THE IMPACT OF STROKE ON AUDIO-VESTIBULAR SYSTEM

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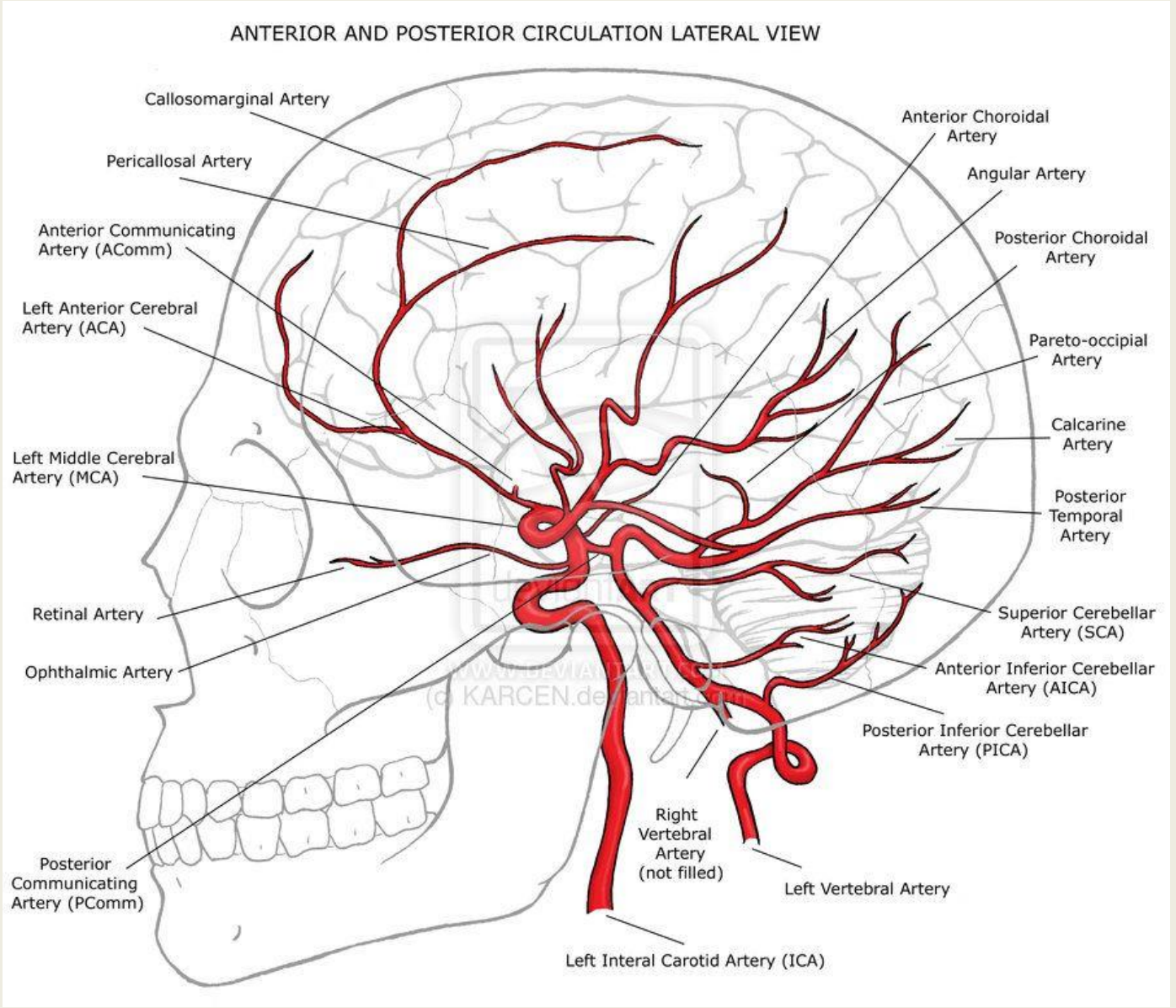
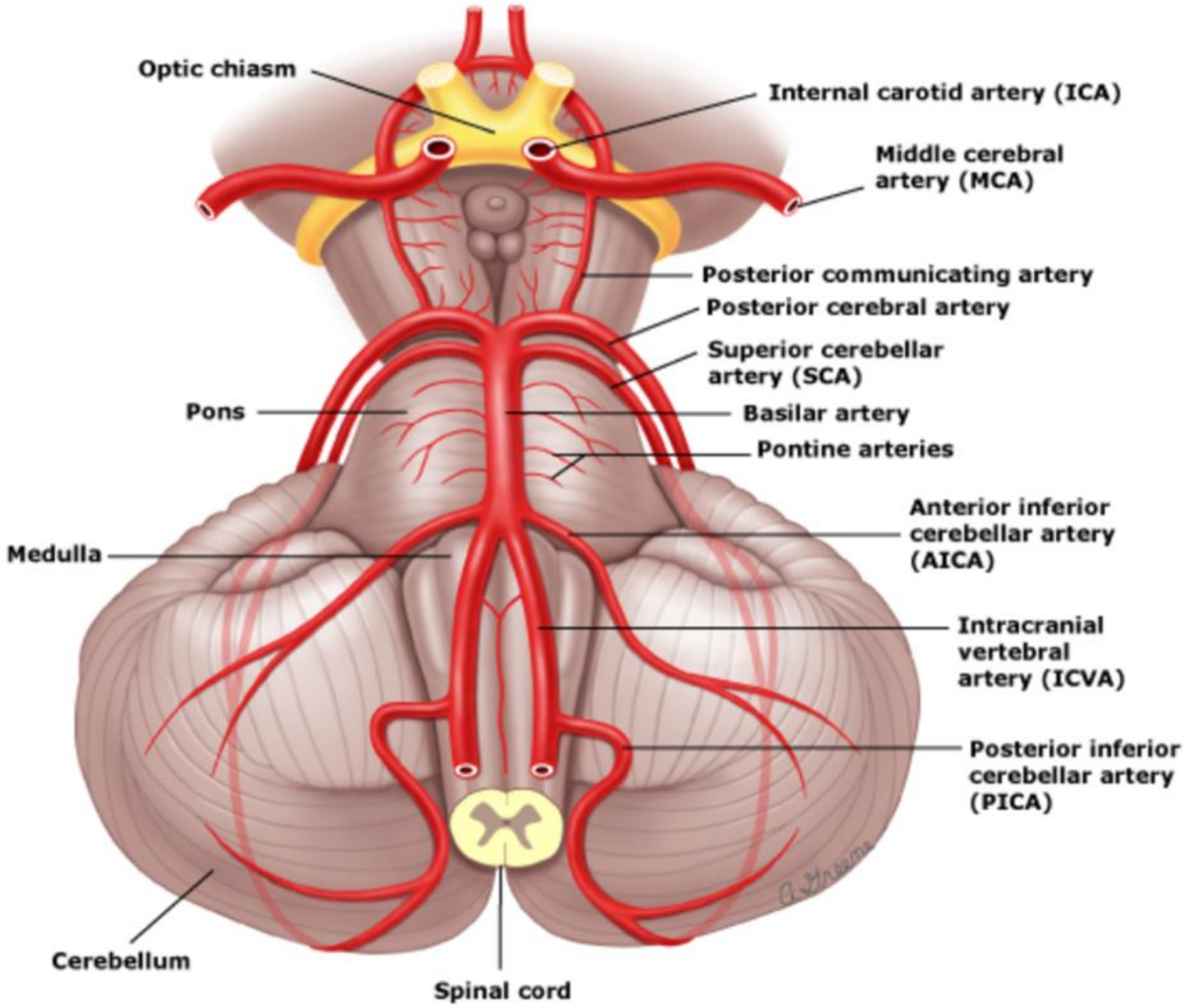
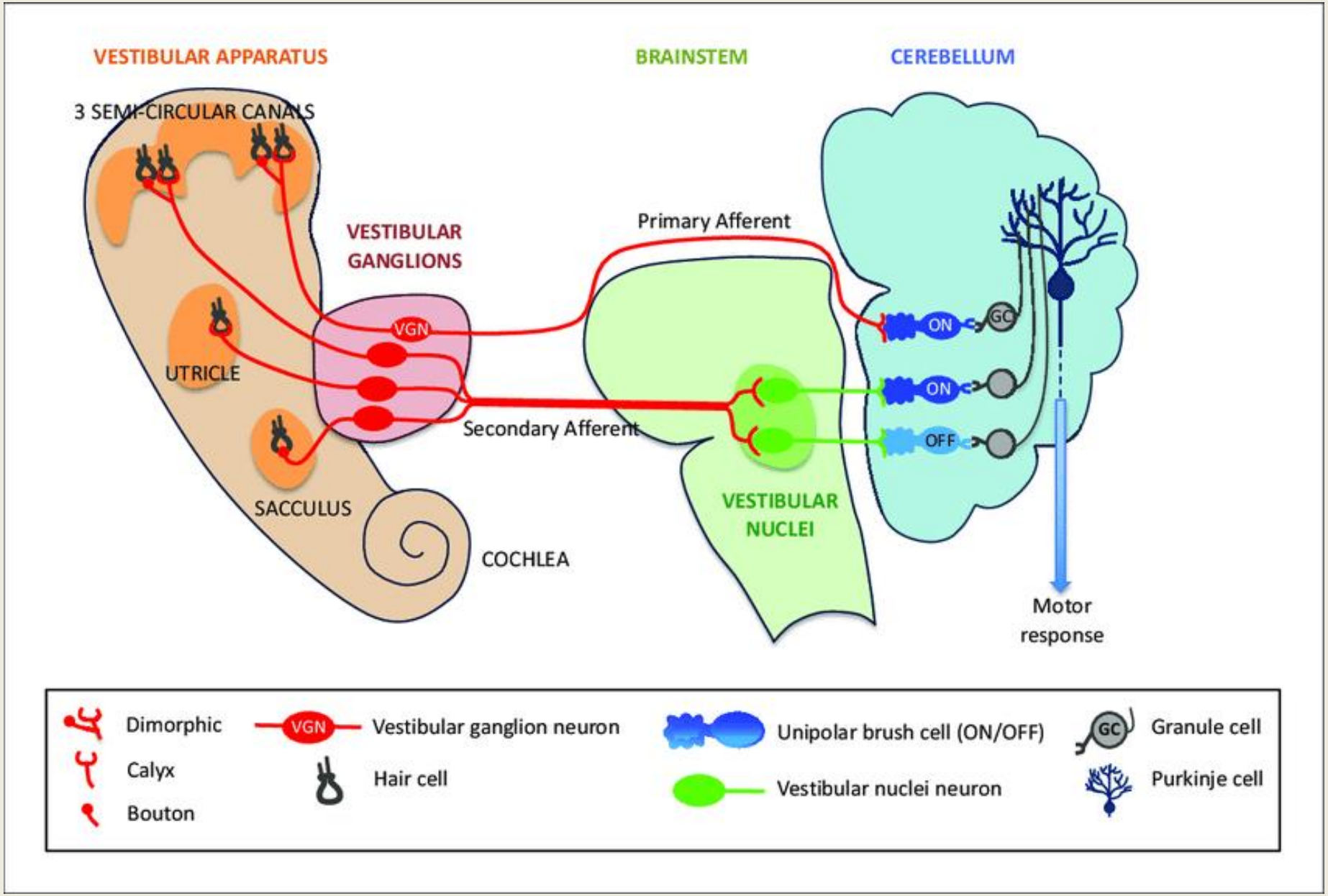
- Cerebrovascular accident (CVA) is the leading cause of neurological disability.

