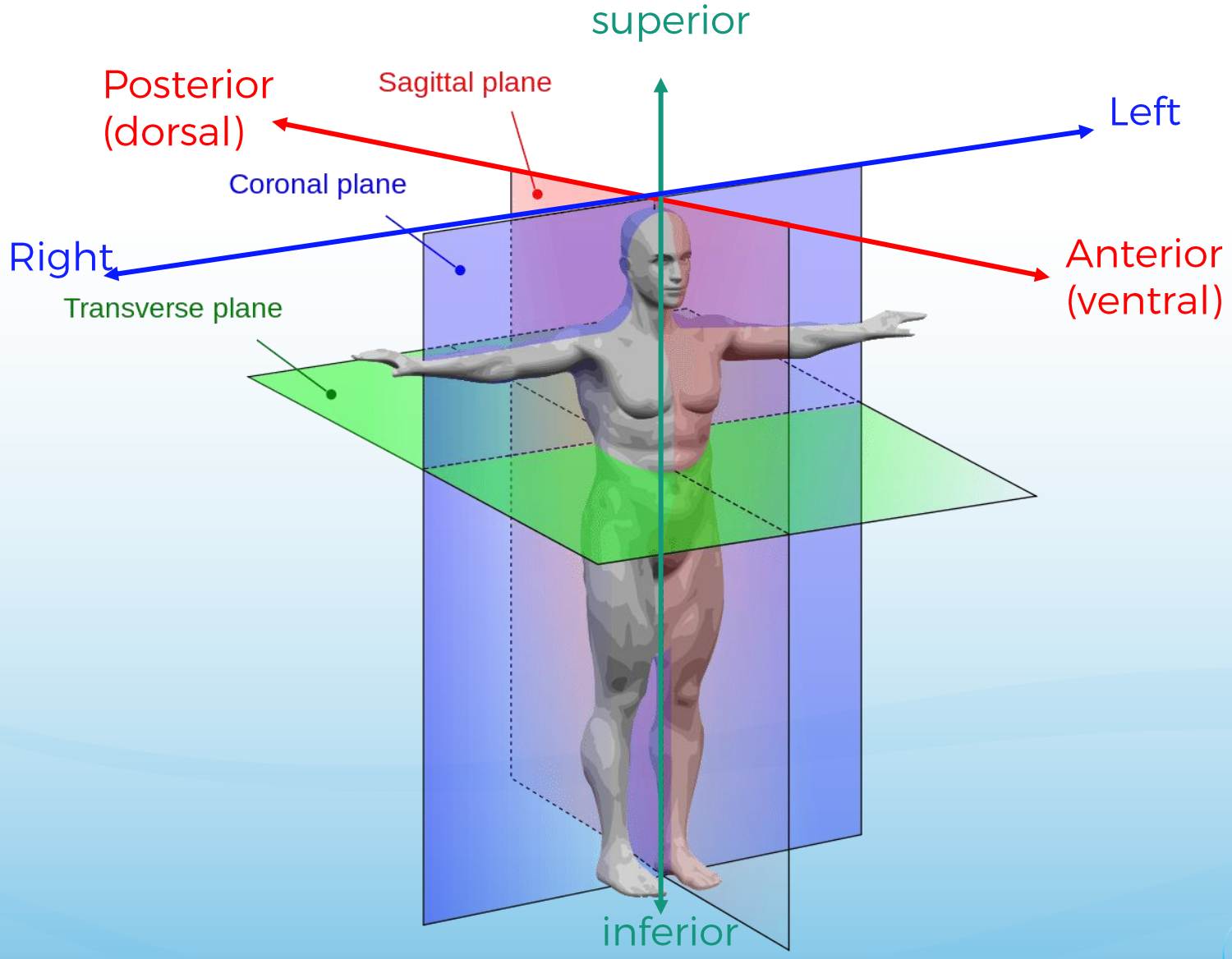
ANATOMICAL POSITION AND DIRECTIONAL TERMINOLOGY

- Coronal Plane (AP)
  - Anterior to posterior
- Sagittal Plane (Lateral)
  - Right to left
- Axial Plane
  - Transverse

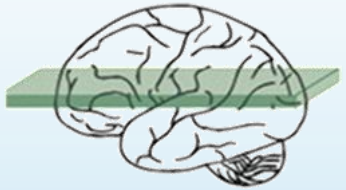


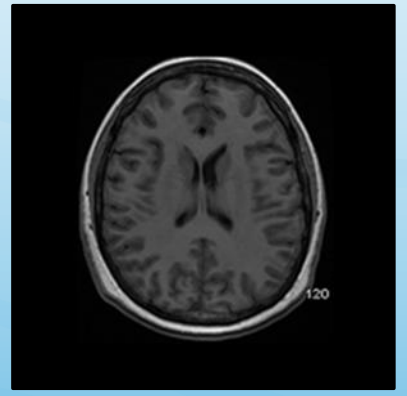
ANATOMICAL POSITION AND DIRECTIONAL TERMINOLOGY

- REMEMBER that "right" and "left" is always with regards to the patient

- In INR terminology "distal" is thought of as distal to the incision or the problem site

AXIAL
HORIZONTAL
TRANSVERSE
upper & lower

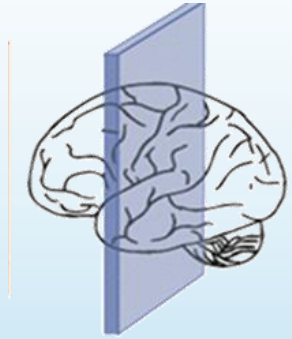


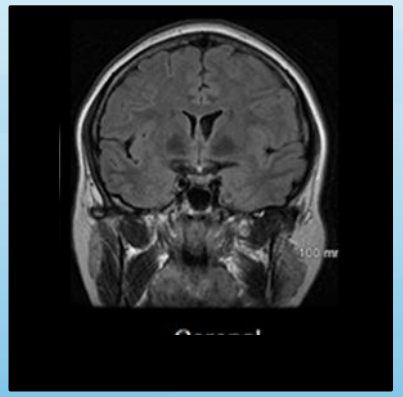


SAGITTAL
or LATERAL

left & right

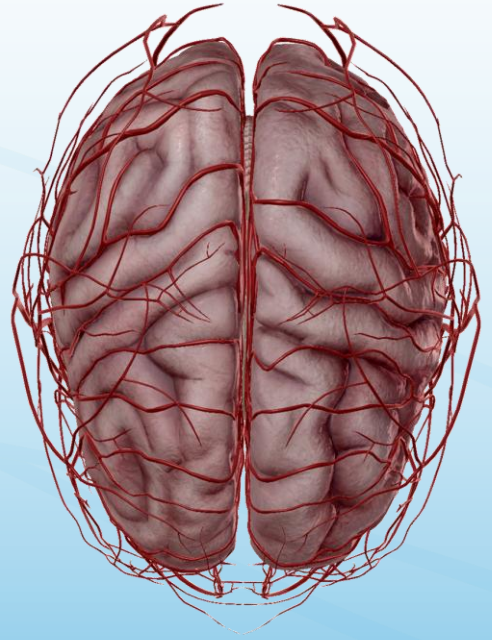
CORONAL
or Anterior to
Posterior (AP)
front & back





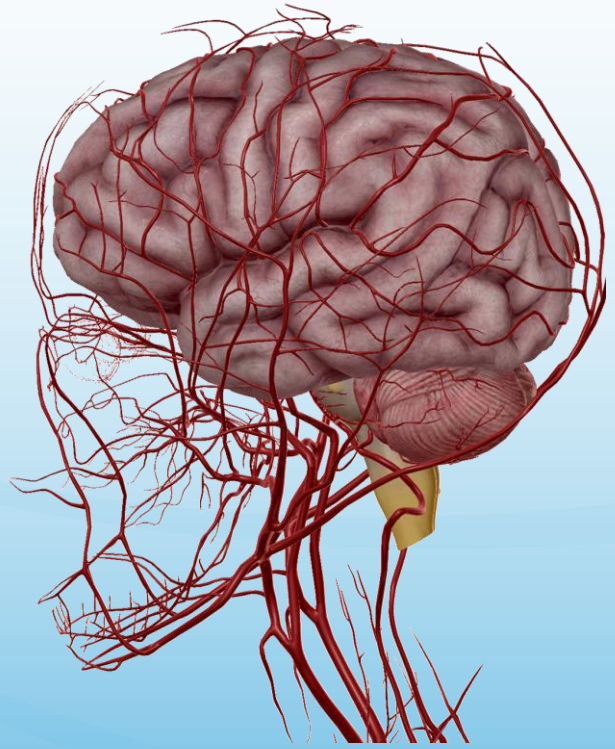
ANATOMICAL POSITION AND DIRECTIONAL TERMINOLOGY

AXIAL
HORIZONTAL
TRANSVERSE
upper & lower

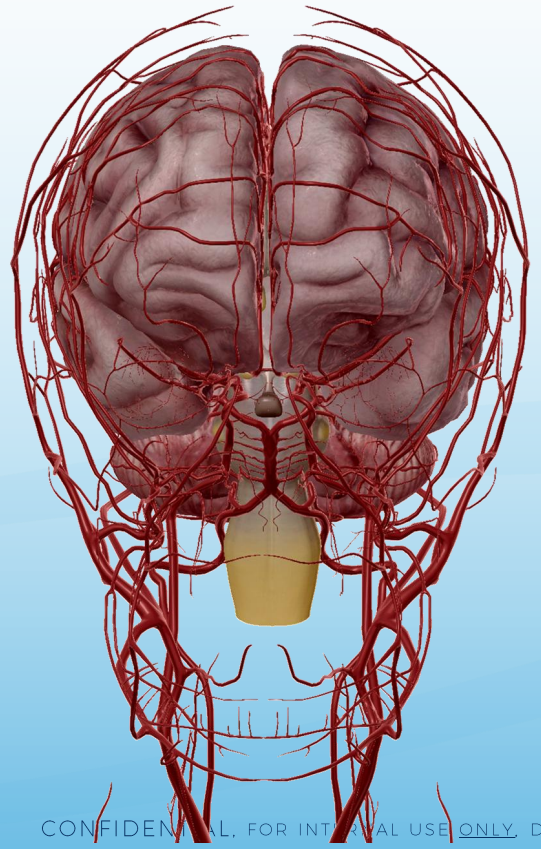


SAGITTAL
or LATERAL

left & right



CORONAL
or Anterior to
Posterior (AP)
front & back



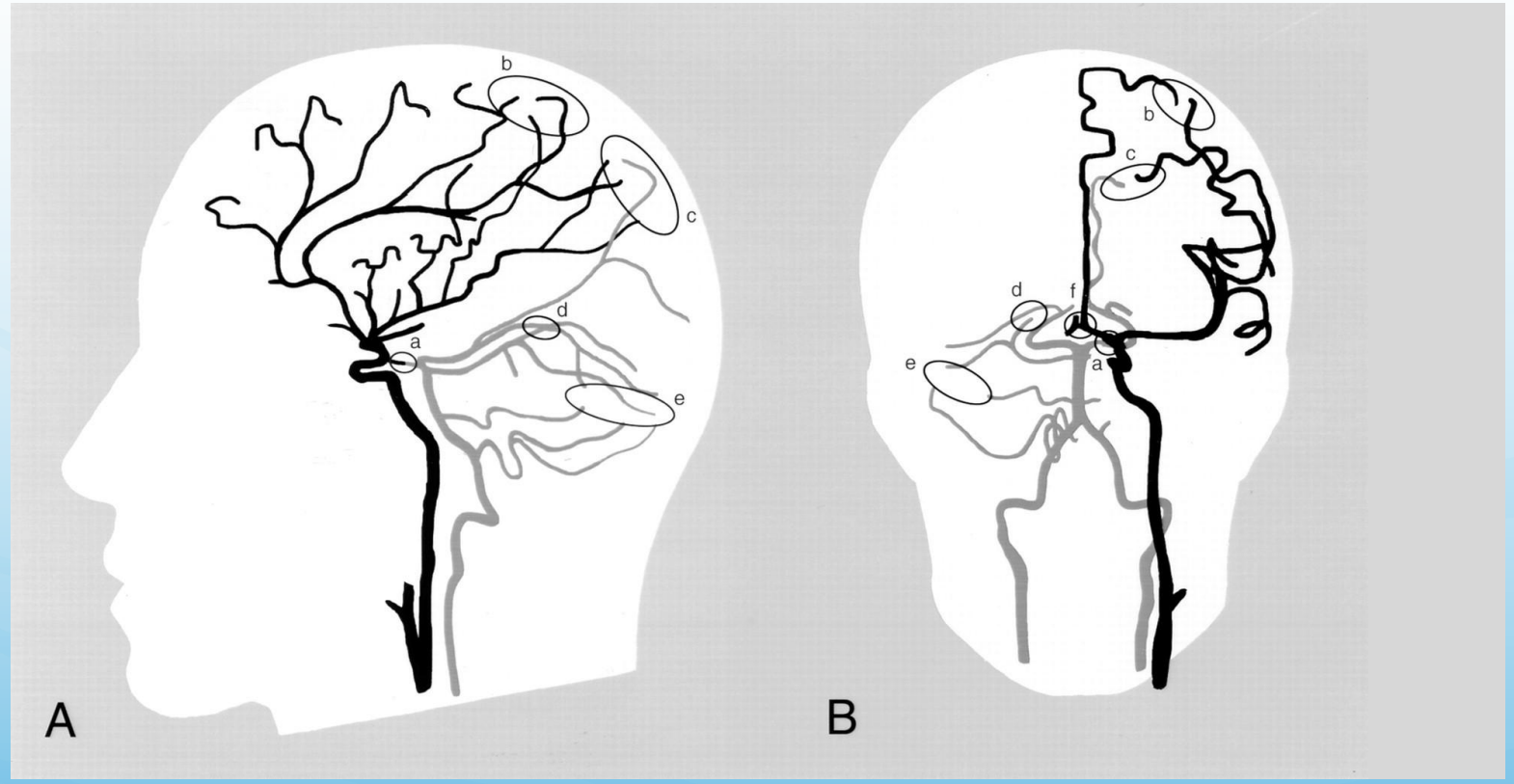
IMAGES ARE OFTEN DESCRIBED AS AP OR LATERAL

Lateral (Side to Side)

X-ray beam enters from one side of the face and exits from the other side

Anterior Posterior (AP)

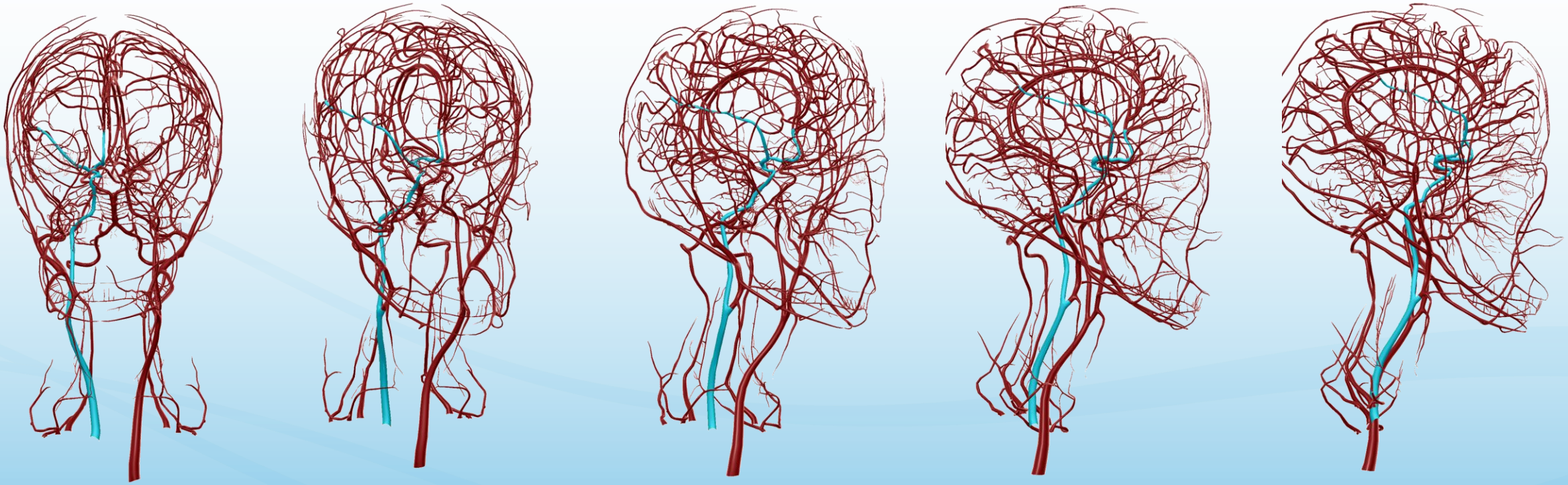
X-ray beam enters anterior (front), exits posterior (back)



