



# *Central Vestibular Disorders*

# Dizziness

- Dysequilibrium
- **Vertigo** (a sense of motion of person or the visual surround)
- Presyncope (near-faint, light-headedness)
- Psychophysiologic dizziness (anxiety and panic)
- Overlapping
- Motion sickness

# Acute vertigo

- A result of vestibular imbalance

Asymmetry in tonic activity within the vestibular system

- Vegetative symptoms (nausea, vomiting, and diaphoresis)
- Get worse with head movement
- Ataxia
- Peripheral (labyrinth or vestibular nerve)
- Central (**Brainstem or Cerebellum**)

# Acute vertigo

- Rotation reflects imbalance
  - Semicircular canal
  - Tendency to fall to the unaffected side (+ve)
- Upright tilting Imbalance
  - Otolith
  - Tendency to fall to the affected side.

# Central vestibular disorders

- Identifying these is critical
  - \*Common 25% older patients presenting to ER with acute isolated vertigo have a cerebellar infarction
  - Life-threatening
  - The earlier the Dx the better the Px
  - Severe neurologic sequelae
  - 1<sup>st</sup>, 2<sup>nd</sup> & 3<sup>rd</sup> Prevention

# Otolaryngologist

- Challenging
- To differentiate central from peripheral
- May have both peripheral and central components.
- Urgency of the workup
- → Neurologic, medical, or psychiatric

# Central ?peripheral

- Neurologic symptoms
  - New severe headache
  - LOC
- Type of nystagmus
- Risk factors
- No improvement within 48 hours

	<b>Central</b>	<b>Peripheral</b>
<b>Imbalance</b>	<b>Severe</b>	<b>Mild to moderate</b>
<b>Neurologic symptoms</b>	<b>Frequent</b>	<b>Rare</b>
<b>Nystagmus</b>	<b>Changes direction in different gaze positions; no change with visual fixation</b>	<b>Unidirectional in all gaze positions; decreases with visual fixation</b>
<b>Hearing loss</b>	<b>Rare</b>	<b>Frequent</b>
<b>Nausea</b>	<b>Variable, may be absent</b>	<b>Severe</b>
<b>Recovery (central compensation)</b>		<b>Rapid</b>

# Central nystagmus

- Multi-directional
- -ve Alexander's law
- Unaffected by removal of fixation
- Purely vertical or Purely torsional nystagmus
- Constant and does not wane with time
- Absence of a head thrust sign
- Multiple Gaze-evoked nystagmus (<30 degrees )  
Occasionally present in only one direction of gaze similar to peripheral nystagmus.

# Gaze-paretic nystagmus RC

Weakness of the extraocular muscles

OR

their innervation

→ **Gaze-evoked nystagmus**

**Gaze-evoked nystagmus** is usually due to a defect in the central neural integrators controlling gaze-holding

# Central Vestibular Disorders

- Vascular
- Inflammatory
- Neoplastic
- Craniocervical junction disorders
- Inherited ataxias
- Metabolic
- Others

# Vascular

- Ischemic stroke/TIA
  - Brainstem
  - Cerebellar
  - Labyrinthine
- Hemorrhage
  - Brainstem
  - Cerebellar
- Migraine
  - **Vertigo**
  - Dysequilibrium
  - Benign paroxysmal **vertigo**
  - Paroxysmal torticollis

# Inflammatory

- Cerebellitis
- Multiple sclerosis
- Susac syndrome
- Behçet's syndrome
- Systemic lupus erythematosus
- Sarcoidosis
- Infectious

Intracranial complications CSOM

# Neoplastic

- Brainstem
- Cerebellar
- Fourth ventricle
- Paraneoplastic
  - Paraneoplastic cerebellar degeneration
  - Opsoclonus/myoclonus

# Craniocervical junction disorders

- Chiari malformation
- Basilar impression
- Syringobulbia

# Inherited ataxias

- Autosomal recessive
  - Friedreich ataxia
  - Ataxia-telangiectasia
  - Vitamin E deficiency
  - Refsum disease
- Autosomal dominant
  - Spinocerebellar ataxias
  - Episodic ataxias

# ***Metabolic***

- **Wernicke's encephalopathy**
- **Diabetes Hypoglycemia**
- **Vitamin B12 deficiency**
- **Hypothyroidism**
- **Hyperventilation**

# Others

- Toxic
  - Medications
  - Alcohol
- Degenerative
  - Parkinson's disease
  - Progressive supranuclear palsy
  - Multiple systems atrophy
  - Normal pressure hydrocephalus

# Others

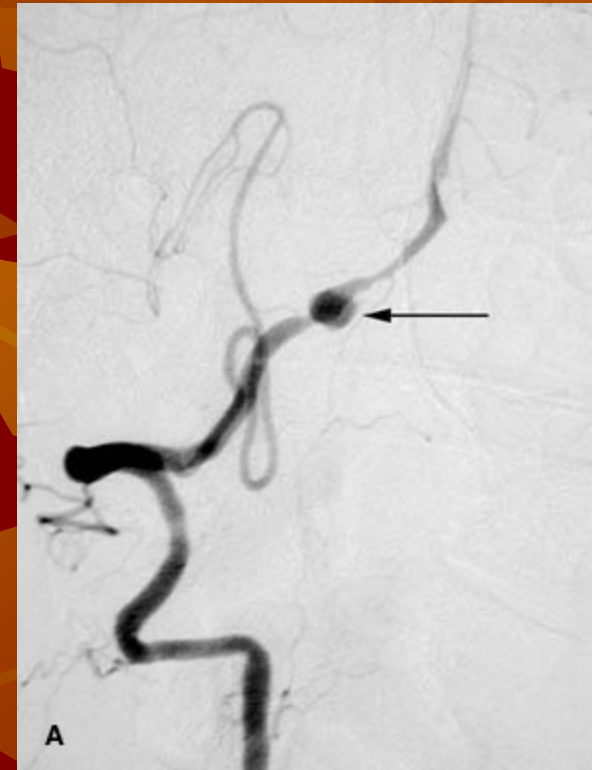
- **Epilepsy**
- **Trauma**
  - **Brain contusion**
  - **Post-concussion syndrome**
- **Physiologic**
  - **Mal de débarquement syndrome**
  - **Motion sickness**
- **Psychophysiologic**
  - **Chronic anxiety**
  - **Panic disorder**
  - **Phobic postural vertigo**
- **Psychogenic gait disorder**

# Others

- **Global cerebral hypoperfusion**
  - **Vasovagal presyncope**
  - **Reduced cardiac output**
  - **Autonomic insufficiency**
  - **Hypovolemia**
  - **Multisensory disturbance**
- **Peripheral neuropathy**
  - **Cervical or thoracic myelopathy**
  - **Visual loss**
  - **Superior oblique myokymia**
  - **Voluntary nystagmus**

# Dissection of the vertebral artery

- 19 y male
- MVA
- Dizziness neck extention
- Visual disturbance
- Drop attacks
- Ataxia



# Vascular

- Ischemic stroke/TIA
  - Brainstem
  - Cerebellar
  - Labyrinthine
- Hemorrhage
  - Brainstem
  - Cerebellar
- Migraine
  - **Vertigo**
  - Dysequilibrium
  - Benign paroxysmal **vertigo**
  - Paroxysmal torticollis

# Ischemic Stroke

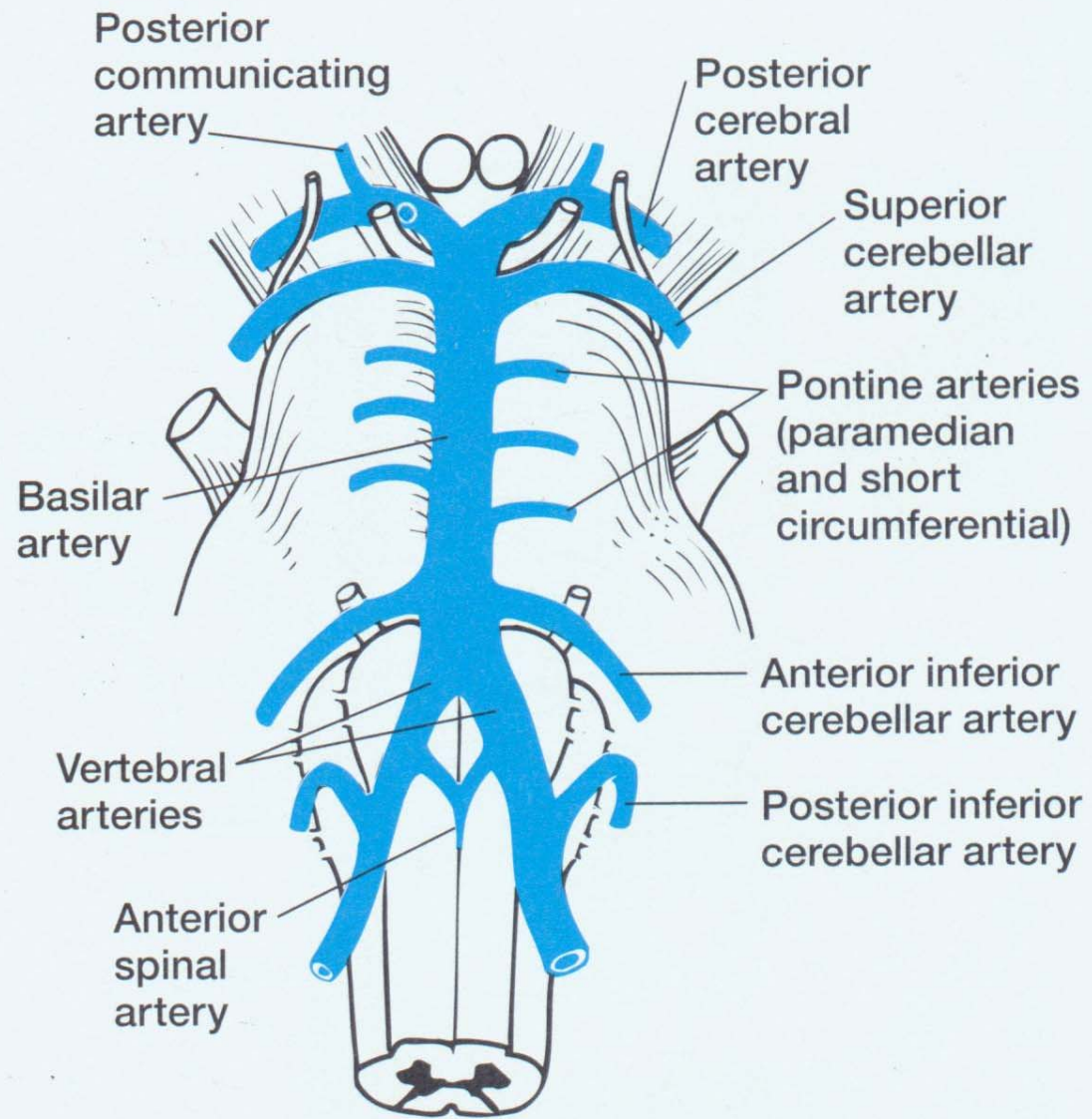
- Risk factors
  - Hypertension
  - Hyperlipidemia
  - Diabetes
  - Smoking.
  - Transient ischemic attacks (TIAs).