- Ischemic vs. hemorrhagic
- Anterior vs. Posterior circulation

- Approximately 20% of ischemic events involve tissue supplied by the posterior (vertebrobasilar) circulation territory.


ANTERIOR AND POSTERIOR CIRCULATION LATERAL VIEW
Callosomarginal Artery
Pericallosal Artery
Anterior Communicating Artery (AComm)
Left Anterior Cerebral Artery (ACA)
Left Middle Cerebral Artery (MCA)
Retinal Artery
Ophthalmic Artery
Posterior Communicating Artery (PComm)
Anterior Choroidal Artery
Angular Artery
Posterior Choroidal Artery
Pareto-occipial Artery
Calcarine Artery
Posterior Temporal Artery
Superior Cerebellar Artery (SCA)
Anterior Inferior Cerebellar Artery (AICA)
Posterior Inferior Cerebellar Artery (PICA)
Right Vertebral Artery (not filled)
Left Vertebral Artery
Left Interal Carotid Artery (ICA)


Optic chiasm
Internal carotid artery (ICA)
Middle cerebral artery (MCA)
Posterior communicating artery
Posterior cerebral artery
Superior cerebellar artery (SCA)
Pons
Basilar artery
Pontine arteries
Anterior inferior cerebellar artery (AICA)
Medulla
Intracranial vertebral artery (ICVA)
Posterior inferior cerebellar artery (PICA)
Cerebellum
Spinal cord


VESTIBULAR APPARATUS
BRAINSTEM
CEREBELLUM
3 SEMI-CIRCULAR CANALS
VESTIBULAR GANGLIONS
Primary Afferent
VGN
UTRICLE
ON
GC
ON
OFF
Secondary Afferent
SACCULUS
VESTIBULAR NUCLEI
COCHLEA
Motor response
Dimorphic
Calyx
Bouton
VGN
Vestibular ganglion neuron
Hair cell
Unipolar brush cell (ON/OFF)
Vestibular nuclei neuron
GC
Granule cell
Purkinje cell

Isolated episodic vertigo of a vascular cause

- Transient ischemia within the vertebrobasilar circulation (i.e. vertebrobasilar insufficiency) is a common cause of episodic vertigo in elderly patients.
- Patients with vertigo due to vertebrobasilar insufficiency, 62% had at least one isolated episode of vertigo, and in 19% vertigo was the initial symptom.
- 26% had canal paresis to caloric stimulation, indicating permanent damage to the peripheral vestibular system involving the inner ear or vestibular nerve.

- Isolated episode of recurrent vertigo, fluctuating hearing loss, and/or tinnitus (similar to Ménière’s disease) as initial symptoms 1–10 days prior to the AICA infarction.