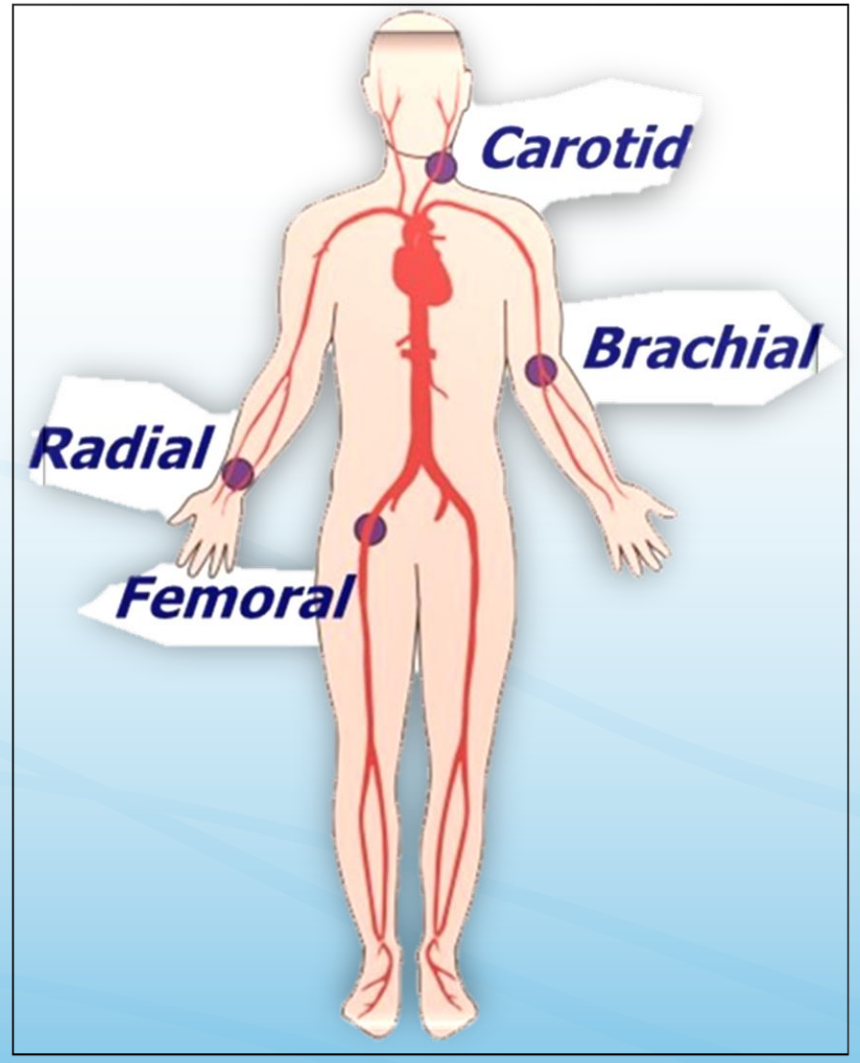
PHYSICIANS CHOOSE THE ANGLE DEPENDING ON THE PLACE AND SHAPE OF THE LESION THEY ARE TREATING

Coronal (AP)

Sagital (Lateral)

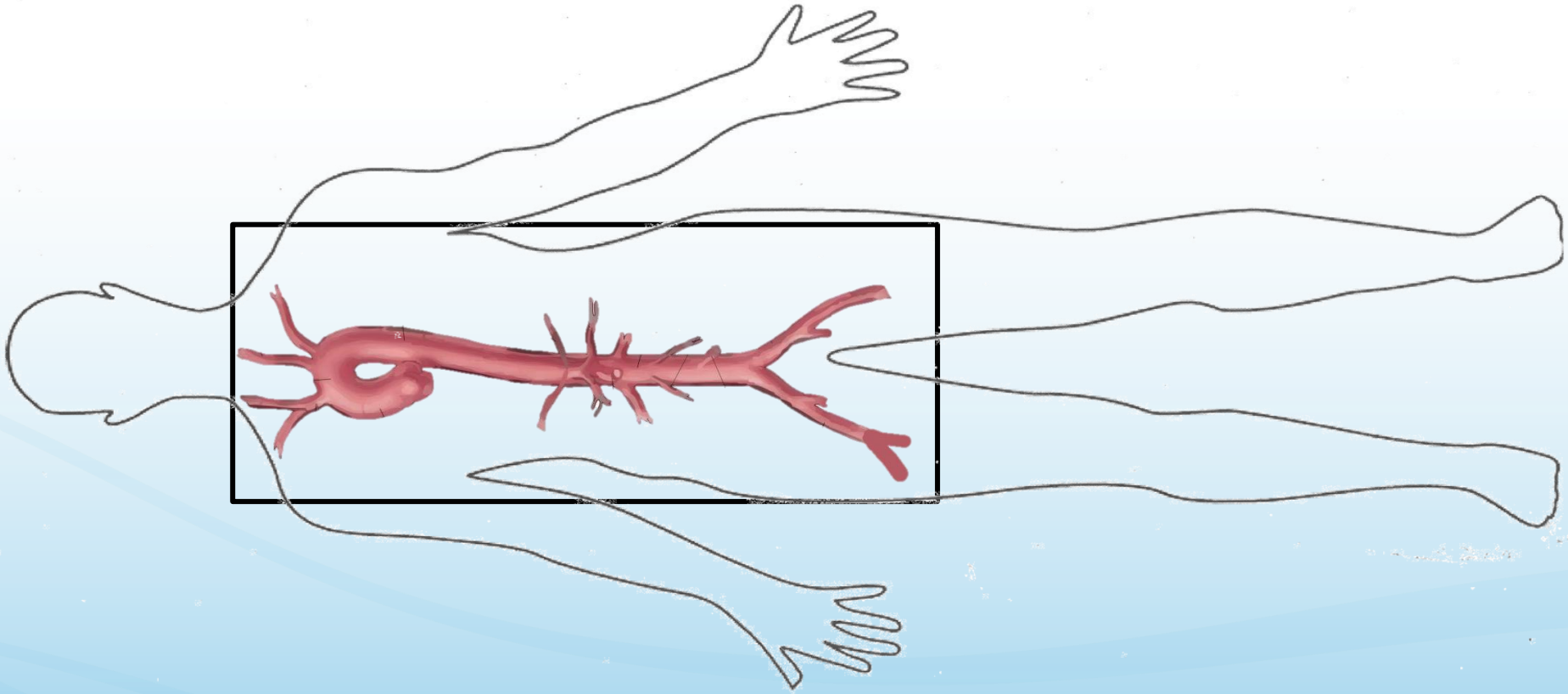


ACCESS SITES

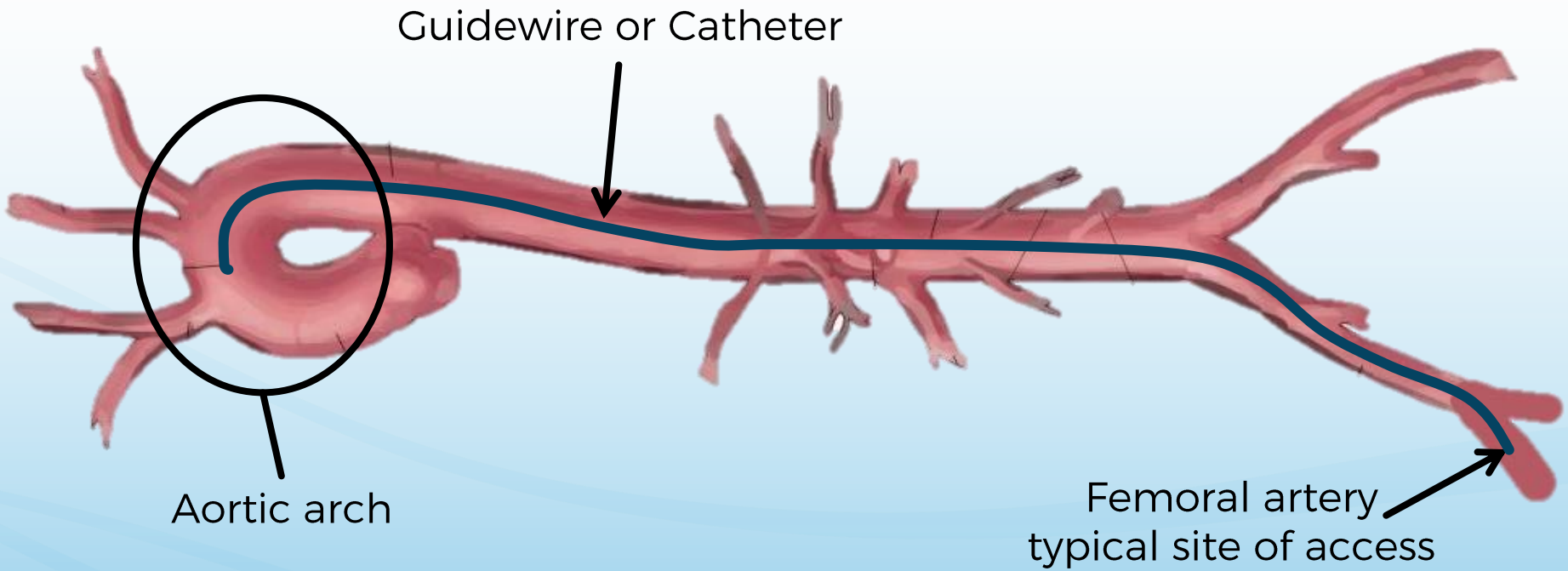


- 95% of cases you will come across will have femoral access
- Radial access
  - popular in cardiovascular intervention
  - trend towards its adoption in neuro-vascular in the past years
- Carotid access may be rarely used in specific situations

FEMORAL ACCESS AND AORTA



FEMORAL ACCESS AND AORTA



ANATOMY

1.1 DIRECTIONAL TERMINOLOGY & ACCESS SITES

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1.3. SIZE INFORMATION

- Size of Cerebral Arteries

FLOW TO THE BRAIN IS DIVIDED INTO ANTERIOR & POSTERIOR CIRCULATION

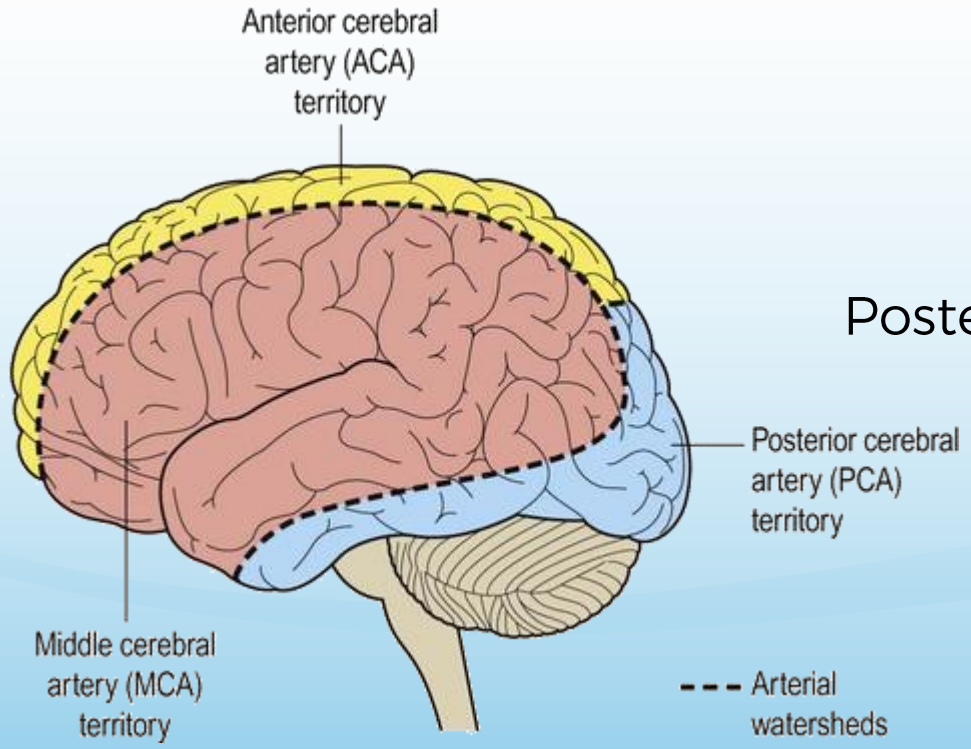
Anterior Circulation

Common Carotid Arteries

External Carotid Artery – ECA

Internal Carotid Artery – ICA

- Anterior Cerebral Artery – ACA
- Middle Cerebral Artery - MCA



Posterior Circulation

Vertebral Arteries

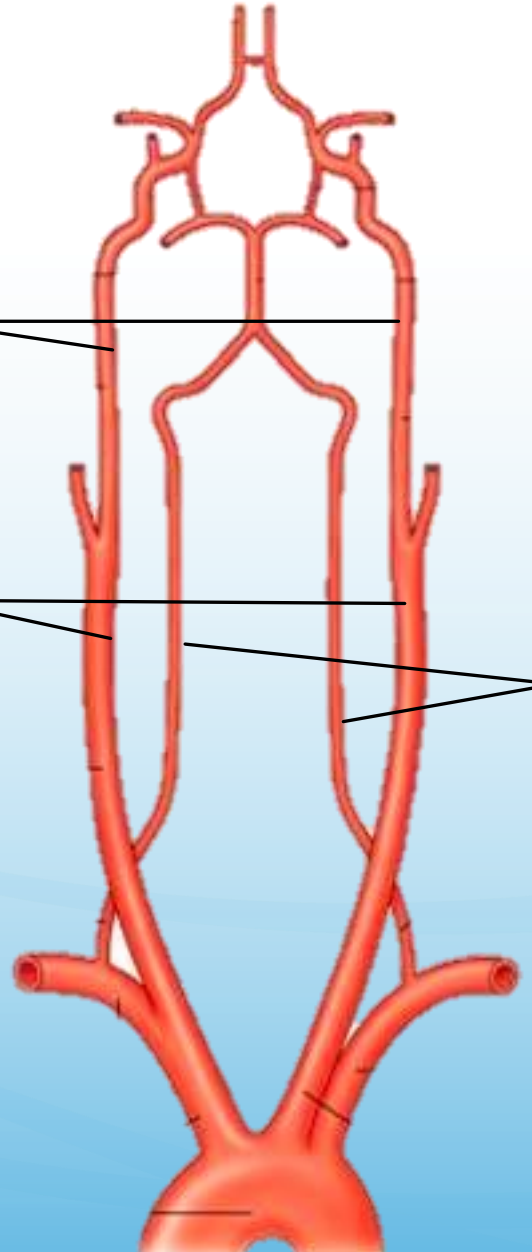
Basilar Artery - BA

Posterior Cerebral Artery - PCA

AORTIC ARCH AND CEREBRAL BRANCHES – AP VIEW

Internal Carotid Arteries - ICA
Anterior Circulation

Common Carotid Arteries



Vertebral arteries
Posterior Circulation

AORTIC ARCH AND CEREBRAL BRANCHES – AP VIEW

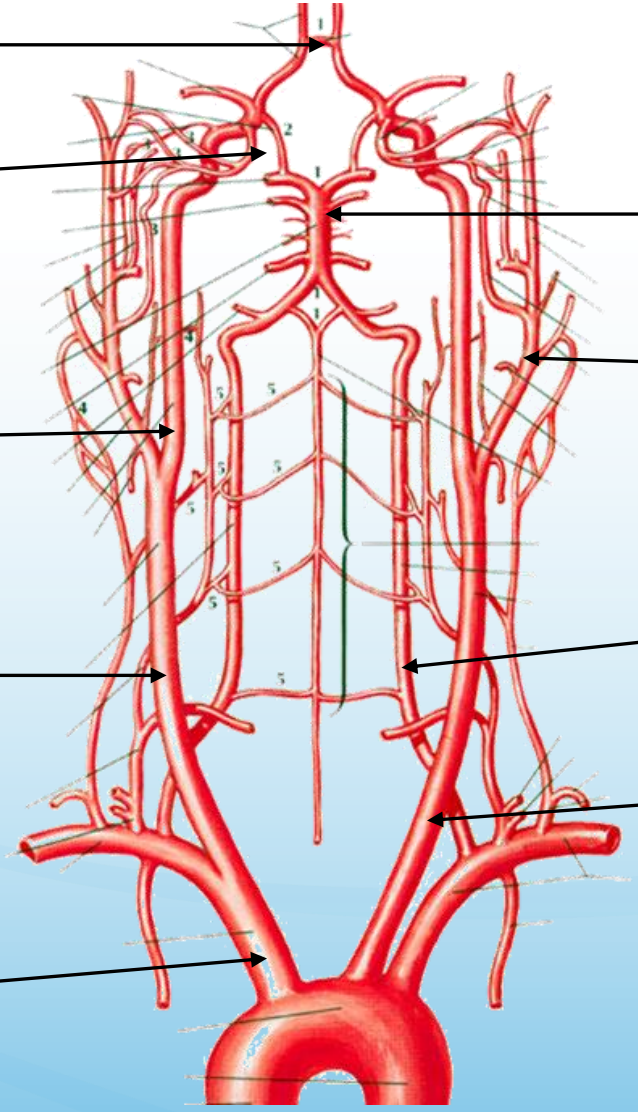
Ant Comm (ACOMM)
Circle of Willis – tying 2 sides of the brain