# **Vertebro-basilar arteries**

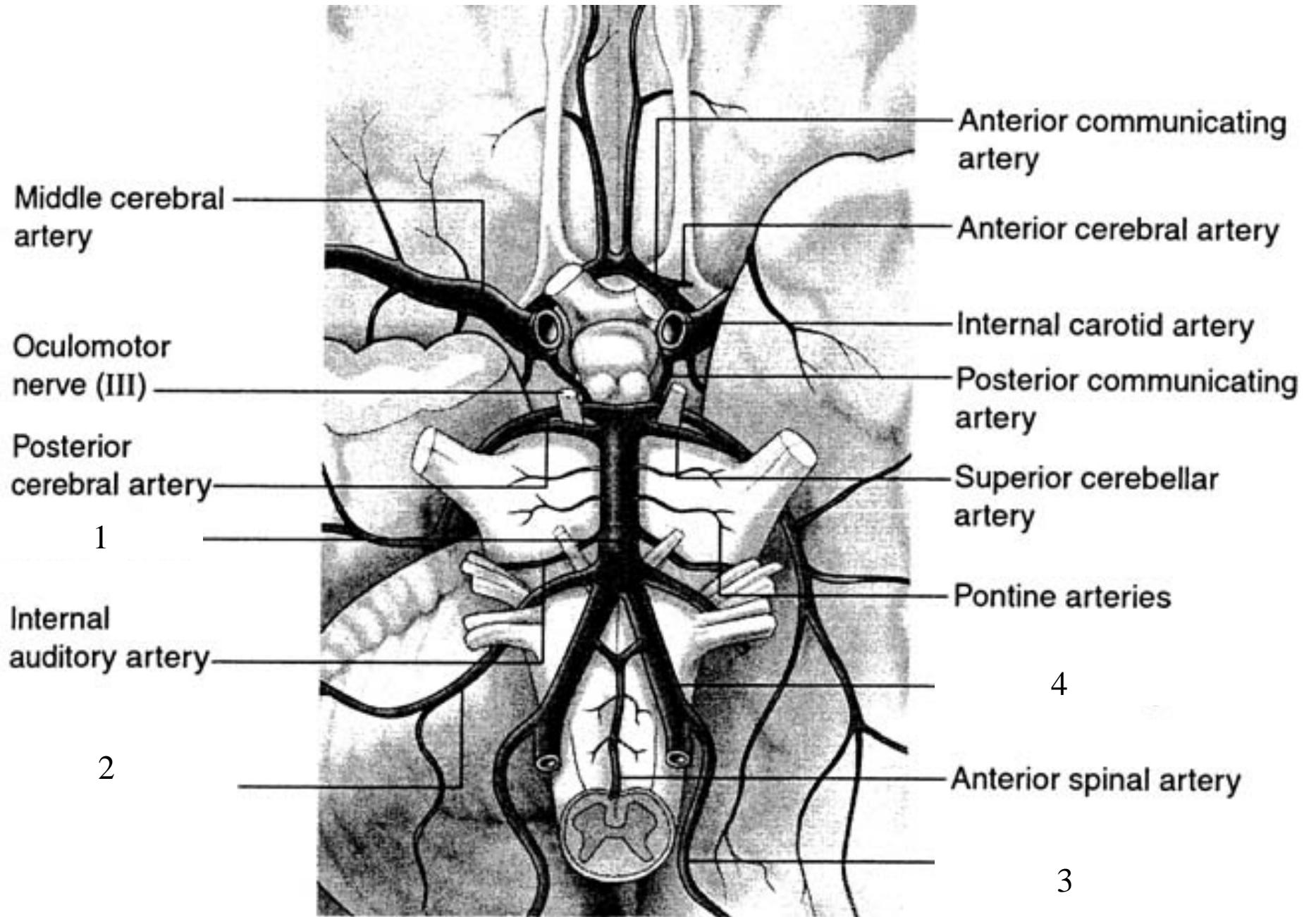
## **Branches:**

- Posterior inferior cerebellar artery (PICA)
- Anterior inferior cerebellar artery (AICA)
- Superior cerebellar artery (SCA)

**Brainstem or Cerebellum**

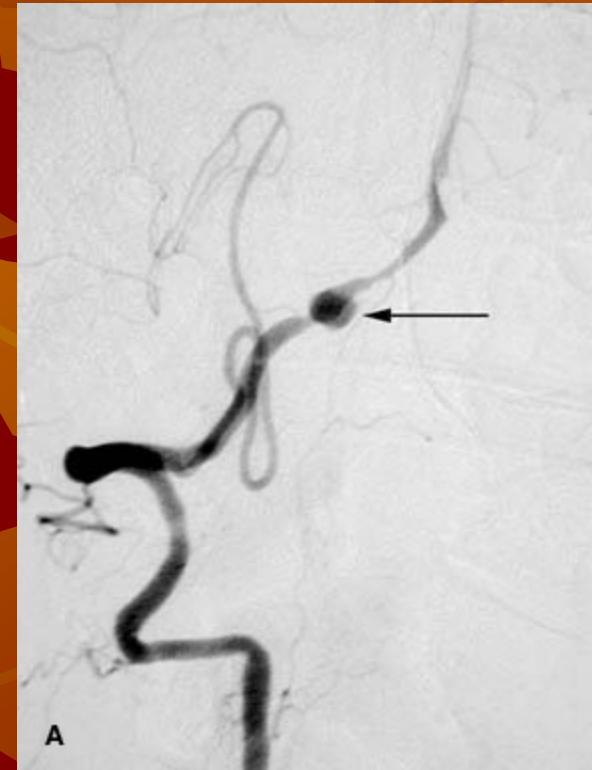


**Figure 7-11.** Principal arteries of the brain stem (ventral view).



# Dissection of the vertebral artery

- 19 y male
- MVA
- Dizziness neck extention
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# Dissection of the vertebral artery

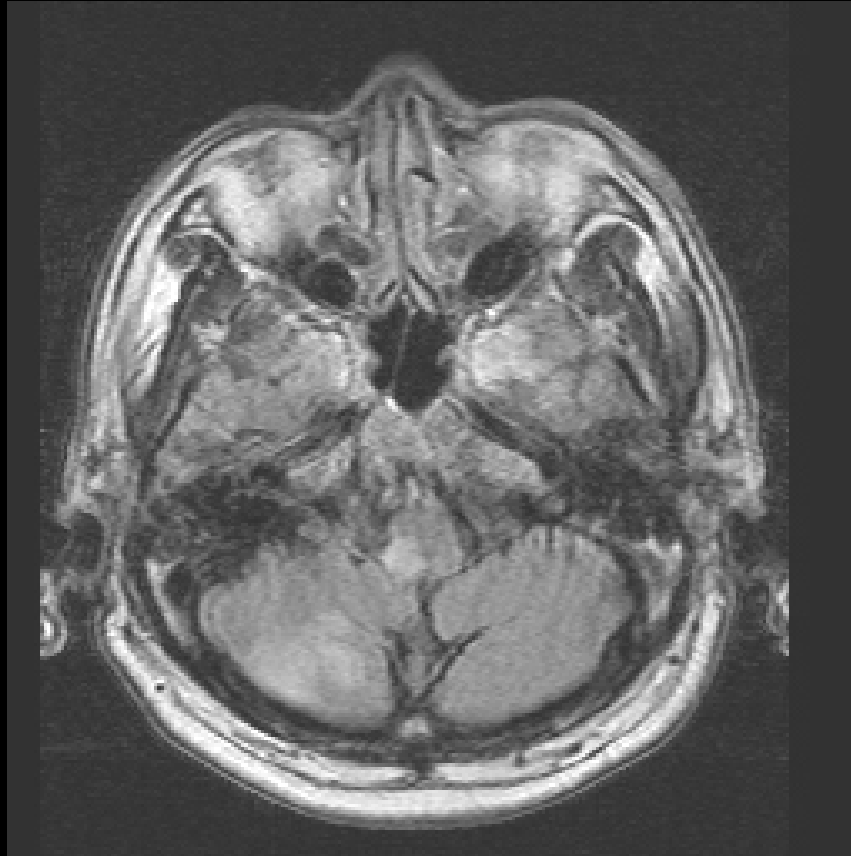
- Dissection → lumen stenosis or occlusion
- Minor neck trauma, neck manipulation, or spontaneously
- Signs of vertebrobasilar ischemia 4Ds  
Dizziness, Diplopia, dysphagia & drop attacks
- Young patient
- No vascular risk factors
- Neck or head pain
- (MRA) → recognized more commonly now