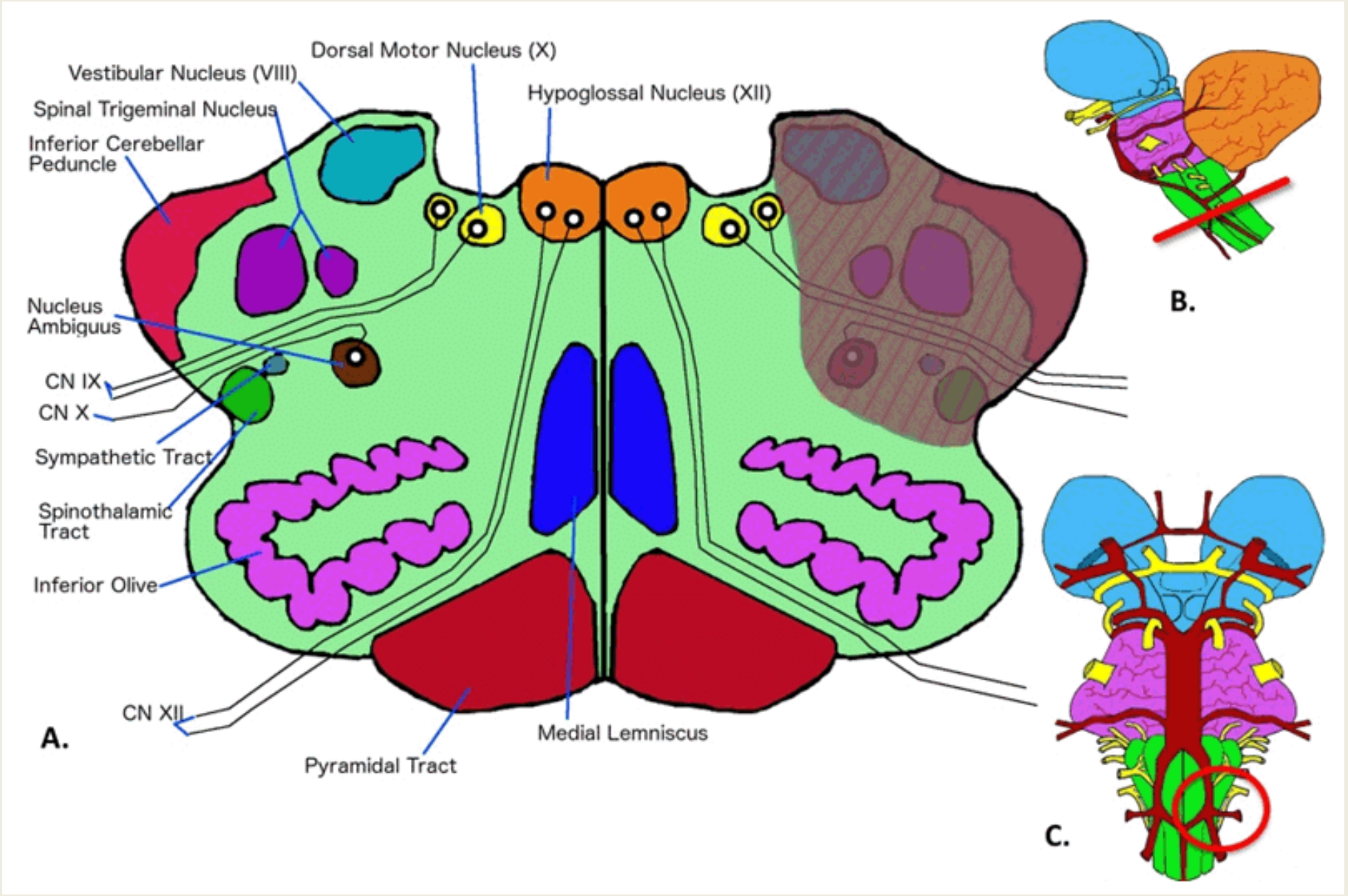
- It is still unclear whether isolated episodic vertigo originates from the brain or the inner ear.

Brainstem stroke

Lateral medullary infarction (Wallenberg syndrome):

- Infarction in the dorsolateral medulla (Wallenberg syndrome) commonly involves the inferior and medial vestibular nuclei and usually manifests with nausea/vomiting, vertigo, and imbalance.

- It is commonly caused by thrombosis of the ipsilateral vertebral artery.


Dorsal Motor Nucleus (X)
Vestibular Nucleus (VIII)
Hypoglossal Nucleus (XII)
Spinal Trigeminal Nucleus
Inferior Cerebellar Peduncle
Nucleus Ambiguus
CN IX
CN X
Sympathetic Tract
Spinothalamic Tract
Inferior Olive
CN XII
Medial Lemniscus
Pyramidal Tract
A.
B.
C.