Right Post Comm (PCOMM)
Circle of Willis – tying anterior and posterior circulation

Right Internal Carotid Artery (ICA)

Right Common Carotid (CCA)

Bracheocephalic



Basilar Artery

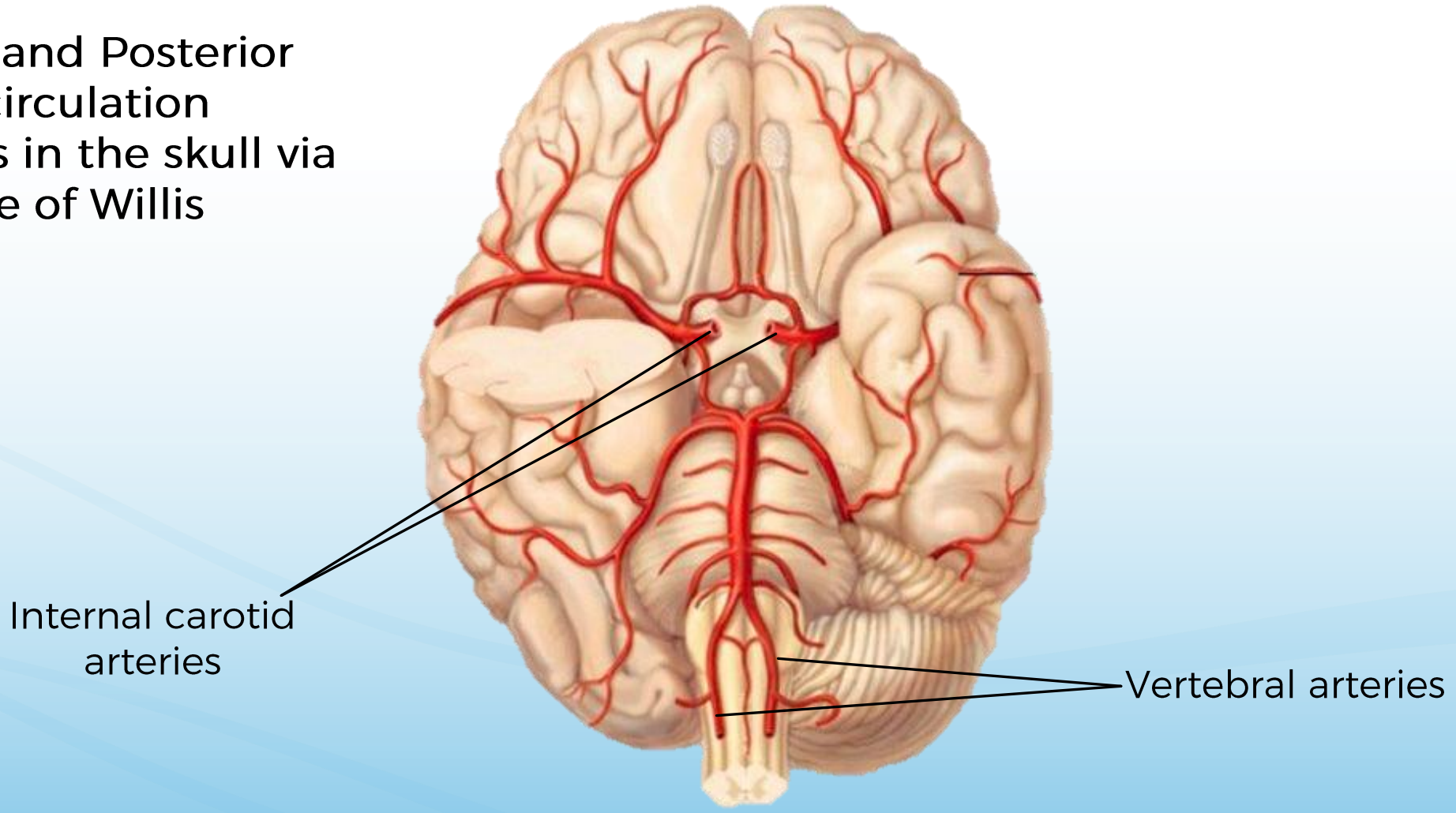
Left ECA

Left Vertebral Artery

Left Comm Carotid Artery

CEREBRAL BRANCHES – AXIAL VIEW

- Anterior and Posterior arterial circulation connects in the skull via the Circle of Willis

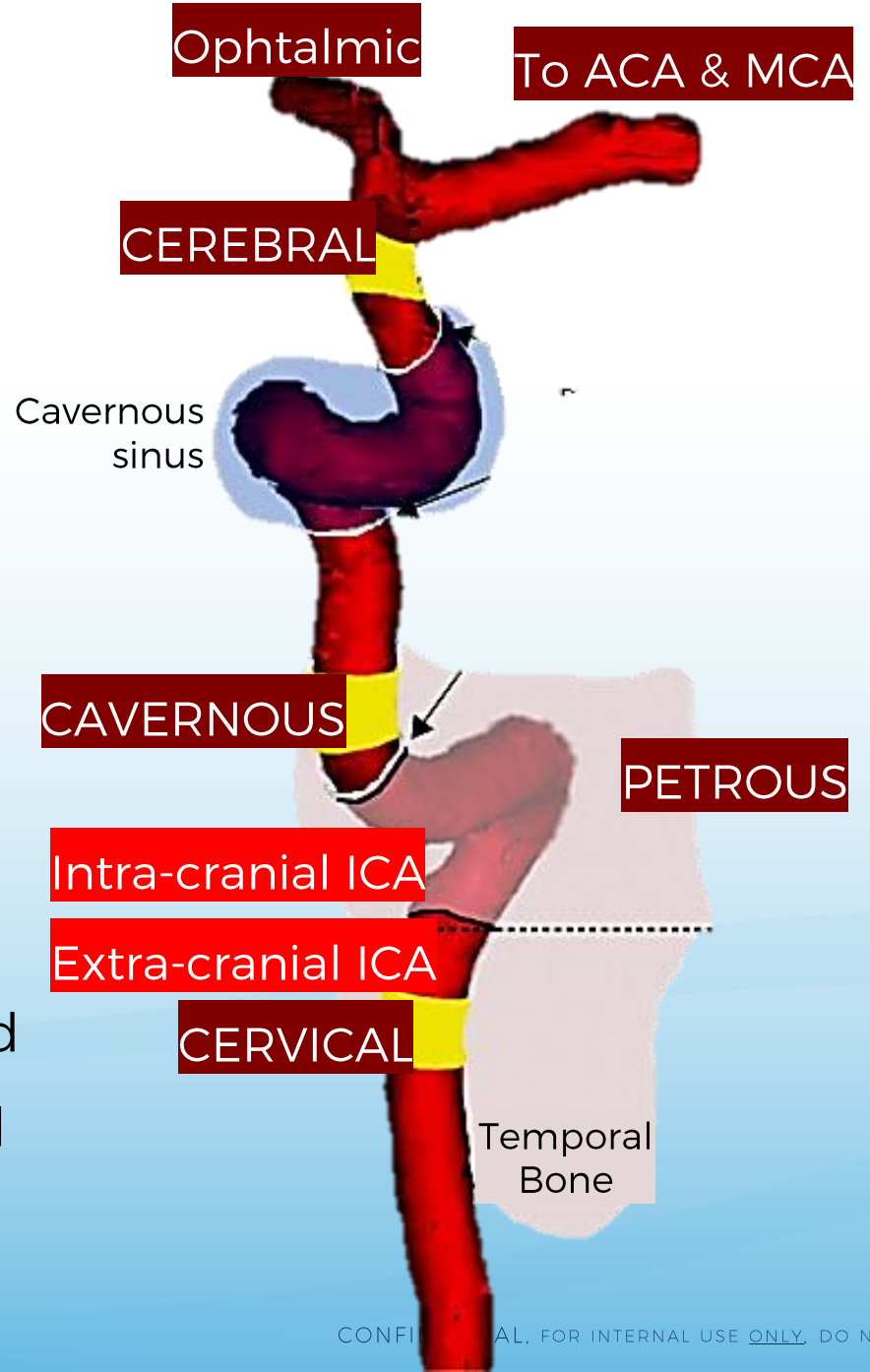


ANTERIOR CIRCULATION

ICA

- Divided anatomically into four segments

Terminologia Anatomica	Bouthillier Nomenclature
CERVICAL	C1 cervical
PETROUS	C2 petrous
	C3 lacerum
CAVERNOUS	C4 cavernous
	C5 clinoid
CEREBRAL or	C6 Ophthalmic / supra-clinoid
SUPRACLINOID	C7 communicating / terminal



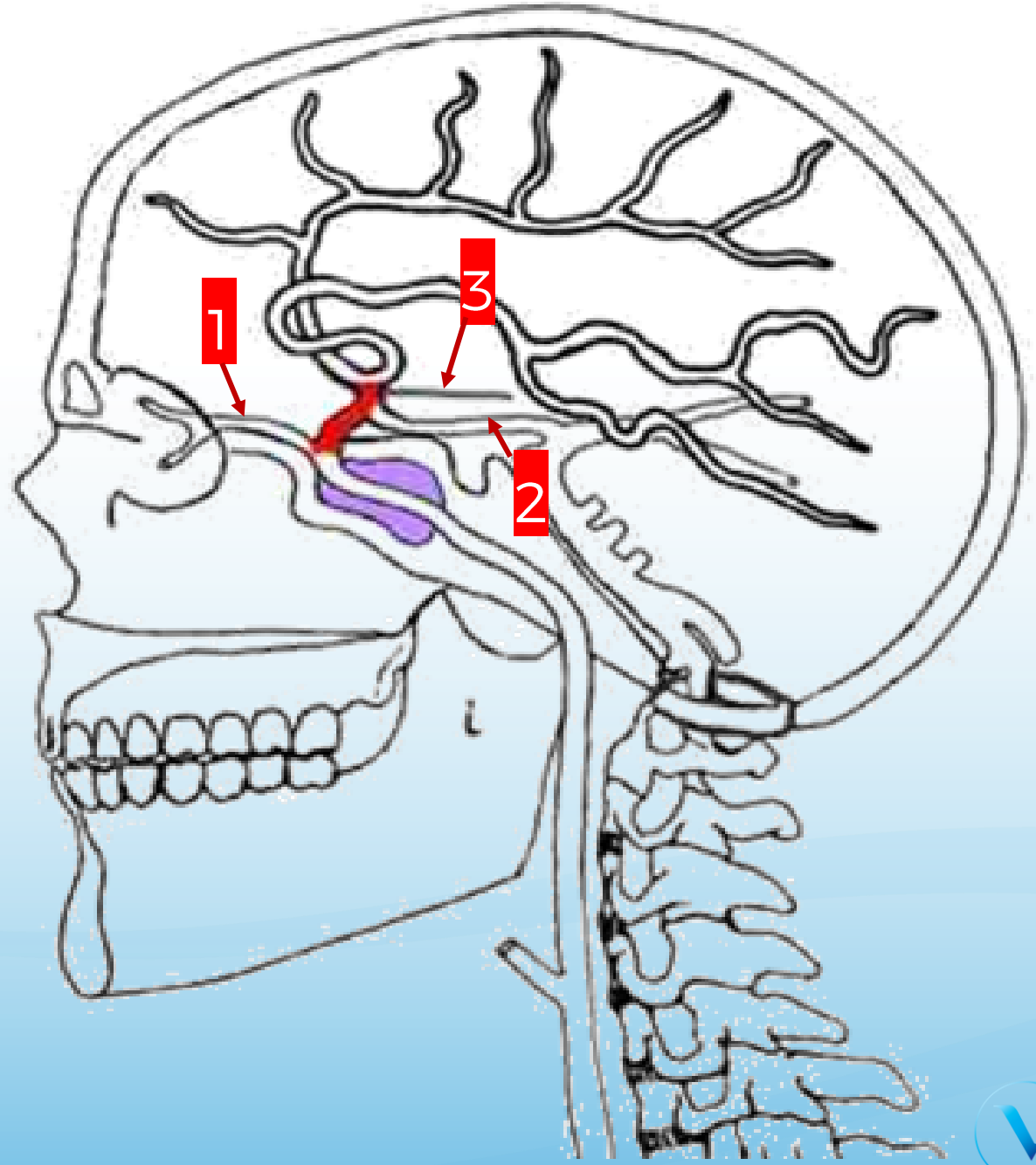
ICA

- Divided anatomically into four segments
  - C1: Cervical
  - C2: Petrous
  - C3: Cavernous
  - C4: Supraclinoid
    - only intracranial segment of the ICA
    - 3 Branches off the Supraclinoid Segment of the ICA