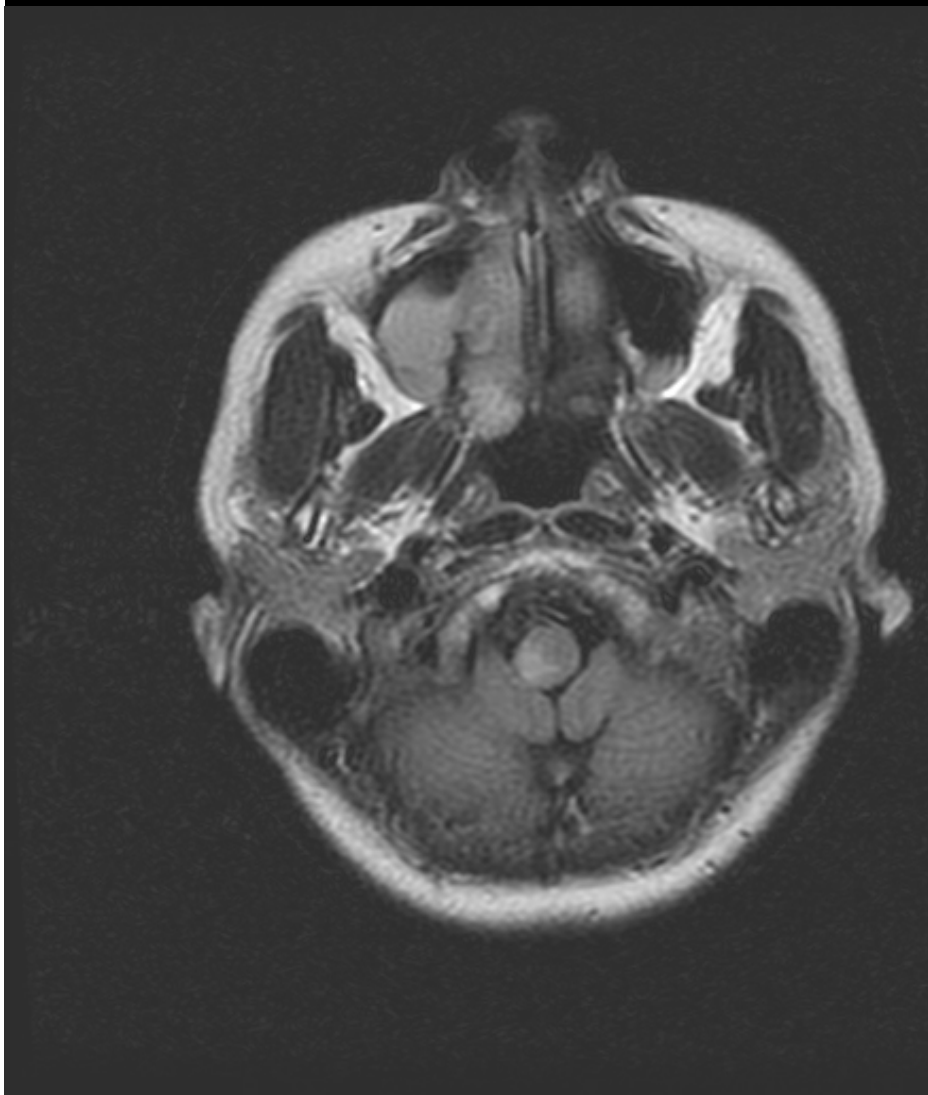
# Vertebrobasilar Transient Ischemic Attacks

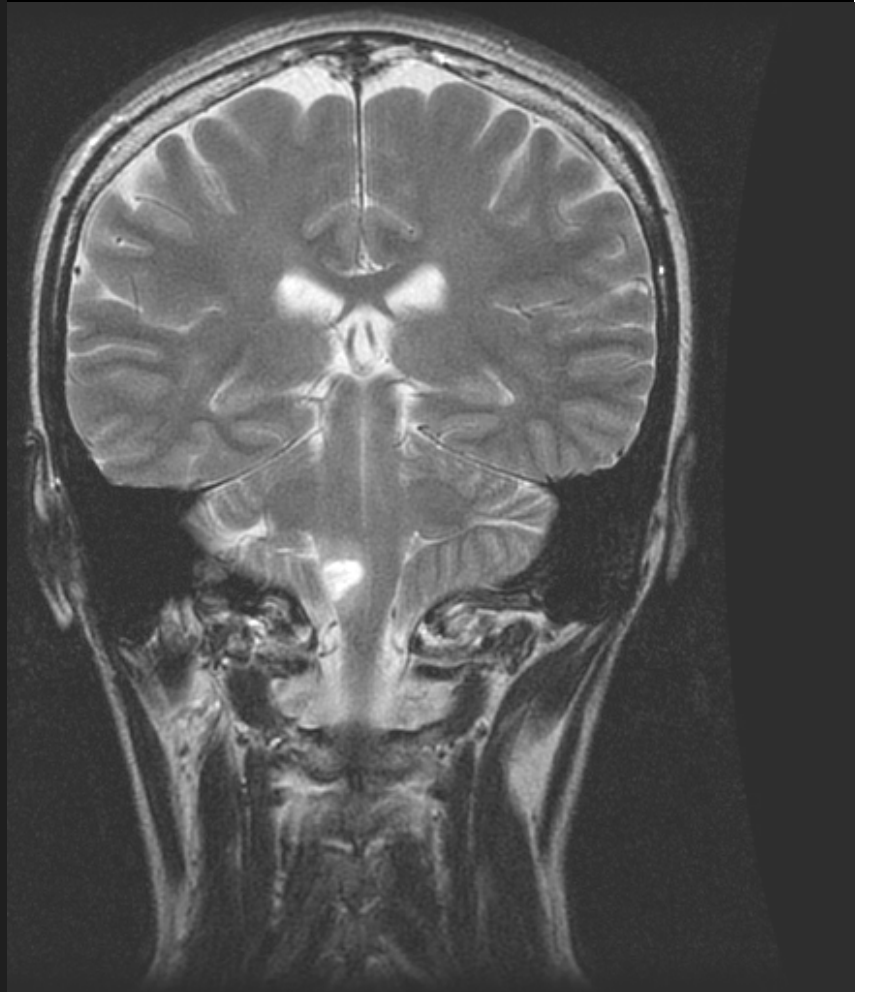
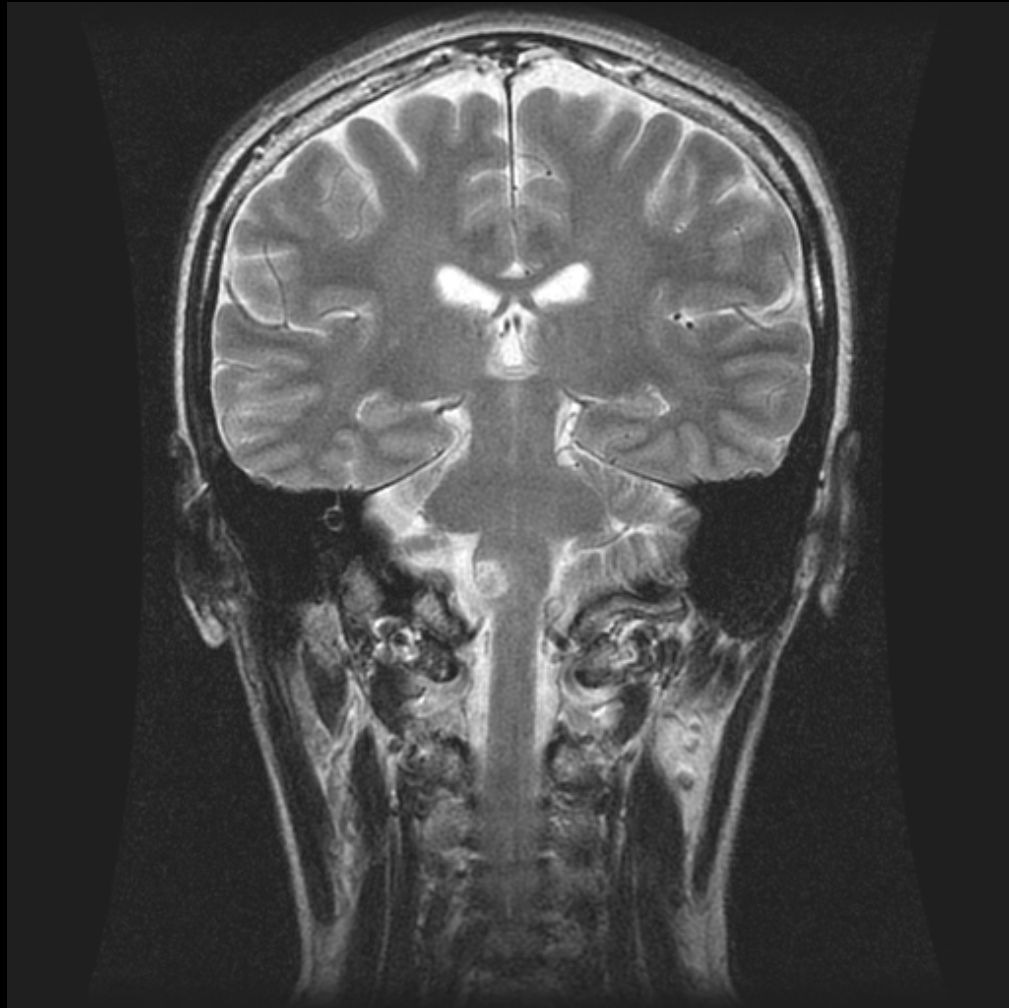
- common cause of spontaneous
- resolve within 24 hours TIA
- visual
  - Diplopia
  - visual illusions and hallucinations
  - visual field defects
  - Blindness
- Drop attacks
- Incoordination
- Weakness in the extremities
- Rx aspirin, Percutaneous stenting

# Case

- 55 Y Female
- Sudden Vertigo
- Rt SSNHL
- Rt side weakness
- Rt Horner's syndrome
- Hiccup









Right VA dissecting aneurysm  
Wallenberg's syndrome with ipsilateral hemiparesis

The background of the slide features a pattern of stylized autumn leaves in various shades of orange, yellow, and brown, set against a dark red background. The leaves are scattered across the entire frame, creating a textured, seasonal aesthetic.