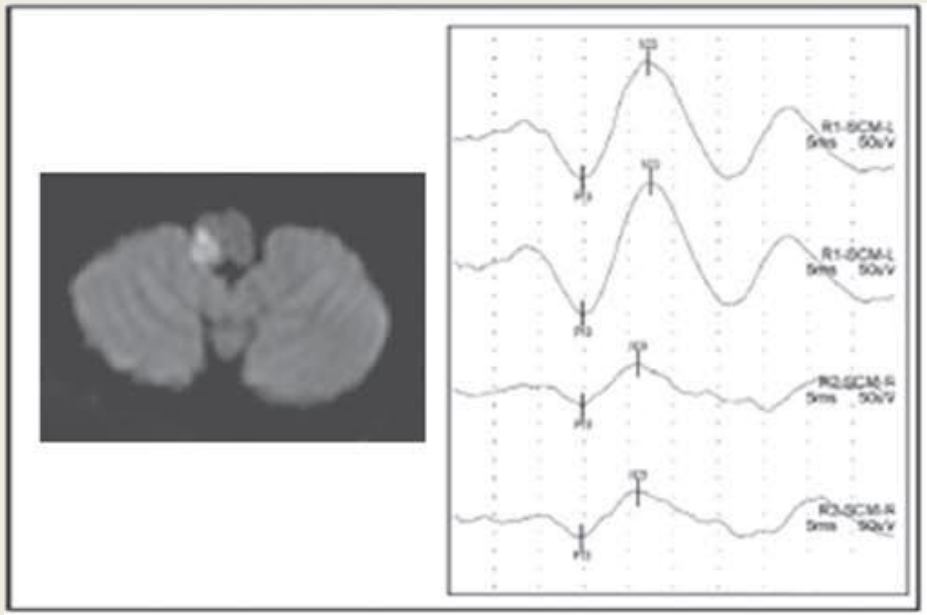
- Typically, horizontal nystagmus beats away from the lesion side. The vertical component is usually upbeating, and torsional nystagmus may be ipsi- or contralesional.

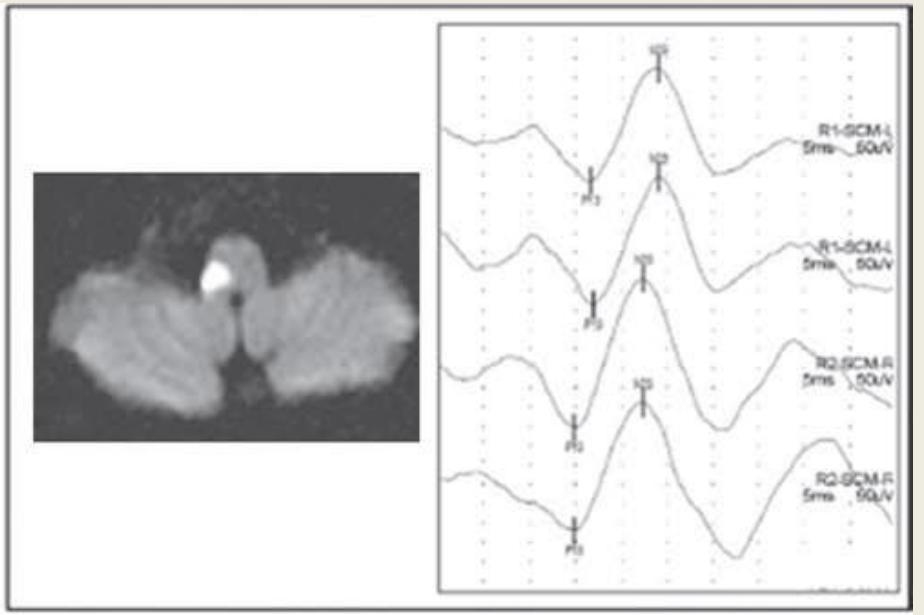
- Head-shaking nystagmus is frequently observed, and the horizontal component is ipsilesional in most patients.