      #1 Ophthalmic Artery

      #2 Posterior Communicating Artery

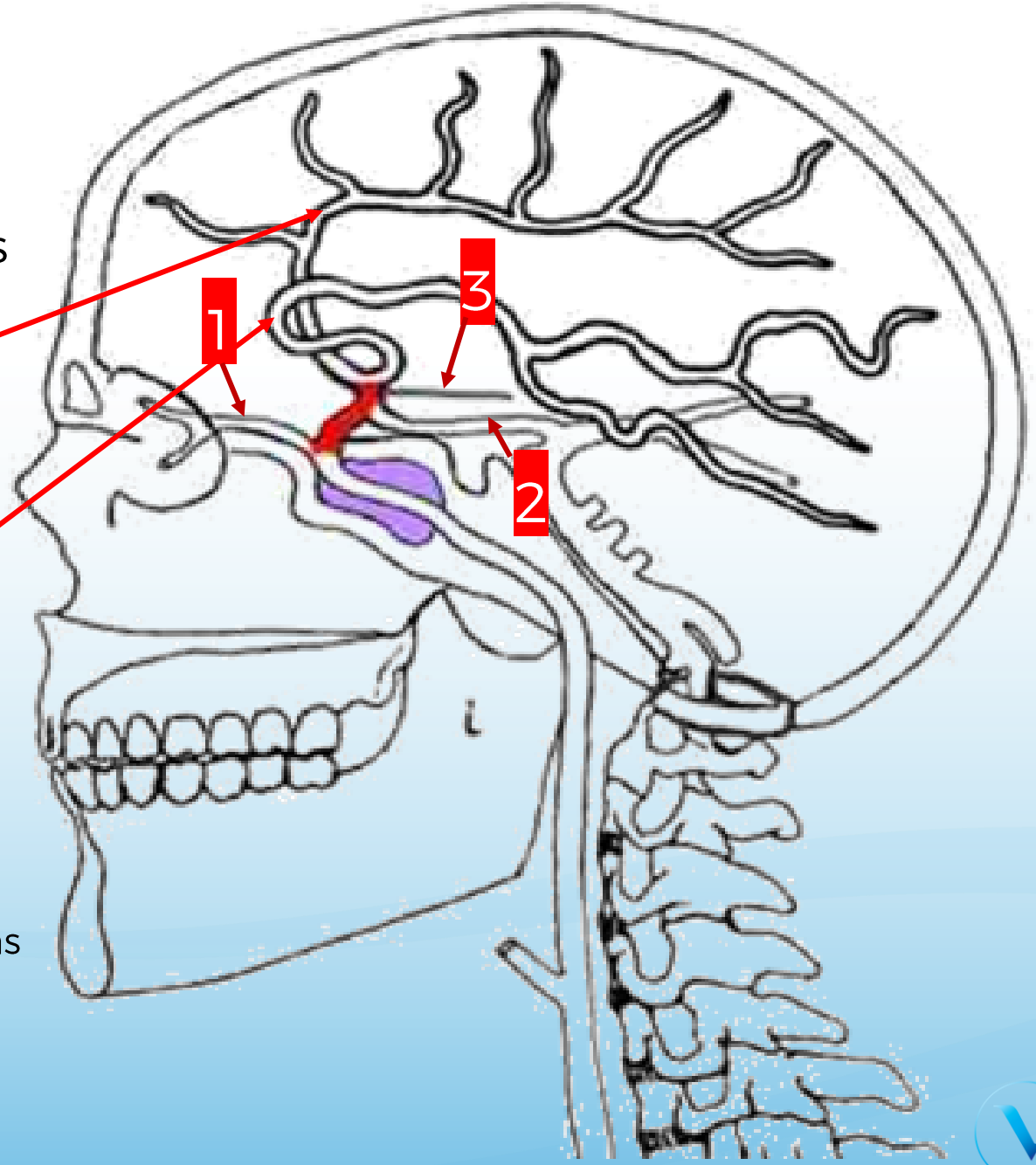
      #3 Anterior Choroidal Artery



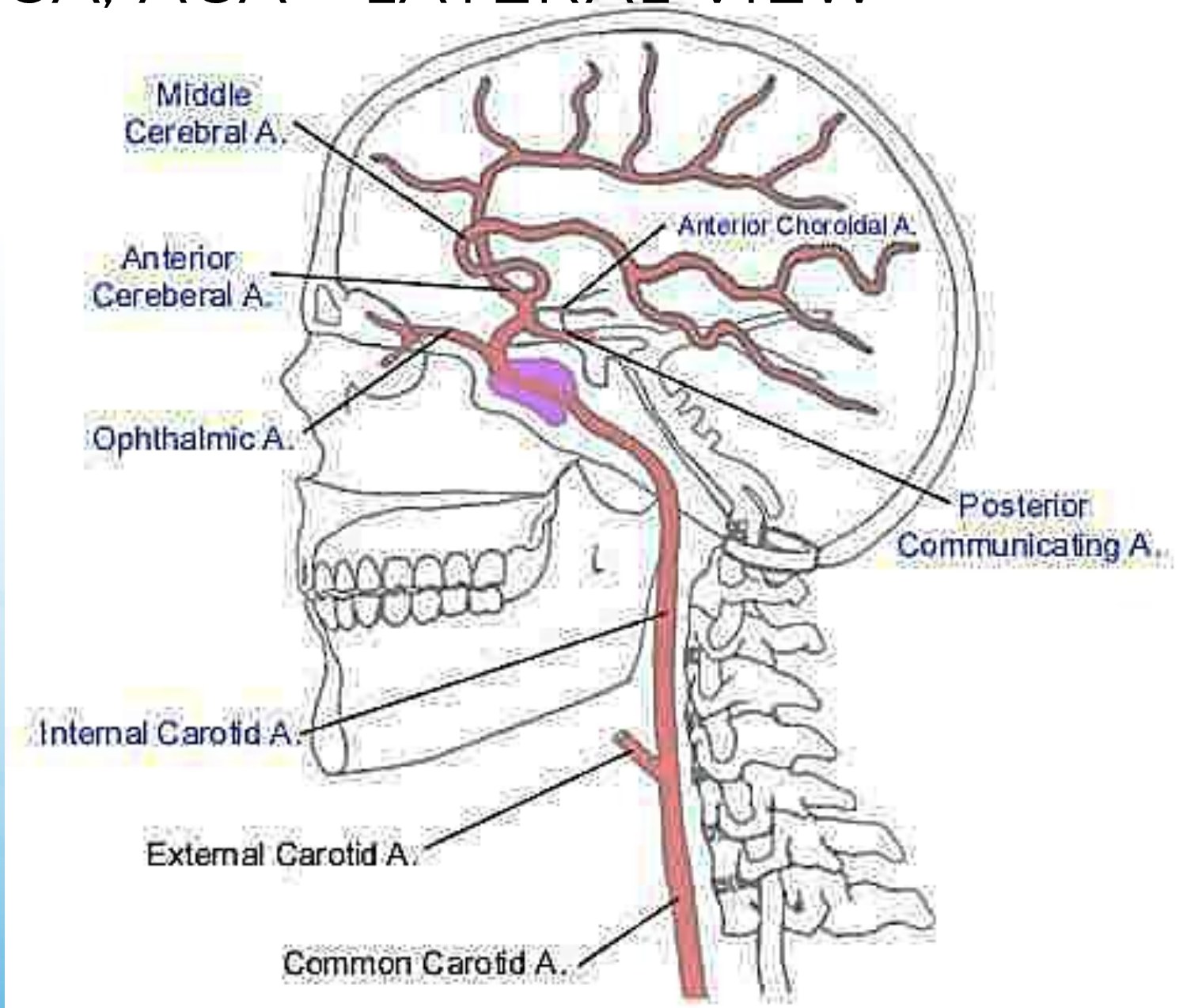
ICA

Above C-4 the Internal Carotid Artery bifurcates into

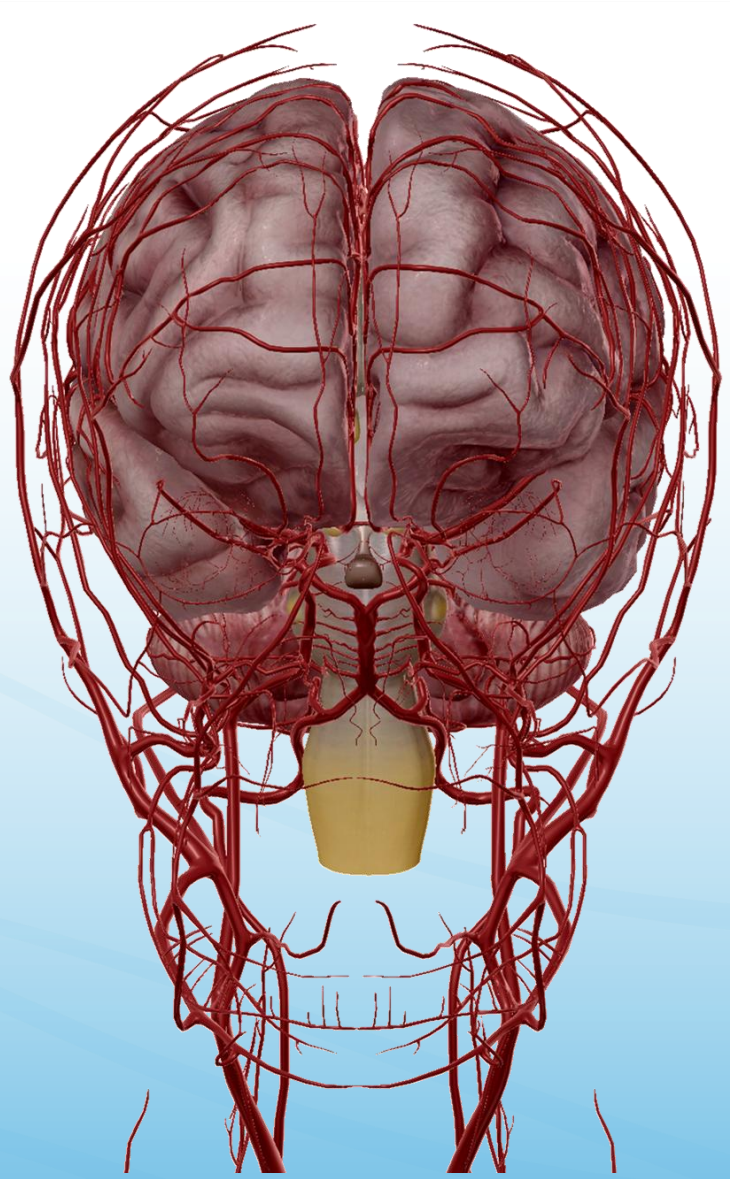
- Anterior Cerebral Artery (ACA)
  - Medial to ICA
  - Divides into A1, A2, A3 segments where A1 has the largest diameter
- Middle Cerebral Artery (MCA)
  - Lateral to ICA
  - Divides into M1, M2, M3, M4 segments where M1 has the largest diameter
  - Most common vessel to be operated on for stroke