# Wallenberg syndrome (Lateral medullary syndrome)

# PICA

- From the vertebral artery
- Supplies
  - Dorsolateral medulla
  - Inferior cerebellar peduncle

# Structures within LMS

## Structure

## Symptoms / sign

Dorsal nuclei of cranial nerves 1X and X

Hoarseness. Dysphagia. Dysarthria. Ipsilateral palatal and vocal cord paralysis. Diminished gag reflex.

Spinothalamic and quintothalamic tracts

Loss of pain / thermal sensation in **contralateral** limbs and trunk +/- face. PICA\*

Sympathetic fibers

Ipsilateral Horner's syndrome (constricted pupil, ptosis, decreased sweating).

Inferior cerebellar peduncle

Ataxia- falling to affected side.

Nucleus ambiguus

Vomiting.

Nucleus and tract of cranial nerve V

Impaired sensation of ipsilateral side of face.

Tractus solitarius

Loss of taste.

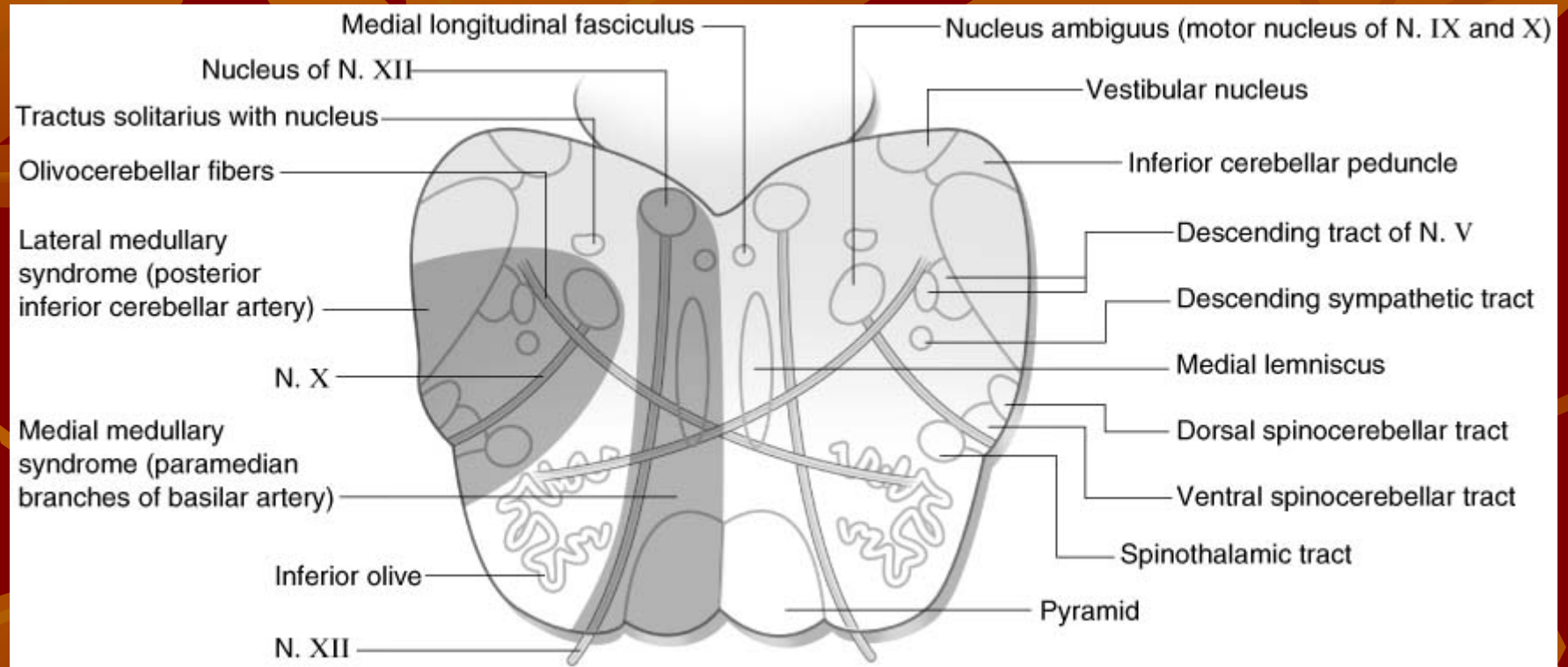
Inferior vestibular nucleus

Nystagmus. Oscillopsia. Diplopia. Vertigo. Nausea.

Reticular formation

Hiccup.

**\*PICA = Parasthesia (pain & tem) In Contra-laterally Abdomen**



# *Lt Lateral Pontomedullary Syndrome*

- Vertigo
- Lt SSNHL
- Ataxia
- Lt Horner's syndrome
- Lt facial anesthesia
- Died

# AICAs

- Basilar artery
- Supply
  - Lateral pontomedullary region
  - Inner ear
  - Middle cerebellar peduncle
  - Anterior inferior cerebellum including the flocculus.

# ***Lateral Pontomedullary Infarction***

- Infarction of the
  - lateral pontomedullary region
  - Middle cerebellar peduncle
  - Anterior inferior cerebellum
- vestibular-masseter syndrome
  - Occlusion of a small branch in the rostral medulla and caudal pons
  - Acute vestibular imbalance
  - Unilateral paresis of the muscles of mastication.

# *Lateral Pontomedullary Infarction*

- AICA → Lab art
  - → infarction of the cochlea and labyrinth
  - → Vertigo
  - → Ipsilateral facial anesthesia
- Contralateral body anesthesia
- Ipsilateral Horner's syndrome
- NO dysphagia or dysphonia.
- Rich anastomotic network → spare 7&8 nerve
- Swelling and herniation of the cerebellar tonsils → quadriplegia, coma, and death.
- Surgical decompression and ventriculostomy to relieve hydrocephalus may be lifesaving

# *Cerebellar Infarction*

## **Brainstem or Cerebellum**

Mimic a peripheral vestibular disturbance,

Overlap with Brainstem PICA, AICA, and SCA.

# Cerebellar Ataxia

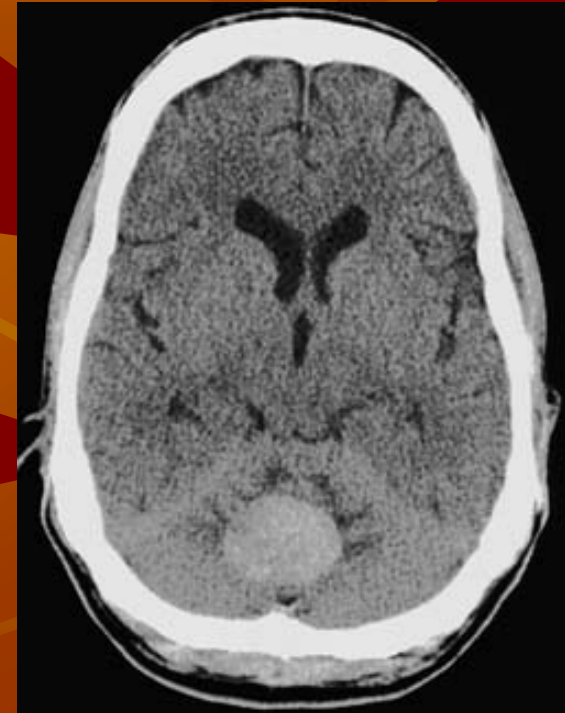
- Lack of coordination without paresis
- Alteration in tone
- Loss of postural sense
- Involuntary movements.

# Cerebellar Ataxia

- Lesions of the midline vermis → disturbances
  - Stance
  - Gait
  - Ocular movements
- 2 large hemispheres
  - Affect limb movements.

# Cerebellar vermis hematoma

- 70 Y male
- HTN, CAD on LMWH
- Headache
- Vertigo
- Ataxia



Symptoms and Signs	Lateral Medullary (PICA) <sup>+</sup>	Lateral Pontomedullary (AICA) <sup>+</sup>	Superior Lateral Pontine (SCA) <sup>+</sup>
Vertigo, nystagmus	Vestibular nuclei, posterior inferior cerebellum	Labyrinth, vestibular nerve, flocculus, paraflocculus	Superior cerebellum, vermis
Gait and ipsilateral limb ataxia	Inferior cerebellar peduncle, posterior inferior cerebellum	Middle cerebellar peduncle, anterior inferior cerebellum	Superior cerebellum, vermis, superior cerebellar peduncle
Tinnitus, hearing loss (ipsilateral)	None	Cochlea, auditory nerve, cochlear nucleus	None
Facial paralysis (ipsilateral)	Facial nerve (rare)	Facial nerve	None
Facial pain or numbness (ipsilateral)	Spinal nucleus and tract of trigeminal nerve	Trigeminal nerve or spinal nucleus/tract	Spinal nucleus and tract of trigeminal nerve
Body hemianesthesia (contralateral)	Spinothalamic tract	Spinothalamic tract	Spinothalamic tract
Horner's syndrome	Descending sympathetic fibers	Descending sympathetic fibers	Descending sympathetic fibers
Dysphagia, hoarseness, decreased gag, vocal cord weakness (ipsilateral)	Vagus nerve and nuclei	None	None
Impaired vibration and position sense (contralateral)	None	None	Medial lemniscus

# Imaging

- CT ,MRI, MRA and angiography
- (CT) of the brain without contrast
  - Normal with cerebellar or brainstem infarction
  - The first imaging test
    - widely available
    - Fast
    - Shows intraparenchymal or subarachnoid blood

# Investigations

- Blood tests for vascular risk factors
- Echo
- Transesophageal echocardiography (TEE)

# Subclavian steal syndrome

## Medicine consult

- 45 Y F
- Dizziness
- Exacerbated by exercising the arm.
- Difference in blood pressure may occur between the two arms.