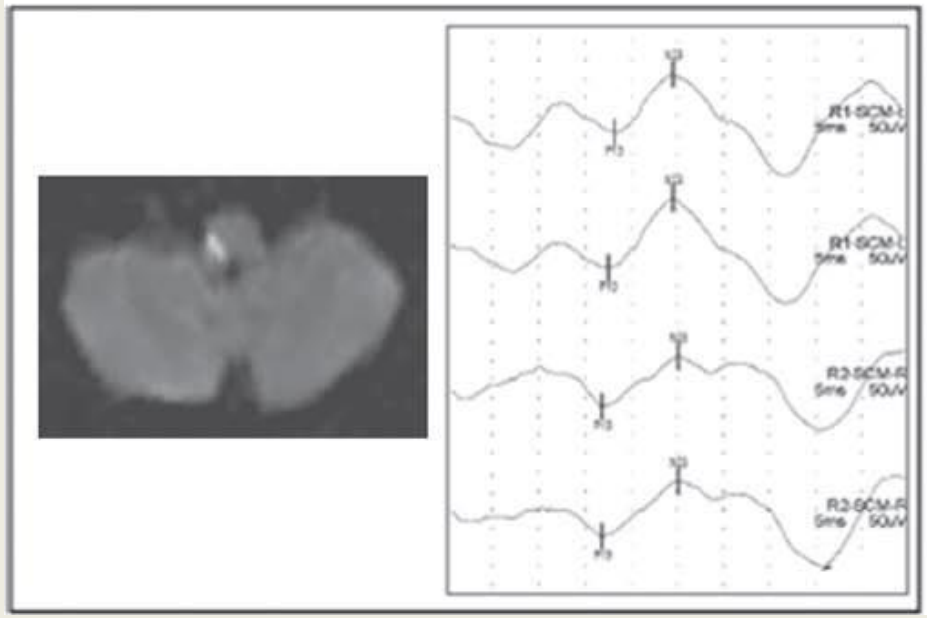
- The ocular tilt reaction (OTR), which consists of head tilt, ocular torsion, and skew deviation, is commonly observed during the acute phase and is ipsilesional.

- Wallenberg syndrome may disrupt descending vestibulospinal tracts and cause prominent imbalance with falling to the ipsilesional side.

- Cervical vestibular-evoked myogenic potentials (cVEMPs) can be abnormal if the sacculocollic reflex pathways are damaged at the level of the vestibular nucleus.







Cerebellar ischemic stroke syndromes

AICA territory cerebellar infarction:

- **Labyrinthine infarction** (due to Internal auditory artery (IAA) infarction) is an important sign for the diagnosis of AICA territory infarction.

- Occlusion of the IAA causes a sudden loss of both auditory and vestibular functions, resulting in acute onset of hearing loss and vertigo.

- Hearing loss is a less widely appreciated and has been traditionally considered as a less common sign of AICA territory infarction.

- However, a recent report showed that 11 out of 12 patients (92%) with AICA infarction showed labyrinthine infarction, which is clinically diagnosed by sudden sensorineural hearing loss on PTA and canal paresis to caloric tests.

- Hearing loss is usually permanent, but dizziness and imbalance gradually improve with central compensation.