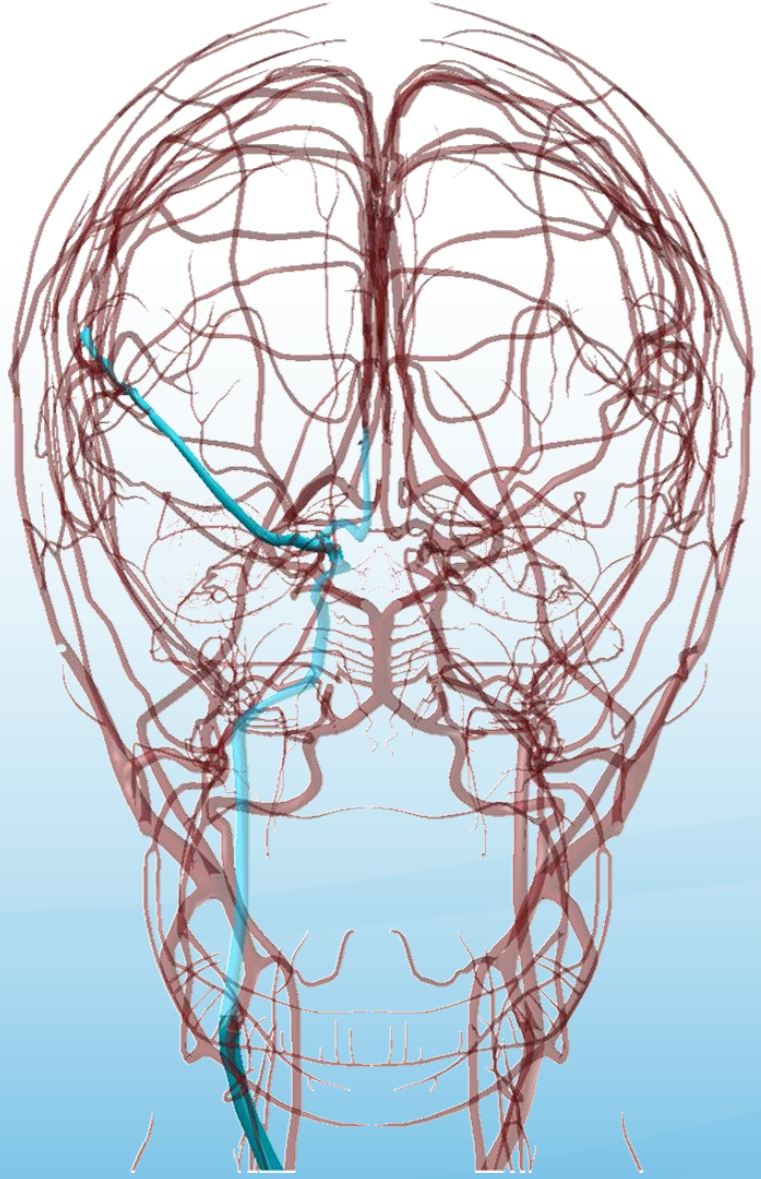


THE ICA, MCA, ACA – LATERAL VIEW

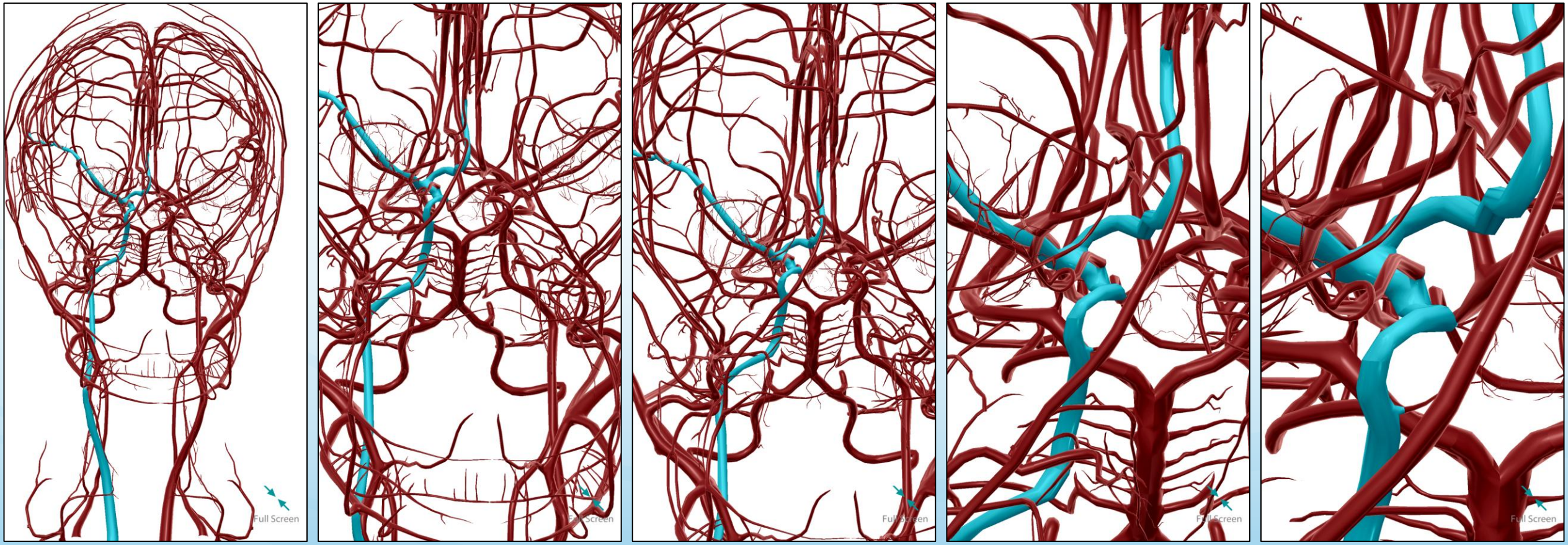


THE ICA, MCA, ACA – AP VIEW



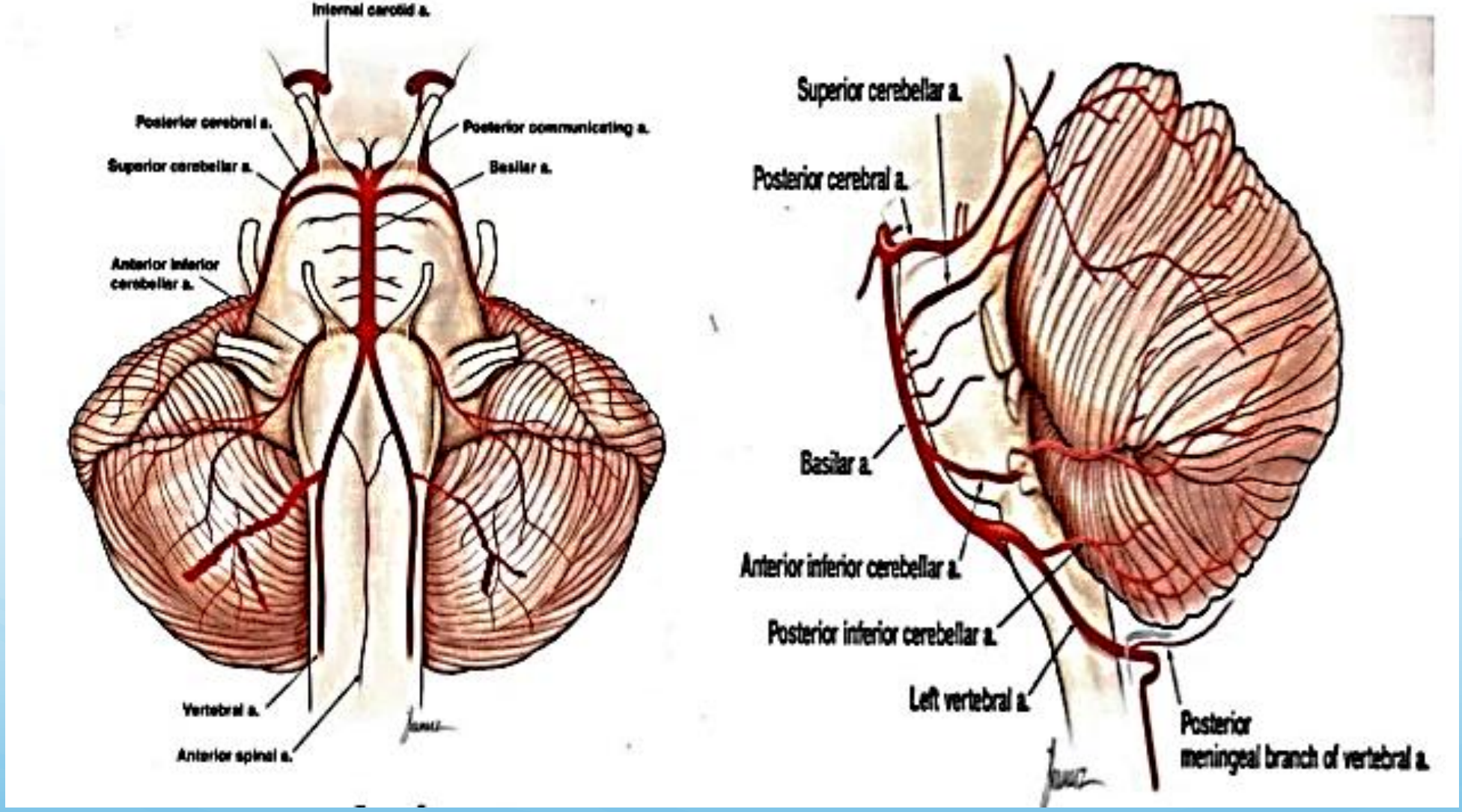


THE ICA, MCA, ACA – AP VIEW



POSTERIOR CIRCULATION

POSTERIOR CIRCULATION – AP & LATERAL VIEW



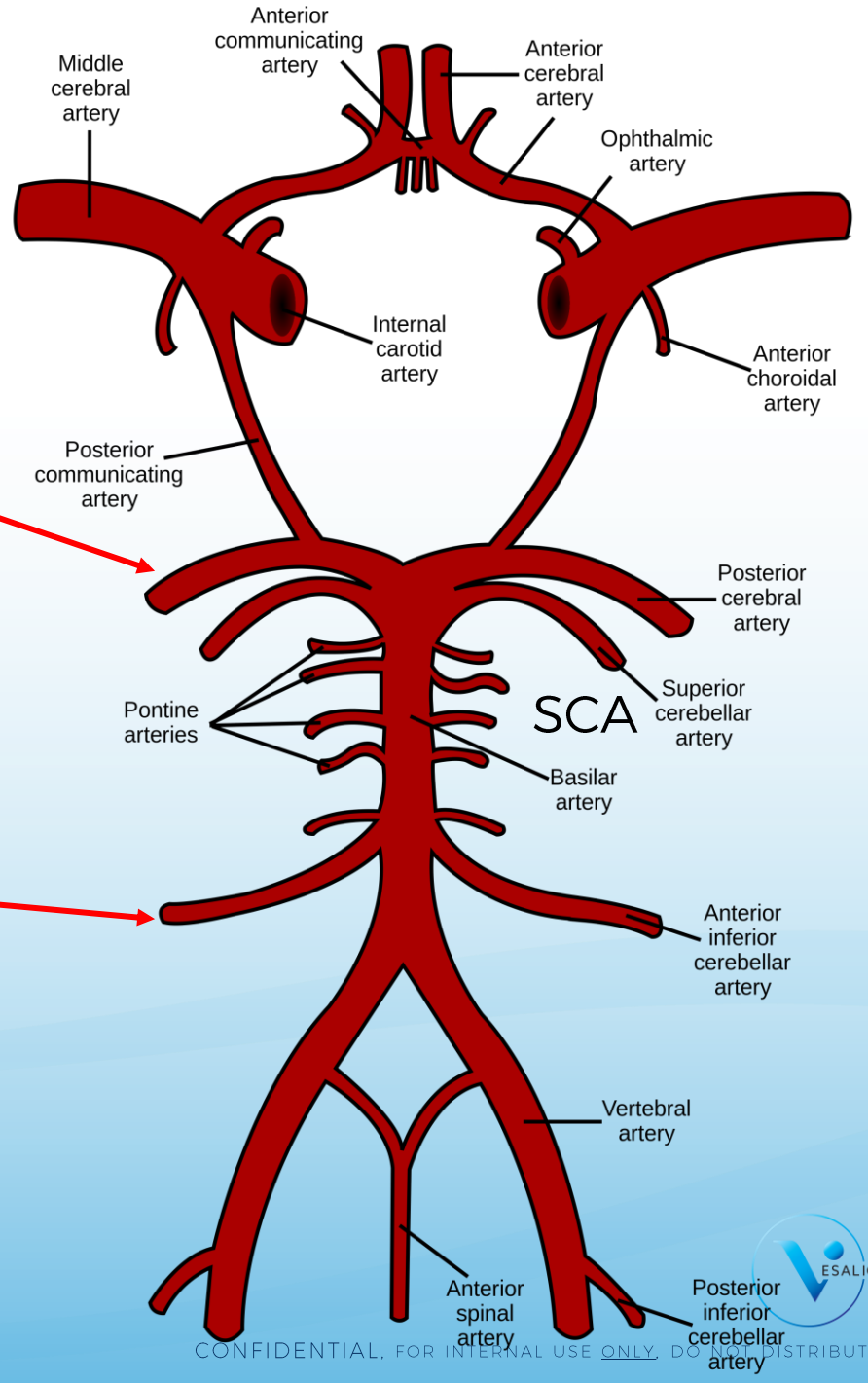
POSTERIOR CIRCULATION – AP VIEW
BASILAR ARTERY & BRANCHES

Posterior Cerebral Artery (PCA)

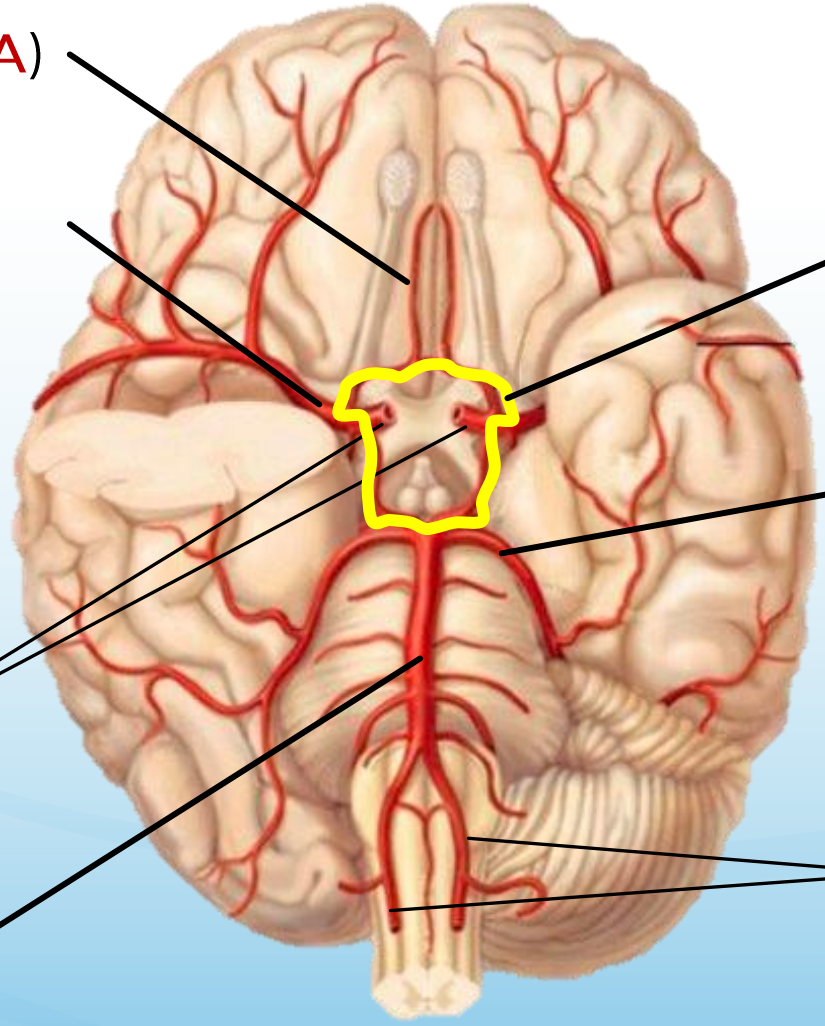
Divides into P1, P2, P3, P4 segments where P1 has the largest diameter

connects to PCom, seen in lateral angios

AICA - rarely seen on angio



CEREBRAL BRANCHES – AXIAL VIEW



Anterior cerebral artery (ACA)

Middle cerebral artery (MCA)

Internal carotid arteries

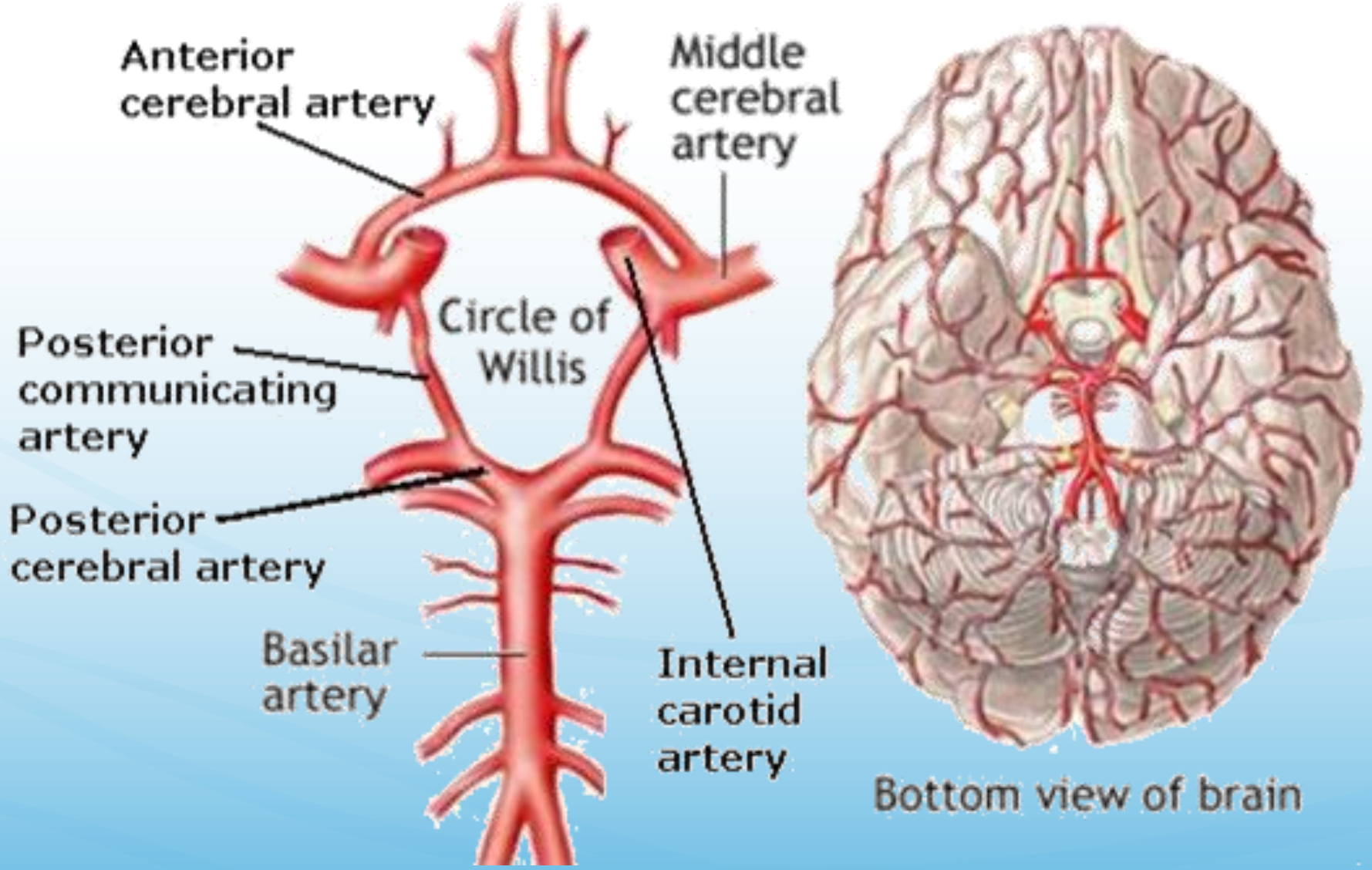
Basilar Artery

Circle of Willis (COW)

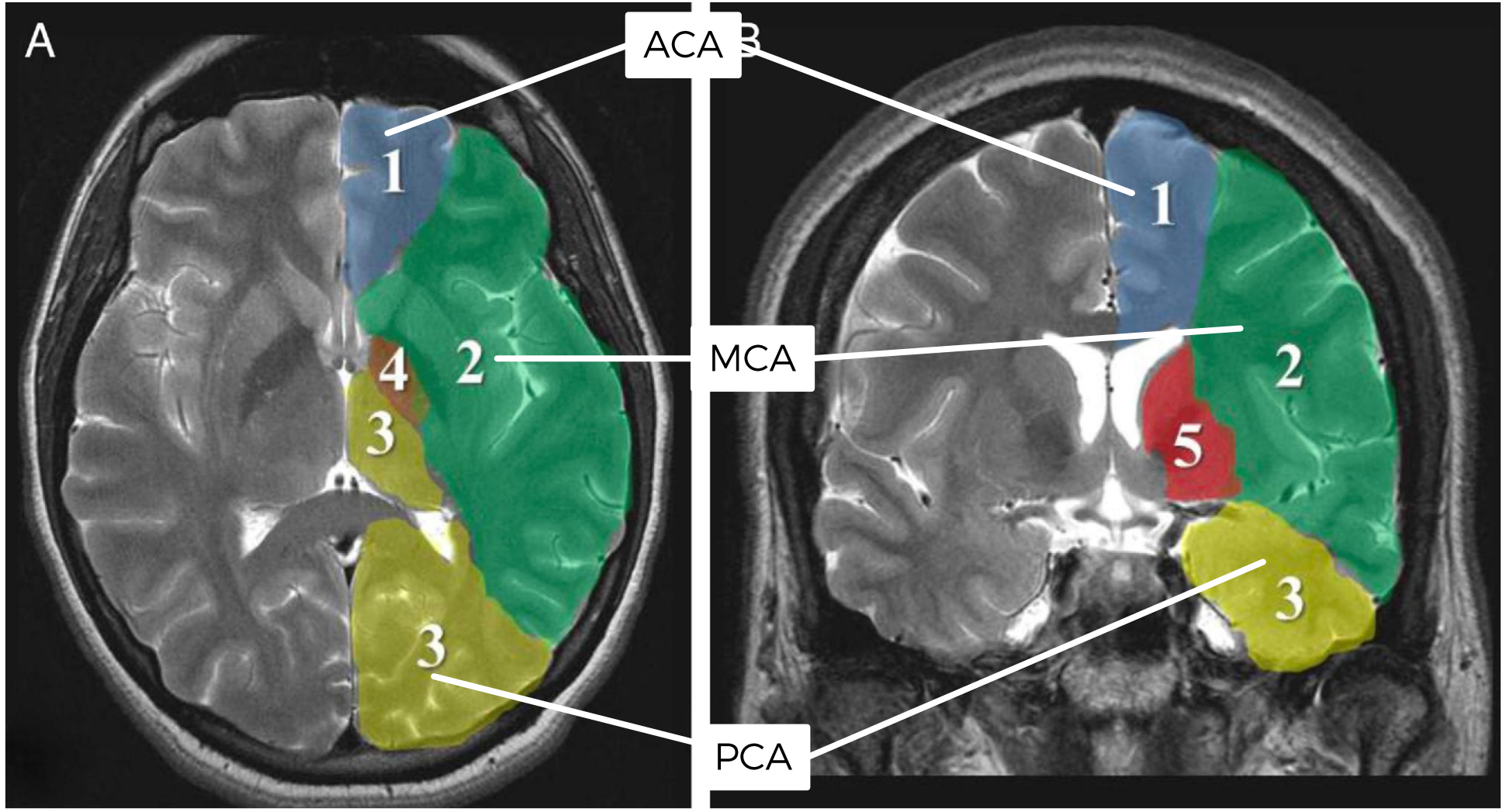
Posterior cerebral artery (PCA)