# Subclavian steal syndrome

- Exacerbated by exercising the arm.
- A bruit may be heard in the axilla or supraclavicular
- Difference in blood pressure may occur between the two arms.
- Stenosis of the proximal subclavian artery prior to the origin of the vertebral artery → retrograde flow down the vertebral artery as blood is siphoned into the arm



# Case

- 37 y F
- +ve FHx of Migraine
- Vertigo
  - Once a week
  - Headache
  - N&V



The background of the slide features a dense pattern of stylized autumn leaves in various shades of orange, yellow, and brown, set against a dark red background. The leaves are depicted with simple outlines and flat colors, creating a layered, collage-like effect.

# *Migraine*

# Migraine Classification

- In 1988 The International Headache Society
- Diagnostic criteria for all headache disorders.
- Gold standard classification
- Revised in 2002



# International Headache Society

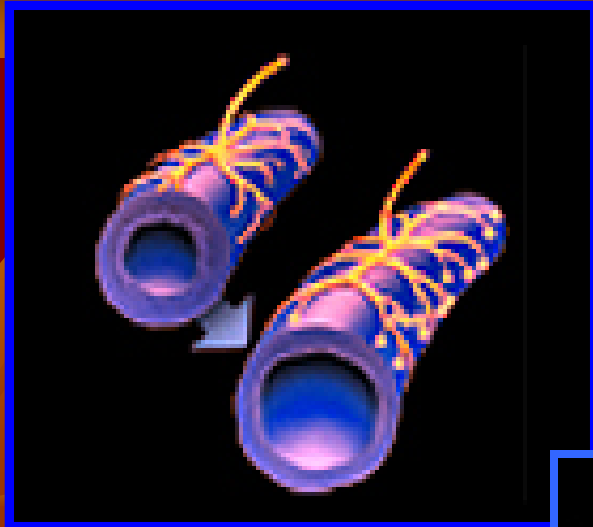
## Diagnostic criteria for migraine without aura

- A. At least 5 attacks fulfilling B–D.
- B. Headache attacks lasting 4 hours to 3 days (untreated).
- C. Headache has at least 2 of the following characteristics: (+ plus)
  - 1. Unilateral location
  - 2. Pulsating quality
  - 3. Moderate or severe intensity (Limit daily activities)
  - 4. Aggravation by stairs or similar routine physical activity
- D. During headache at least 1 of the following:
  - 1. Nausea or vomiting
  - 2. Photophobia and phonophobia

Ruled out other disorder by appropriate investigations (0)