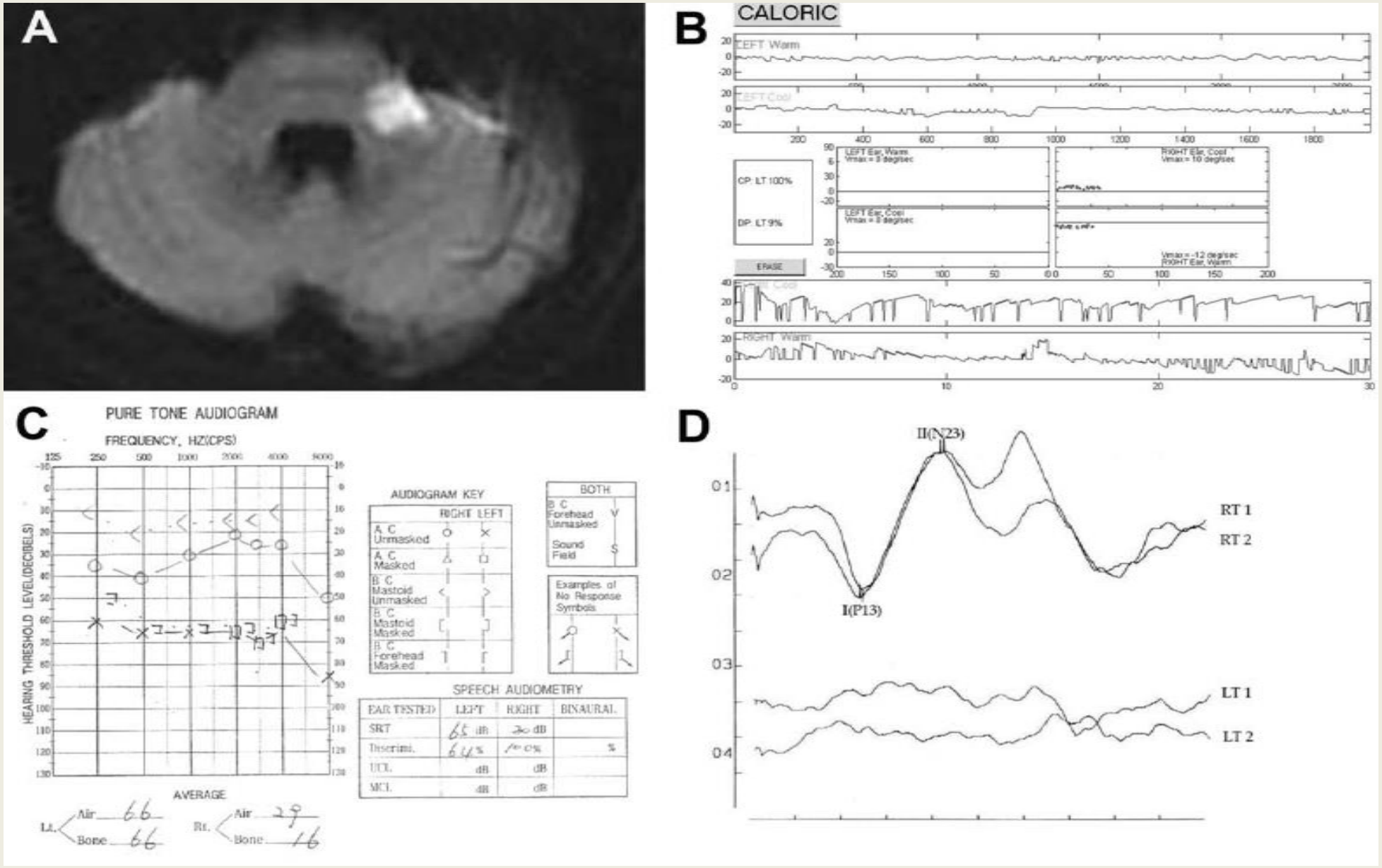
- The most common pattern of vestibular dysfunction in AICA territory infarction was a combination of peripheral, and central ocular motor or vestibular signs.

- Eighty-two consecutive patients with AICA infarction were evaluated using bithermal caloric tests and PTA; All but two (80/82: 98%) patients had acute prolonged vertigo.

- The most common pattern of audiovestibular dysfunctions was the combined loss of auditory and vestibular function (60%); selective loss of vestibular (5%) or cochlear (4%) function was rarely observed.

- AICA infarction can cause the OTR ipsilaterally.

- The peripheral vestibular structure with the inner ear may have a crucial role in producing abnormal VEMP response associated with AICA Infarction.


A
B
CALORIC
LEFT Warm
LEFT Cool
CP: LT 100%
DP: LT 9%
ERASE
RIGHT Cool
RIGHT Warm
C
PURE TONE AUDIOGRAM
FREQUENCY, HZ(CPS)
HEARING THRESHOLD LEVEL(DECIBELS)
AUDIOGRAM KEY
RIGHT LEFT
A C Unmasked
A C Masked
B C Mastoid Unmasked
B C Mastoid Masked
B C Forehead Masked
BOTH
B C Forehead Unmasked
Sound Field
Examples of No Response Symbols
SPEECH AUDIOMETRY
EAR TESTED
LEFT
RIGHT
BINAURAL
SRT
Discrim.
UCL.
MCL.
AVERAGE
Lt. Air 66 Bone 66
Rt. Air 29 Bone 16
D
II(N23)
I(P13)
RT 1
RT 2
LT 1
LT 2

- Pseudo-acute peripheral vestibulopathy associated with medial PICA territory cerebellar infarction.
- Acute hearing loss associated with non-AICA (mostly PICA) territory cerebellar infarction.
- Acute vestibular syndromes due to cerebellar haemorrhage and vascular compression syndromes.