Vertebral arteries

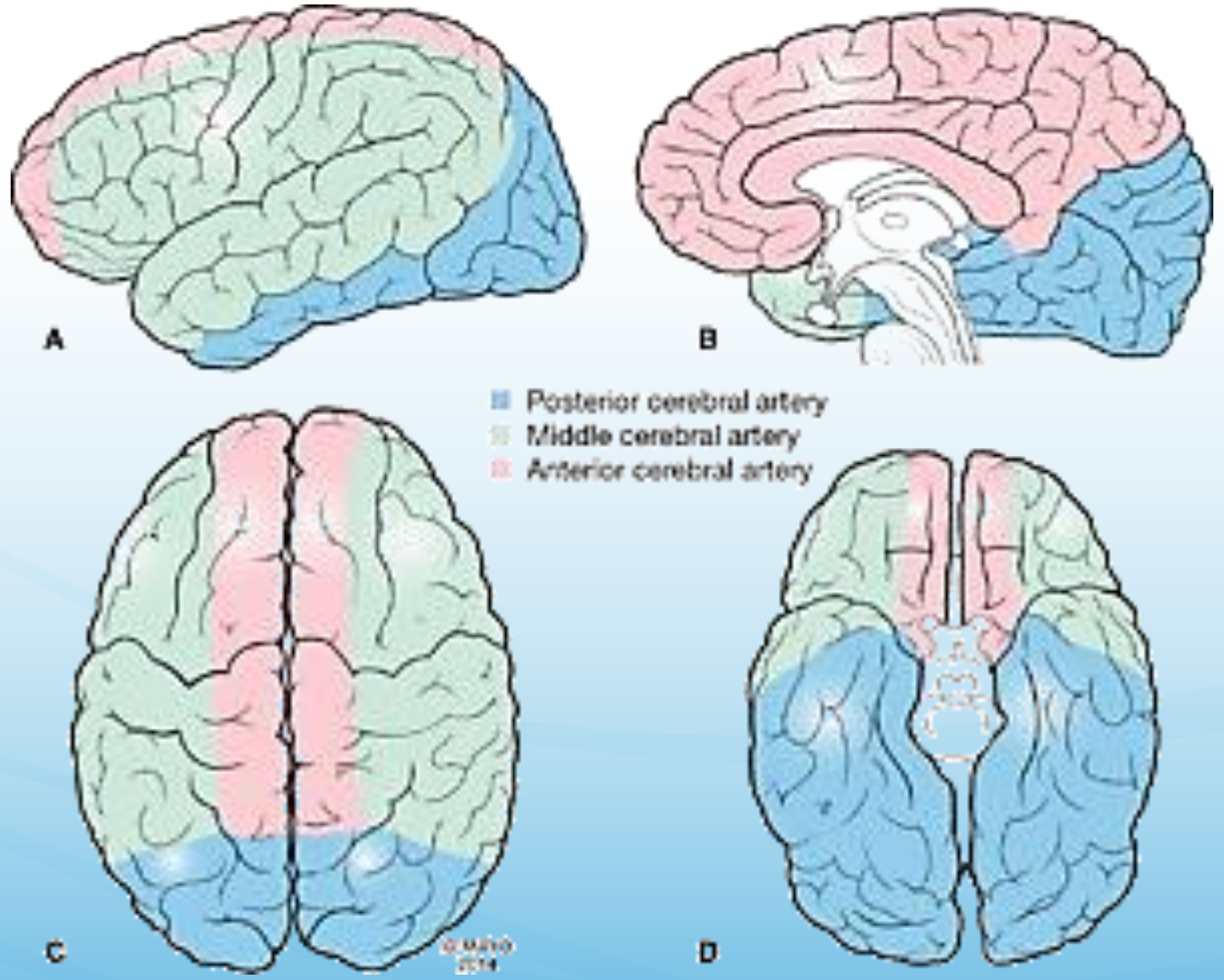
COW - THE STRENGTH OF COLLATERAL FLOW DIRECTLY IMPACTS THE PENUMBRA



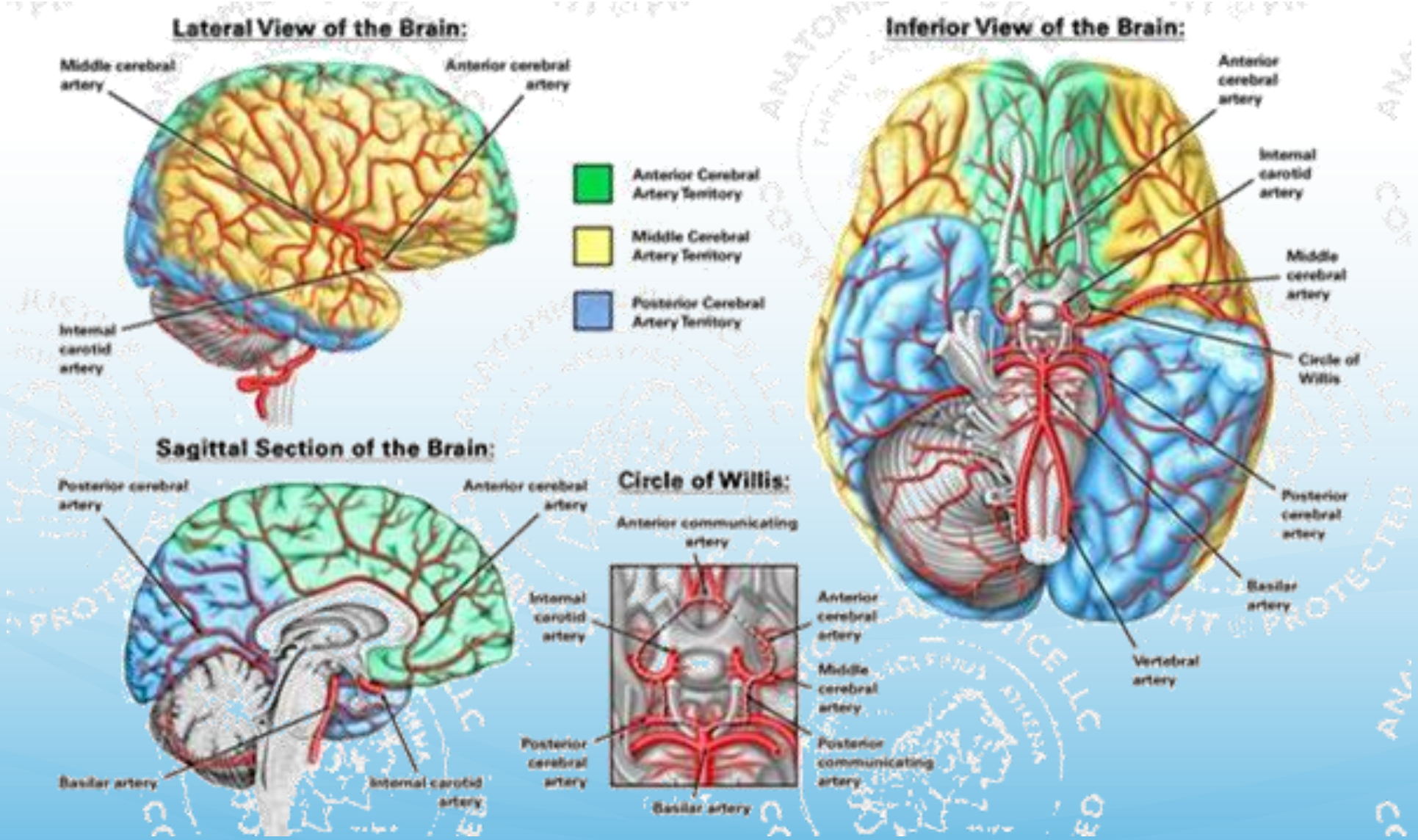
AREAS AFFECTED BY BLOCKAGE OF DIFFERENT BRANCHES – AXIAL & AP VIEWS



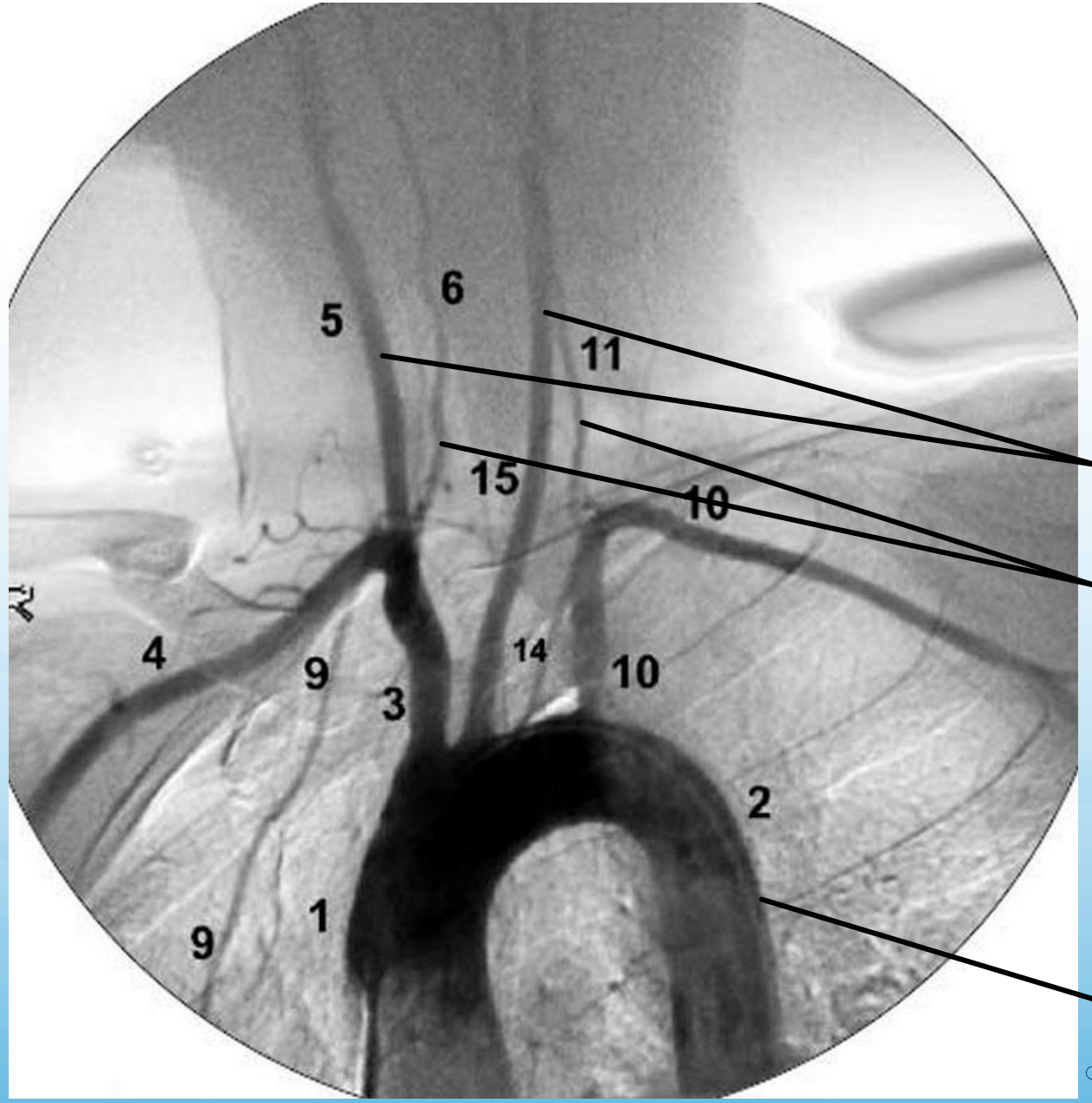
AREAS AFFECTED BY BLOCKAGE OF DIFFERENT BRANCHES – LATERAL & AXIAL VIEWS



AREAS AFFECTED BY BLOCKAGE OF DIFFERENT BRANCHES – LATERAL & AXIAL VIEWS



ANGIOGRAPHIC APPEARANCE - THE AORTIC ARCH



Carotid arteries

Vertebral arteries

Aortic arch

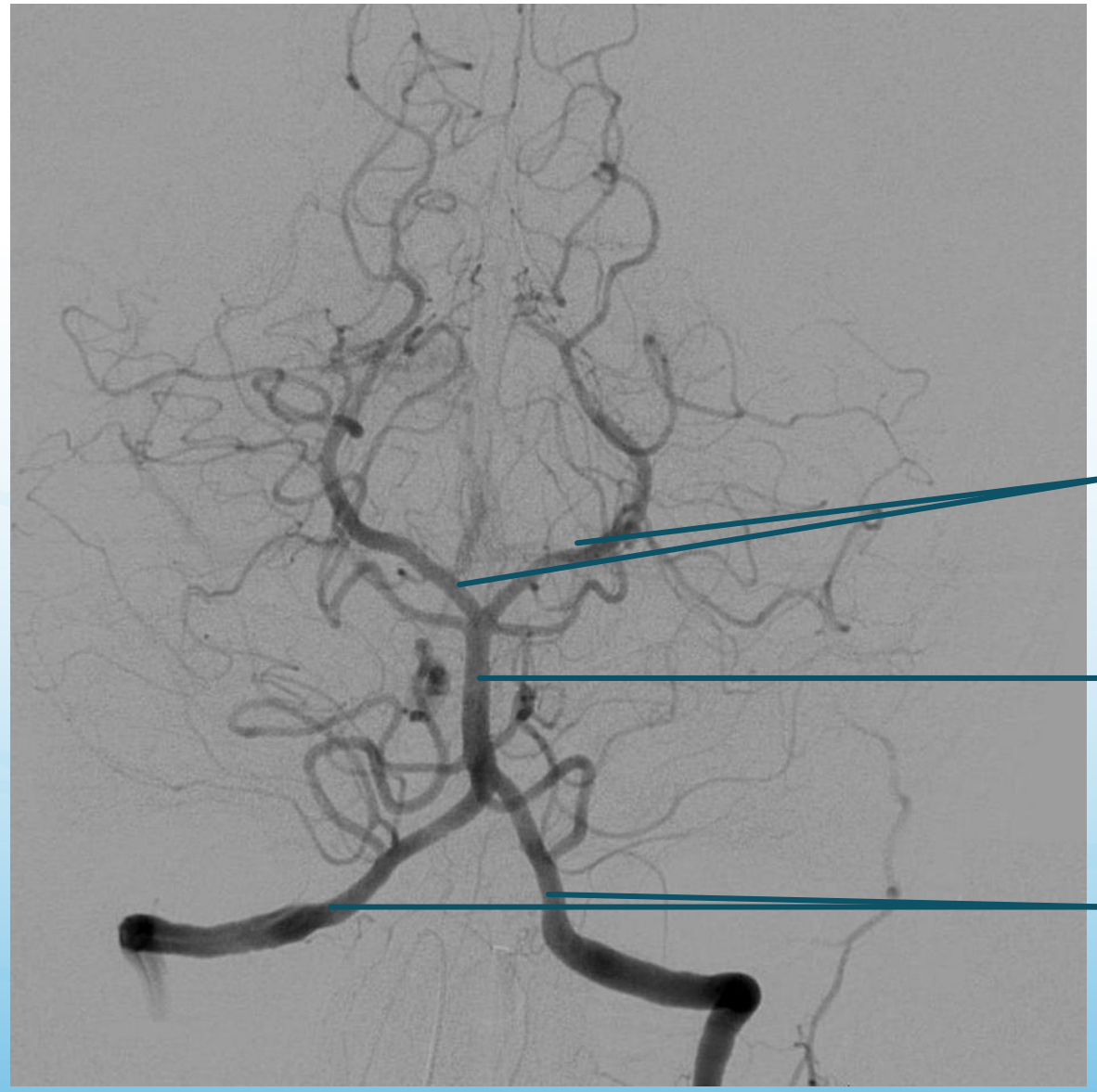
ANGIOGRAPHIC APPEARANCE - INTRACRANIAL VESSELS

Anterior cerebral artery (ACA)

Middle cerebral artery (MCA)

Internal carotid Artery (ICA)

ANGIOGRAPHIC APPEARANCE - INTRACRANIAL VESSELS



Posterior cerebral arteries (PCA)

Basilar artery (BA)

Vertebral Arteries (VA)