Hagr 5, 4, 3, 2+, 1 & 0

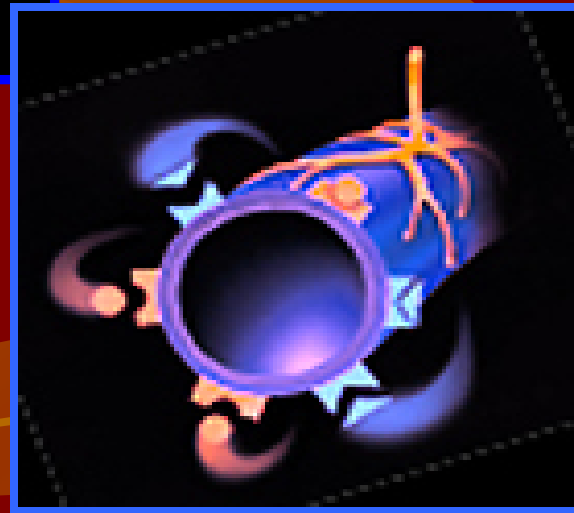




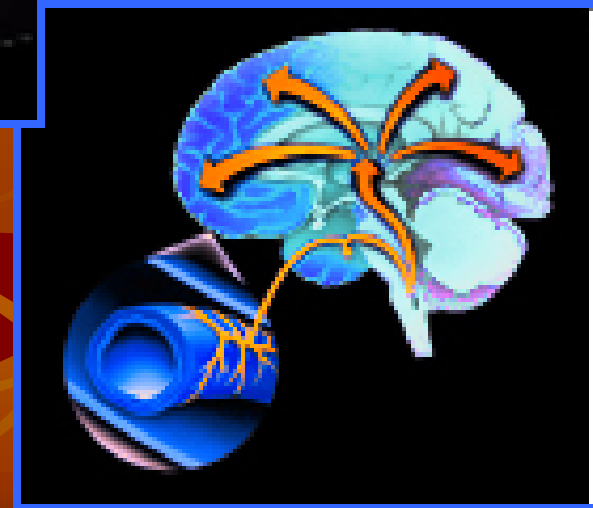
**Arterial  
Activation**

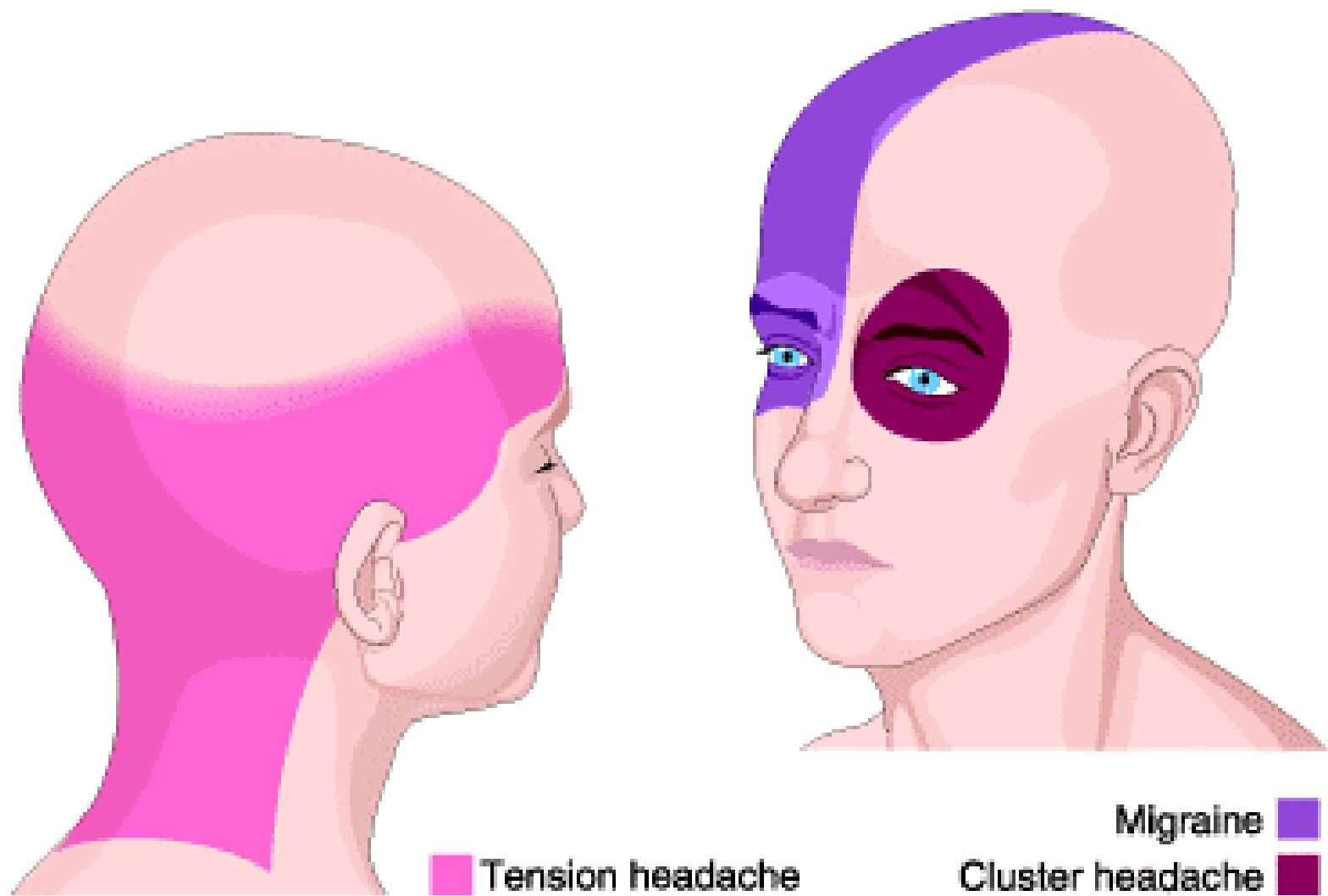


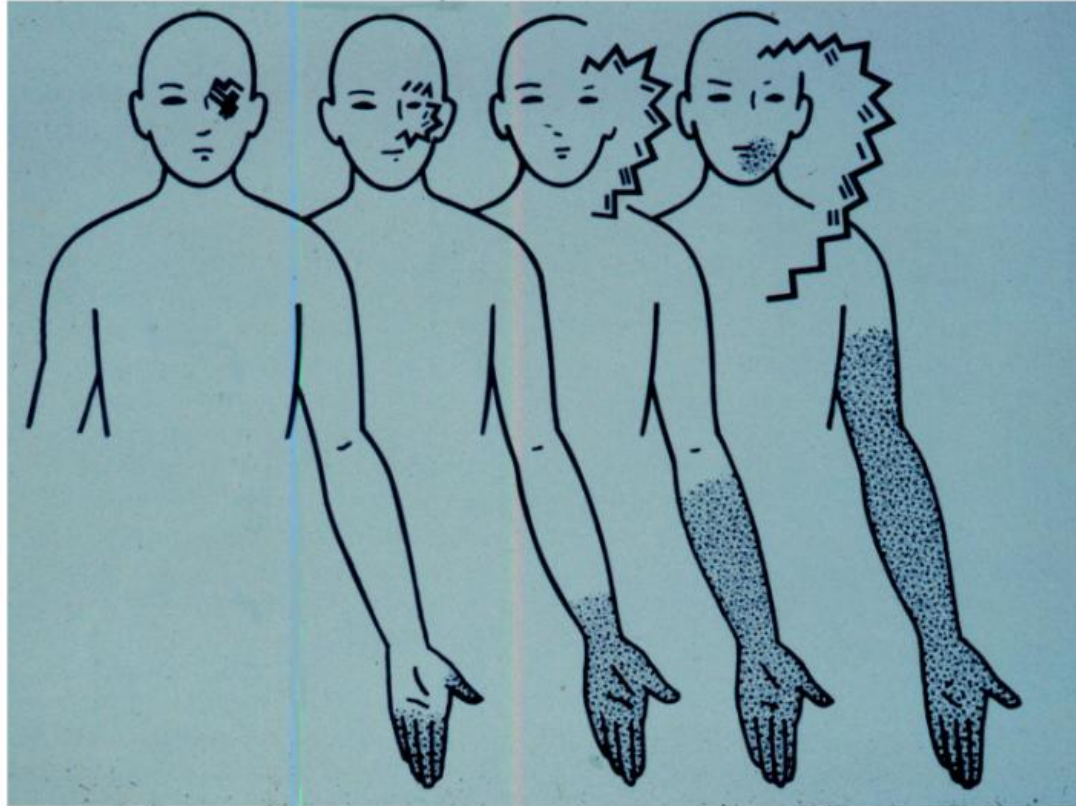
**Release of  
Neurotransmitter**



**Worsening of Pain**







# *Incidence*

- The prevalence of migraine is 16%
- higher in women (25%) than in men (8%)
- 75% Migraine without aura
- Begins in the first three decades of life
- Prevalence peaking in the fifth decade
- commonly undiagnosed

# ***Migraine Triggers***

- Stress – emotional or physical
- Insufficient food or long gaps between food
- Certain foods
- Environmental factors:
  - loud noise
  - bright, flickering or flashing lights/glare
  - strong smells
- Changes in routine – On-Call, shift work .....etc.
- Hormonal factors – menstruation, menopause, the pill, HRT

# ***Vestibular migraine***

- **The nomenclature is inconsistent**
  - **Migrainous vertigo**
  - **Vestibular migraine**
  - **Benign recurrent vertigo**
  - **Migraine-related vestibulopathy**
  - **Migraine-associated dizziness.**
  - **Basilar migraine**

# *Vestibular migraine*

- 1861 by Ménière An association between Ménière's disease and **migraine**
- No universally accepted diagnostic criteria
- Overlap
  - 28% Ménière's have **Migraine** during attack
  - 25% of migraine
  - 68% **vertigo** with headache
  - 81% Phonophobia
  - Otolithic crises of Tumarkin

# *Self-help Measures*

- **Keep a diary**
- **Avoid triggers to which you know you are sensitive**
- **Eat regularly, avoid sugary snacks and include slow release carbohydrate foods in your diet**
- **Drink plenty of water**
- **Limit your intake of drinks containing caffeine and alcohol**
- **Take regular exercise**
- **Get plenty of fresh air and practise deep breathing**
- **Ensure that ventilation indoors is good and try to keep rooms at a constant temperature**
- **Avoid strong perfumes etc**
- **Avoid bright, flashing or flickering lights (e.g. fluorescent)**
- **Avoid large reflective surfaces (e.g. plain white walls)**
- **Wear sunglasses and/or a hat in bright sunlight**
- **Ensure that computer screens are properly adjusted and fitted with anti-glare filters**
- **Take regular breaks, especially if you are working at a VDU or if your work is repetitive**
- **Take care with your posture**
- **Ensure that your working environment is as ergonomically designed as possible**
- **Learn relaxation techniques**

# Flunarizine (*SIBELIUM*)

- 10 mg < 65 Y
- Drowsiness (at night)
- Extrapyrarnidal and depressive (5 mg > 65 Y)
- Increased appetite

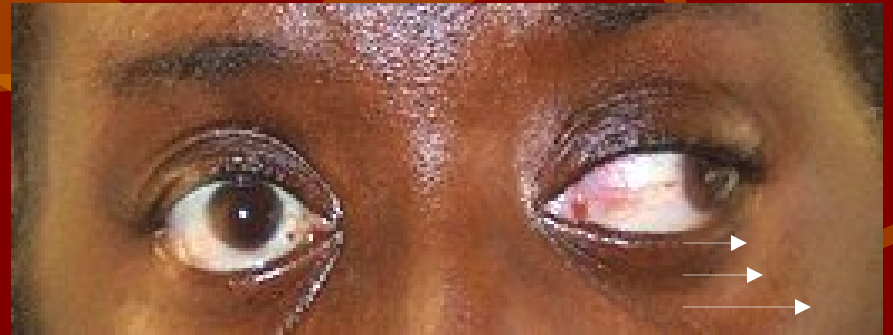
# Behçet's

- 55 Y male
- Mouth and genital ulcers
- Joints pain
- Vertigo 3 hours
- MRI report  
multifocal lesions resemble multiple sclerosis.



## Case

- 35 Y M
- Vertigo
- Nystagmus
- Convergence is normal



**Internuclear ophthalmoplegia**

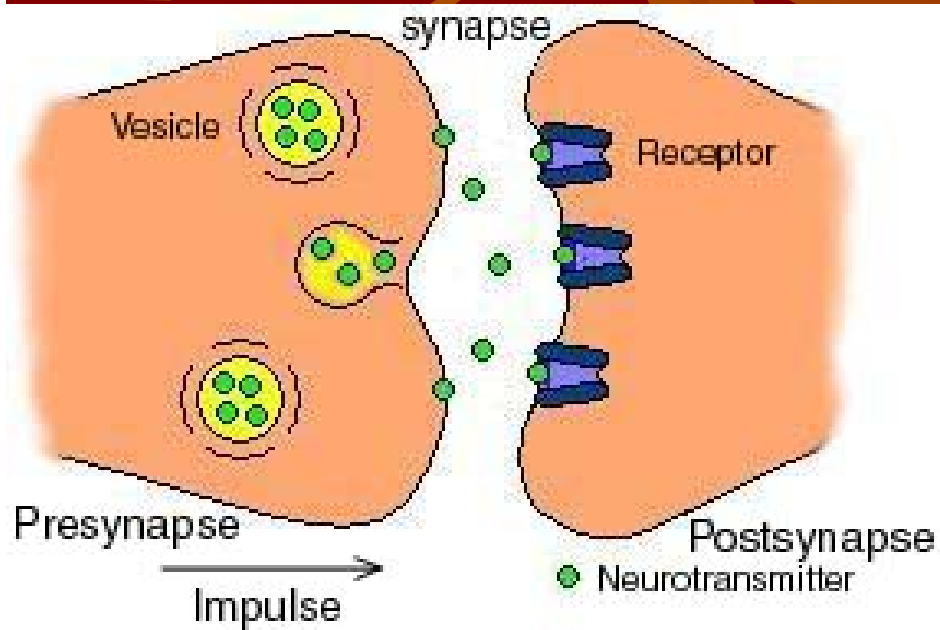
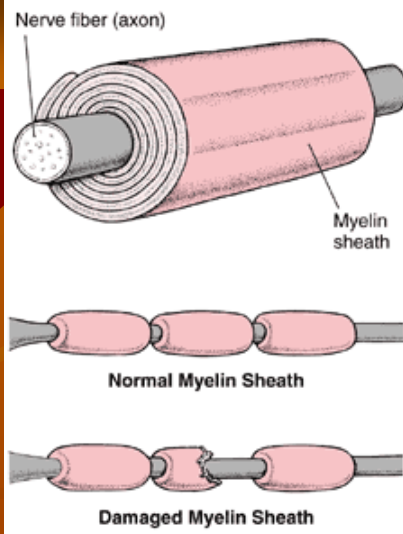
# Inflammatory

- Cerebellitis
- Multiple sclerosis
- Susac syndrome
- Behçet's syndrome
- Systemic lupus erythematosus
- Sarcoidosis
- Infectious

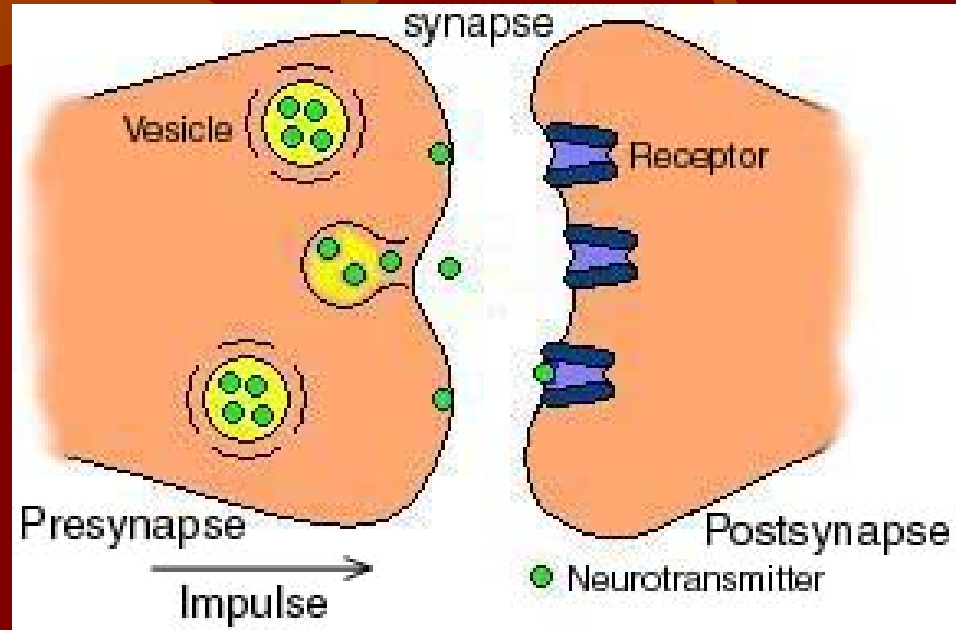
Intracranial complications CSOM

# ***Multiple Sclerosis***

- Demyelinating disorder of the CNS  
(oligodendroglia not Schwann cells for peripheral nerve (unaffected))
- Unknown cause ?autoimmunity, infection and heredity
- 15 and 50 years of age (peak onset at age 24)
- women (2:1)
- Relapsing and remitting or progressive.
- Diagnosed
  - **Disseminated S/S of CNS dysfunction in time and space**  
UMNL, sensory, CN, optic neuritis, internuclear ophthalmoplegia .....
  - MRI demyelinating plaques



**Normal Synapse**

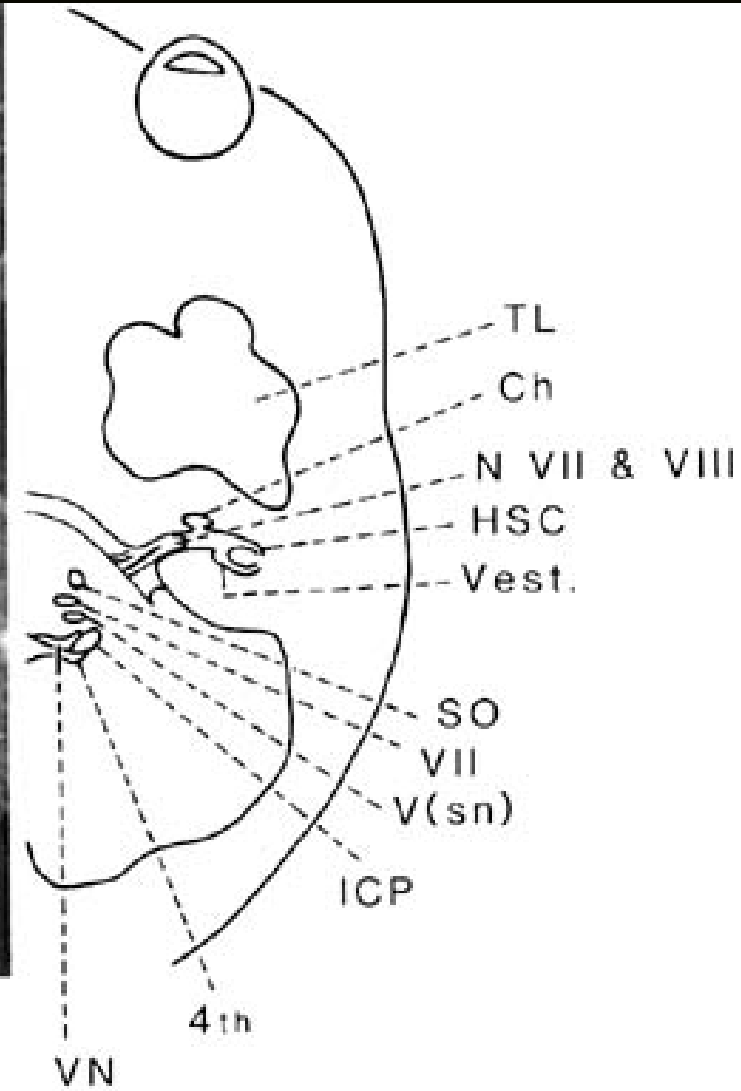


**MS synapse**

# Vertigo & *Multiple Sclerosis*

- Initial symptom in about 5%
- 50% during the disease
- Sustained over days or weeks
- Paroxysmal or positional
- Oscillopsia
- Selective involvement of the vestibular nuclei
  - Indistinguishable from a peripheral deficit
  - +/- suppressed by visual fixation
- Oligoclonal bands or a raised IgG (CSF) support Dx
- Slow visual, auditory, or somatosensory Evoked potentials
- Vertigo ? May resemble vestibular neuritis

Demyelinating plaque of Oligodendroglia myelin at the root entry zone



# Internuclear ophthalmoplegia

- Medial longitudinal fasciculus (MLF) lesion connects 6 nerve nuclei to the contralateral medial rectus muscle nucleus
- Conjugate gaze → loss of contralateral medial rectus adduction
- Abducting nystagmus of the ipsilateral eye
- The horizontal saccadic and pursuit
- Convergence is usually normal

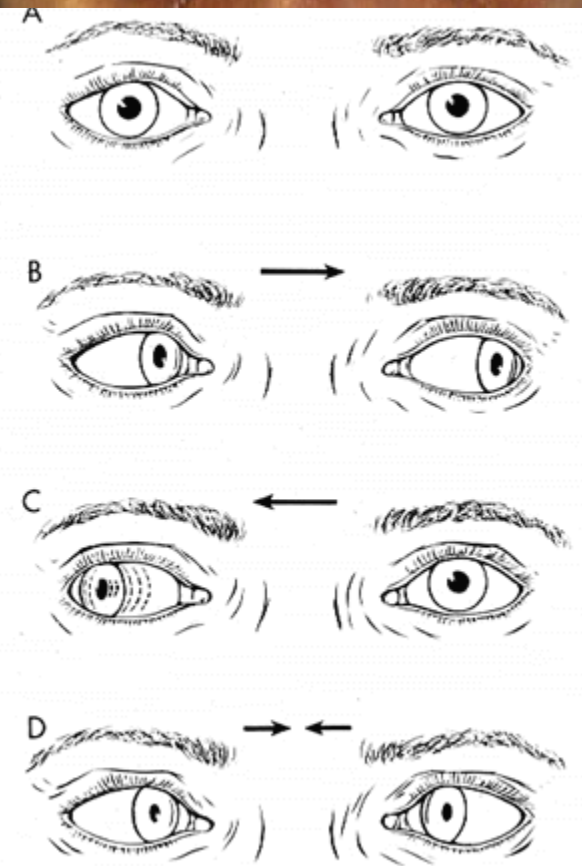
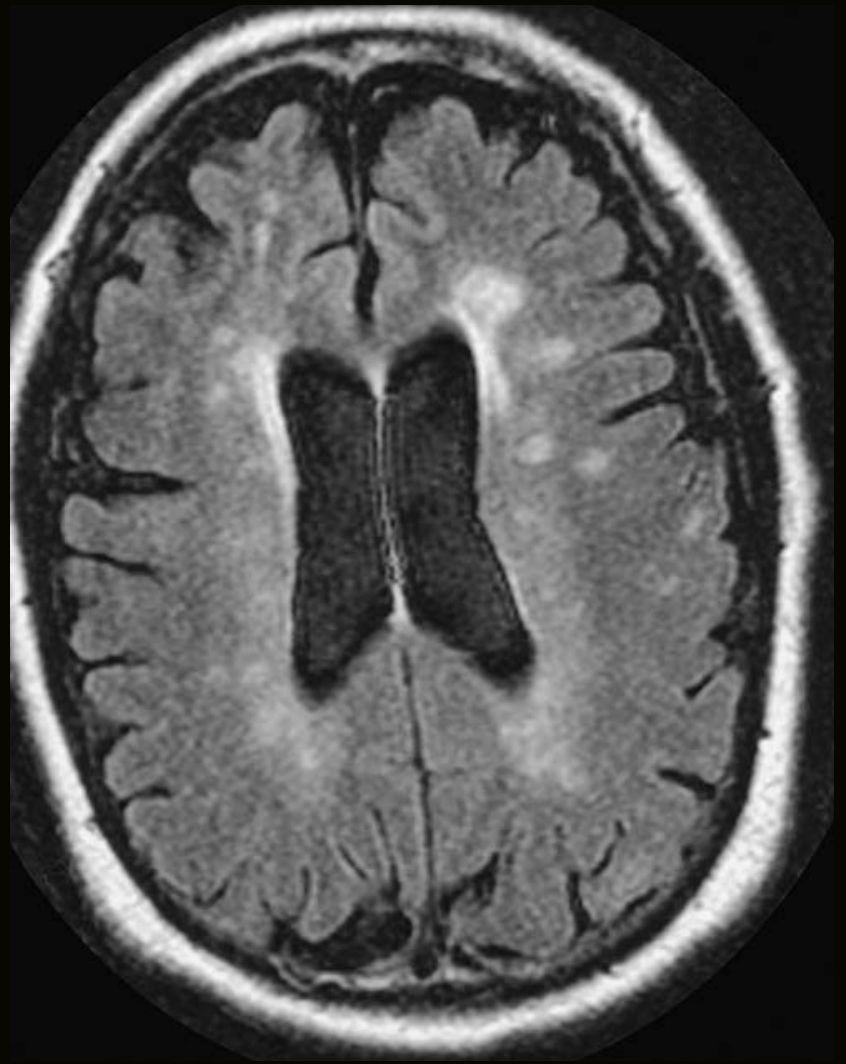
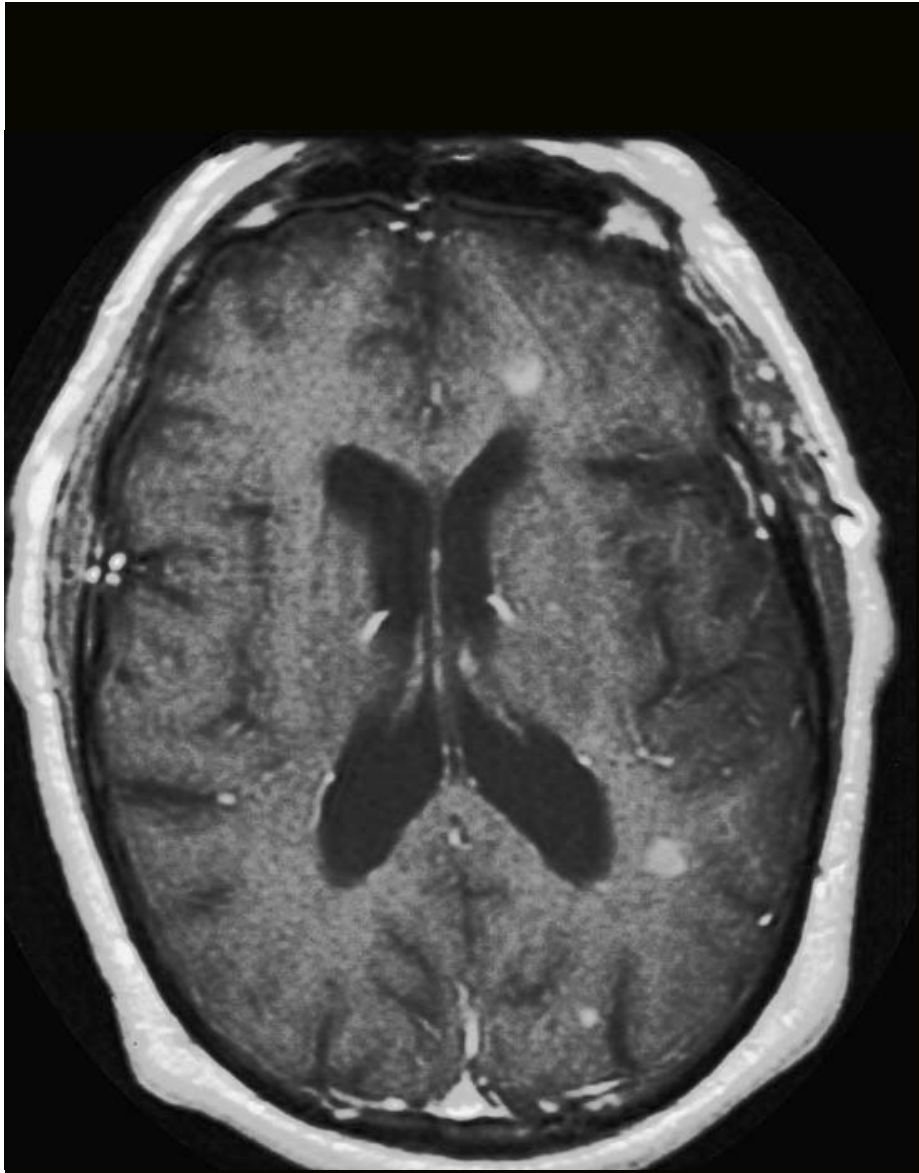