WHAT IS STROKE

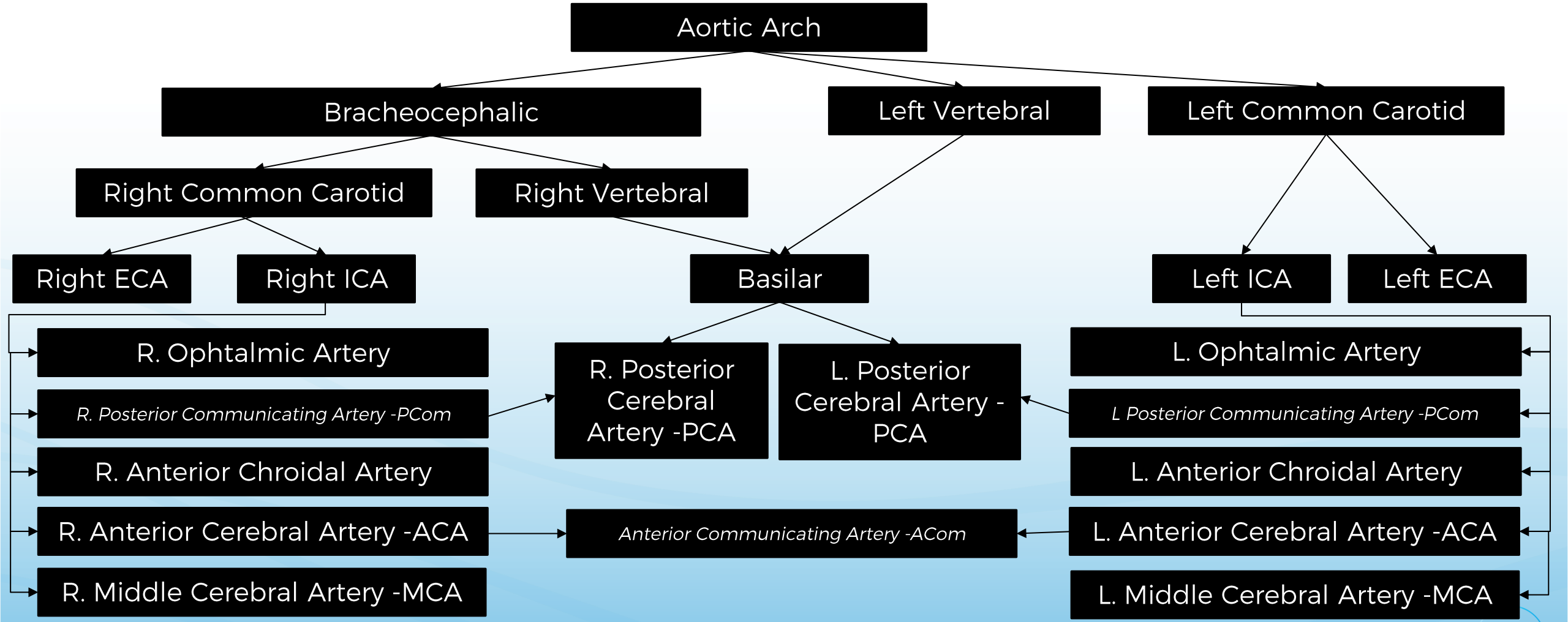
NORMAL

STROKE

INTRACRANIAL VESSELS ARE FURTHER SUBCATEGORIZED IN SEGMENTS

- MCA is composed of M1, M2, M3 and M4 segments
- ACA is composed of A1, A2, A3 and A4 segments
- PCA is composed of P1, P2, P3 and P4 segments

MOST IMPORTANT ARTERY NAMES TO RETAIN
(THIS IS NOT THE FULL PICTURE !)



MOST IMPORTANT ARTERY NAMES TO RETAIN
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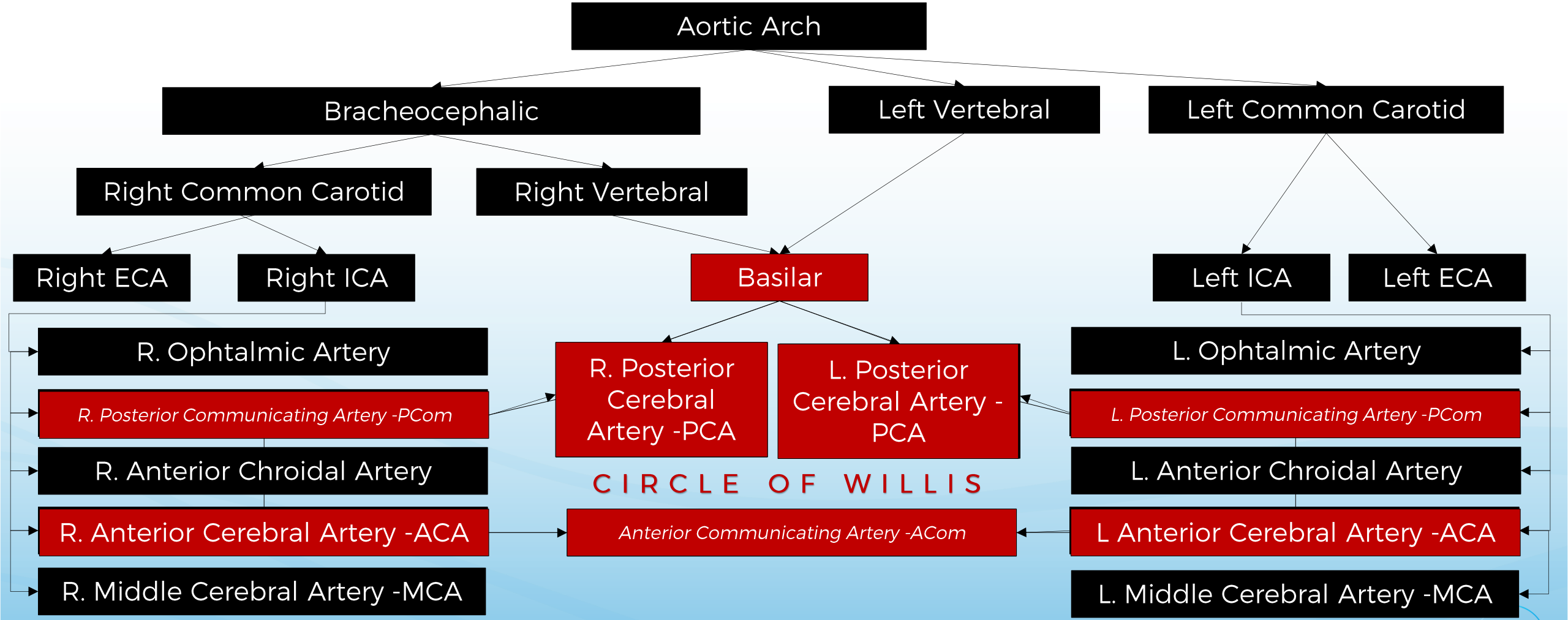

ANATOMY

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1.3. SIZE INFORMATION

- Size of Cerebral Arteries

DIAMETERS OF MAJOR CEREBRAL ARTERIES

Anterior Cerebral Artery -ACA

Middle Cerebral Artery -MCA

Basilar Artery -BA

Posterior Cerebral Artery -PCA

Table 1 - The transversal diameters of the branches part of the circle of Willis (in millimeters).

Vessel	Mean	Standard Error	Max	Min
ACA R	2.0	0.07	2.9	1.1
ACA L	2.2	0.09	3.3	1.5
Total ACA	2.1	0.06	3.3	1.1
MCA R	2.7	0.07	3.6	1.9
MCA L	2.7	0.06	3.6	1.9
Total MCA	2.7	0.05	3.6	1.9
BA	2.9	0.09	3.7	2.1
PCA L	2.1	0.07	3.0	1.2
PCA R	2.0	0.08	2.8	1.0
Total PCA	2.1	0.06	3.0	1.0

EFFECT OF AGE AND GENDER

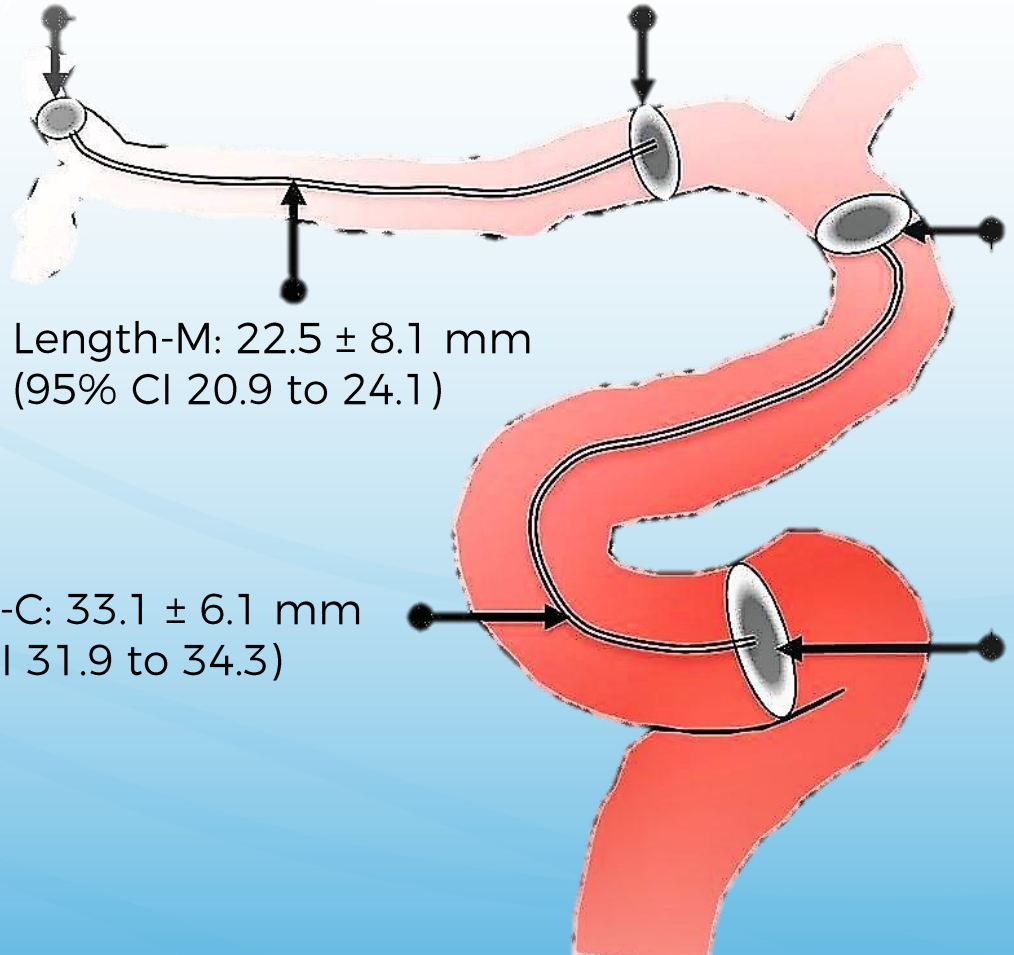
- Females and younger people tend to have smaller diameter arteries

Table 2 - Vessel diameters according with subgroups.

	F(n=15)		M(n=15)		>40y/o(n=16)		<40y/o(n=14)	
Vessel	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
ACA	2	0,32	2,2	0,52	2,1	0,43	2,1	0,45
MCA	2,6	0,4	2,7	0,34	2,7	0,36	2,6	0,38
PCA	1,9	0,44	2,3	0,37	2,2	0,42	1,9	0,46
BA	2,5	0,37	3,2	0,41	3	0,45	2,7	0,53
Mean age	42	16,6	47	16,6	57	12	31	7,55

ACA= anterior cerebral artery; MCA= middle cerebral artery ; PCA=posterior cerebral artery ;BA=basilar artery ;M=male; F=female; y/o=years old.

SIZE OF AN ARTERY CHANGES FROM PROXIMAL TO DISTAL END



DIAMETER -M1: 3.1 ± 0.4 mm
(95% CI 3.0 to 3.1)

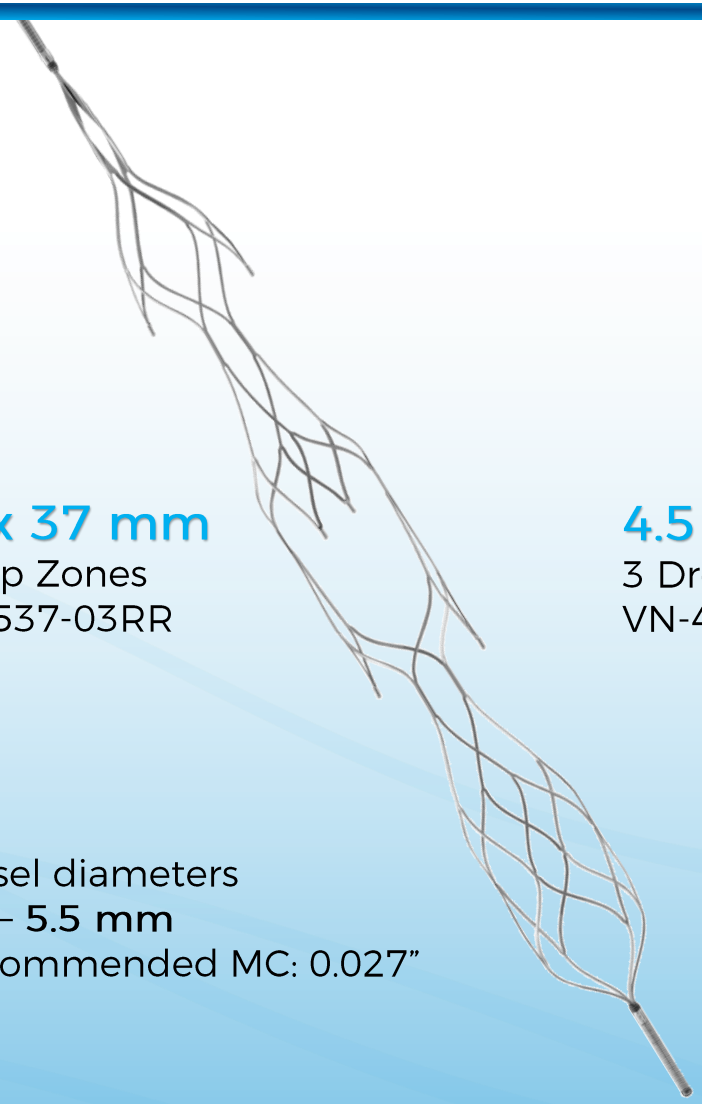
DIAMETER -T: 3.6 ± 0.4 mm
(95% CI 3.5 to 3.7)

Length-M: 22.5 ± 8.1 mm
(95% CI 20.9 to 24.1)

Length-C: 33.1 ± 6.1 mm
(95% CI 31.9 to 34.3)

DIAMETER -C: 5 ± 0.6 mm
(95% CI 4.9 to 5.2)

Neva™

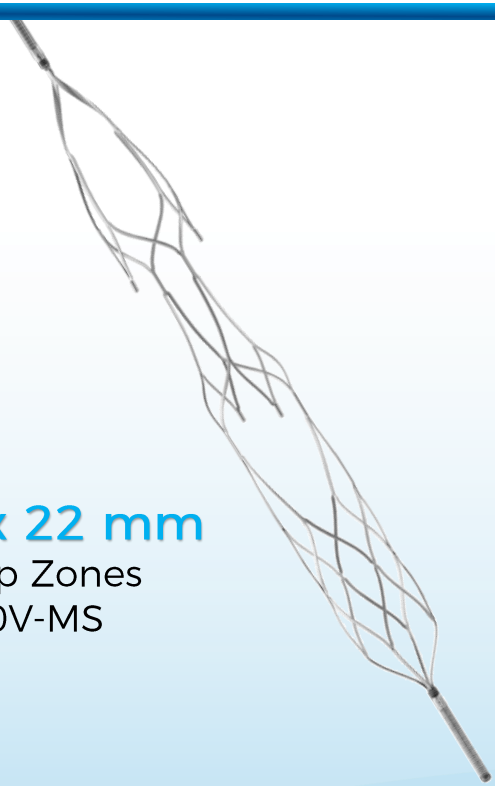


5.5 x 37 mm
3 Drop Zones
VN-5537-03RR

Vessel diameters
3.5 – 5.5 mm
Recommended MC: 0.027”

4.5 x 29 mm
3 Drop Zones
VN-4529-03RR

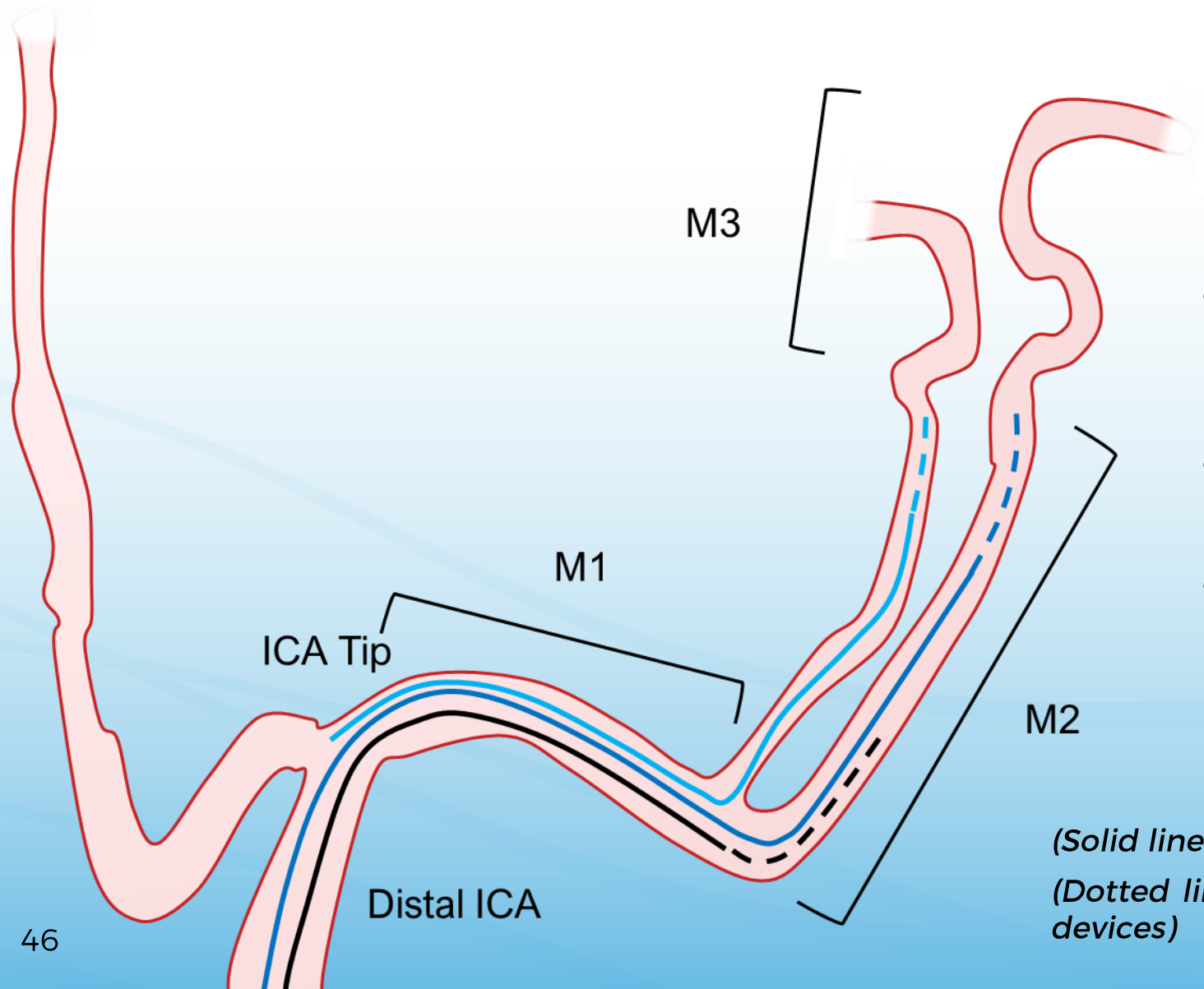
Vessel diameters
2.0 – 4.5 mm
Recommended MC: 0.021”



4.0 x 22 mm
2 Drop Zones
30020V-MS

Vessel diameters
2.0 – 4.0 mm
Recommended MC: 0.021”

CHOOSING THE CORRECT SIZE IN MCA OCCLUSIONS



NeVa 4.0 x 22 & NeVa 4.5 x 29

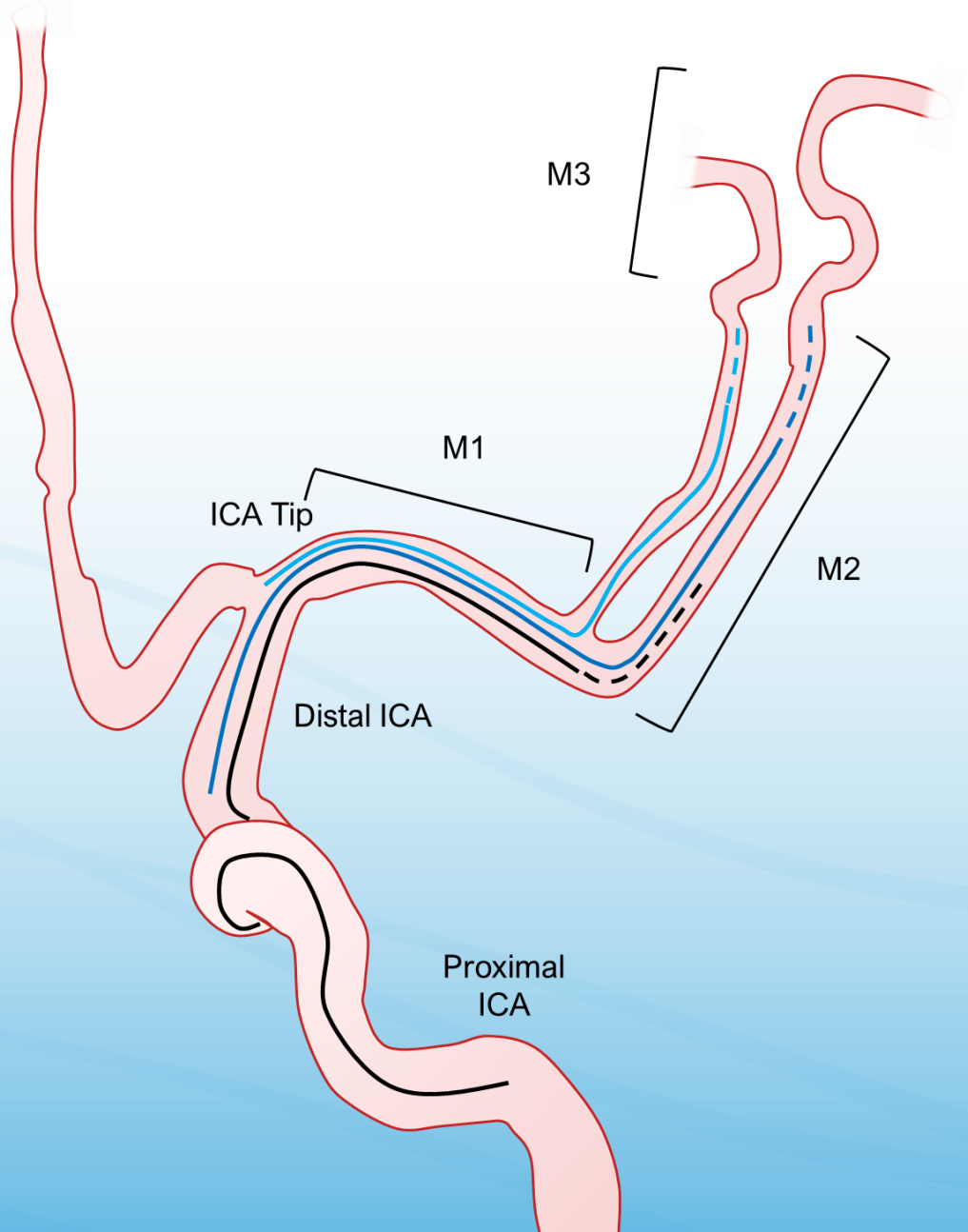
appropriate for **MCA-M1, proximal M2, ACA** and **PCA** occlusions

- distal deployment of both sizes into the insular segment (M2) of the MCA is possible
- avoid deployment into the opercular (M3) segment or beyond
- select 4.0 x 22 for more tortuous, or smaller segments

(Solid lines = site of occlusion)

(Dotted lines = landing spot of distal portion of devices)

CHOOSING THE CORRECT SIZE IN ICA OCCLUSIONS



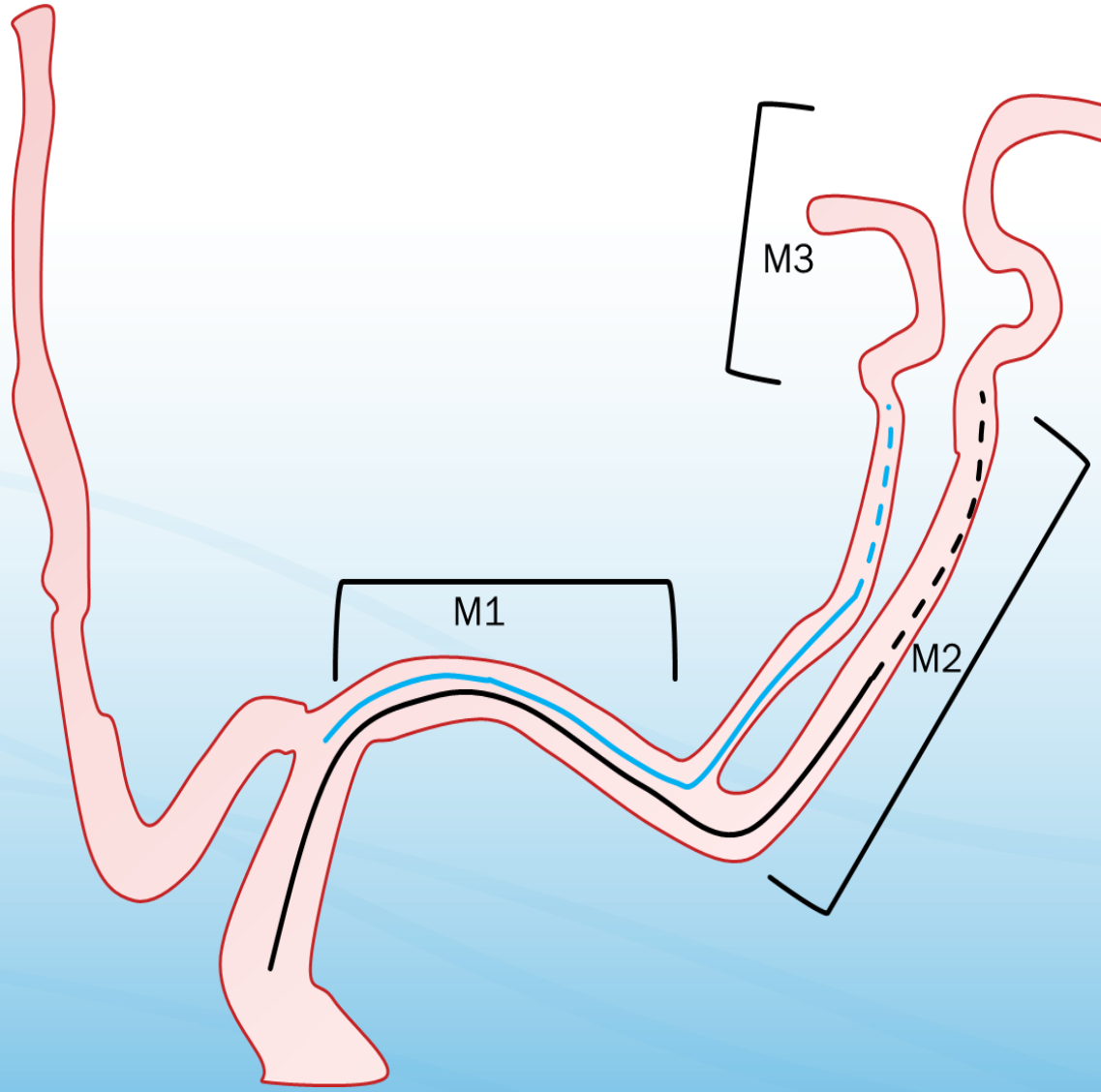
NeVa 4.5 x 29 & NeVa 5.5 x 37

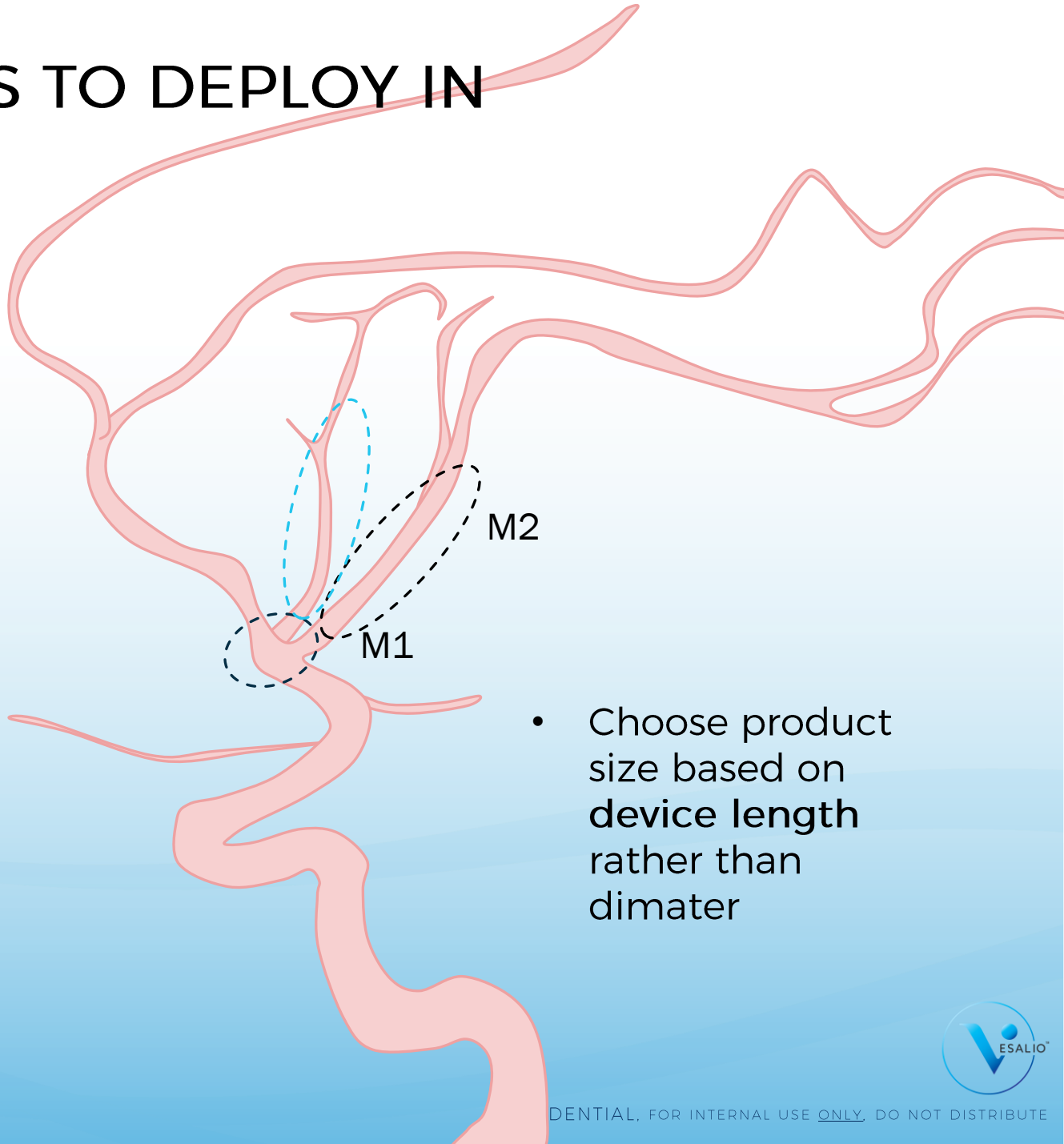
- appropriate for **MCA-M1, ICA Tip, distal ICA** occlusions
- distal deployment into the insular segment (M2) of the MCA is possible
- avoid deployment into the opercular (M3) segment or beyond
- consider using the smaller NeVa sizes in challenging anatomies with shorter segments and sharp tortuosity

(Solid lines = site of occlusion)

(Dotted lines = landing spot of distal portion of devices)

CHOOSE STRAIGHT SEGMENTS TO DEPLOY IN





- Choose product size based on **device length** rather than dimater

LEARNING GOAL

TEST YOURSELF

- Retain key information on main cranial arteries for stroke thrombectomy
  - CCA
  - VA
  - ICA
  - BA
  - **MCA**
  - **ACA**
  - **PCA**
  - Acom
  - Pcom

  - Full name?
  - How many are there?
  - Are they part of anterior or posterior circulation?
  - Are they partially or fully intra-cranial? (or not at all?)
  - Where do they branch out from, what do they branch out into? (i.e. what comes before and after?)
  - Which parts of the brain do they irrigate?
  - What is their diameter and which NeVa could you recommend?