Fig 60



# Susac's syndrome

## retinocochleocerebral vasculopathy

- 25 y woman
- Neurology ?MS
- Vertigo 3 hours+ HL
- Ophth:  
retinal artery occlusions
- PTA  
low-frequency hearing loss



# Case

- 50 Y male
  - Vertigo
  - Rt SSNHL
  - **Brun's Nystagmus**
    - Lt nystagmus of medium amplitude in the primary position
    - Lt fine horizontal rotatory nystagmus on gaze to the left
    - Slow, large-amplitude right beating nystagmus on gaze to the right
  - ABR Rt I-III = 3 ms
  - Hyperventilation Nystagmus
- 
- ? Vertigo



# Brun's nystagmus

- Combination of
  - Gaze-evoked central nystagmus  
(from compression of the pons)
  - Horizontal-rotatory peripheral nystagmus  
(from damage to the vestibular nerve)
- Secondary to CPA lesions

# Neoplastic

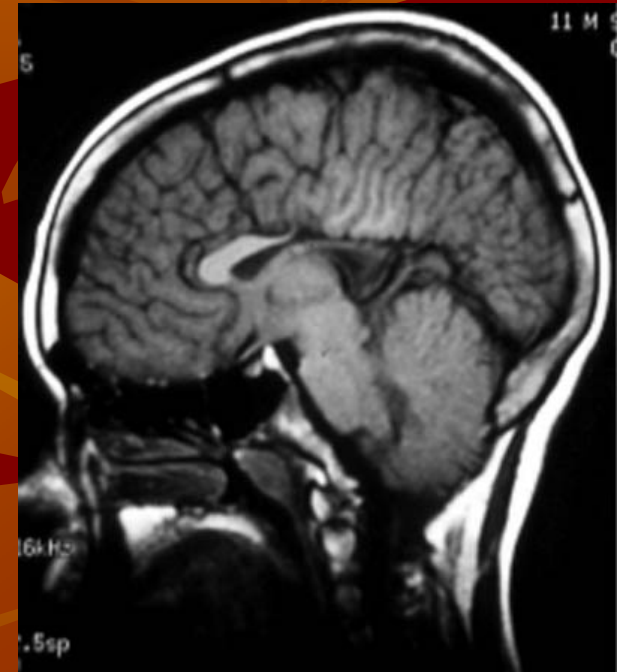
- Brainstem
- Cerebellar
- Fourth ventricle
- Paraneoplastic
  - Paraneoplastic cerebellar degeneration
  - Opsoclonus/myoclonus

# Paraneoplastic syndromes

- ? autoimmune reaction
- Asymptomatic malignancies
- Abruptly and progresses rapidly

# Case

- 7 y boy
- Vertigo
- Headache
- Dysphagia & dysarthria
- Normal hearing



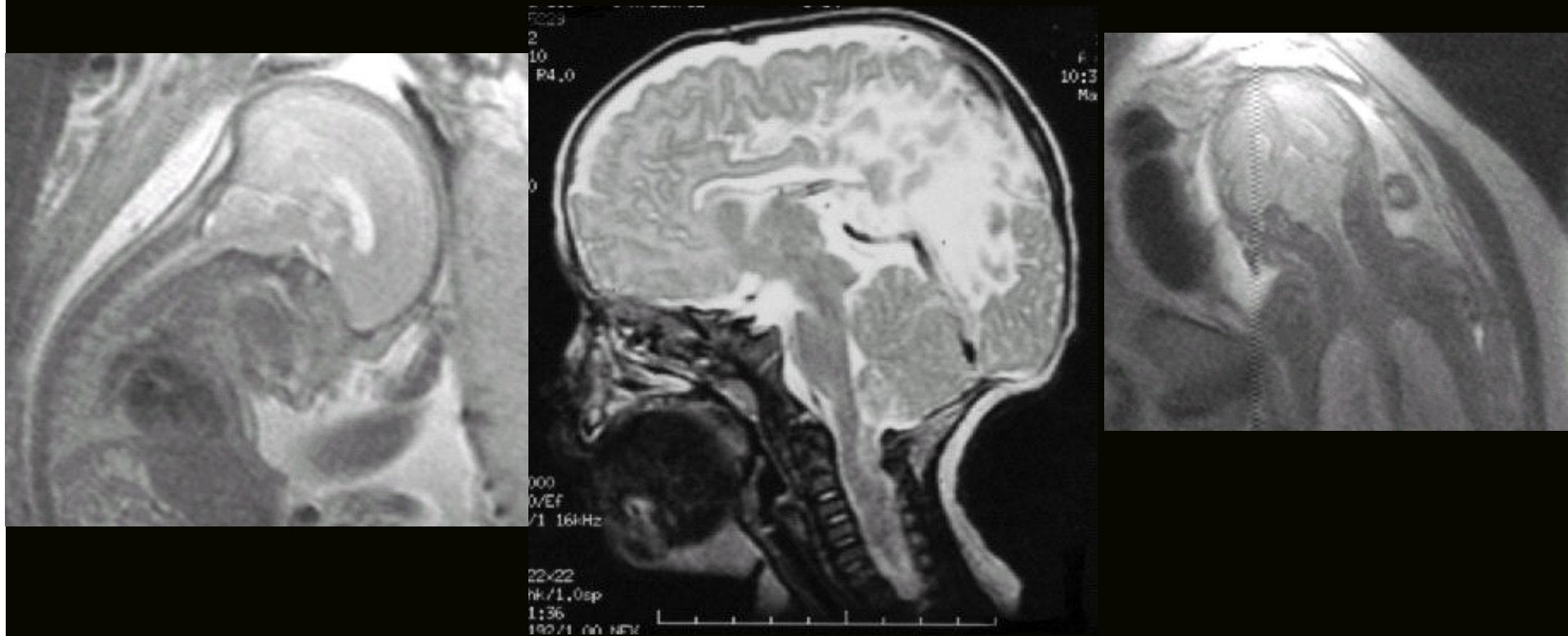
# Craniocervical junction disorders

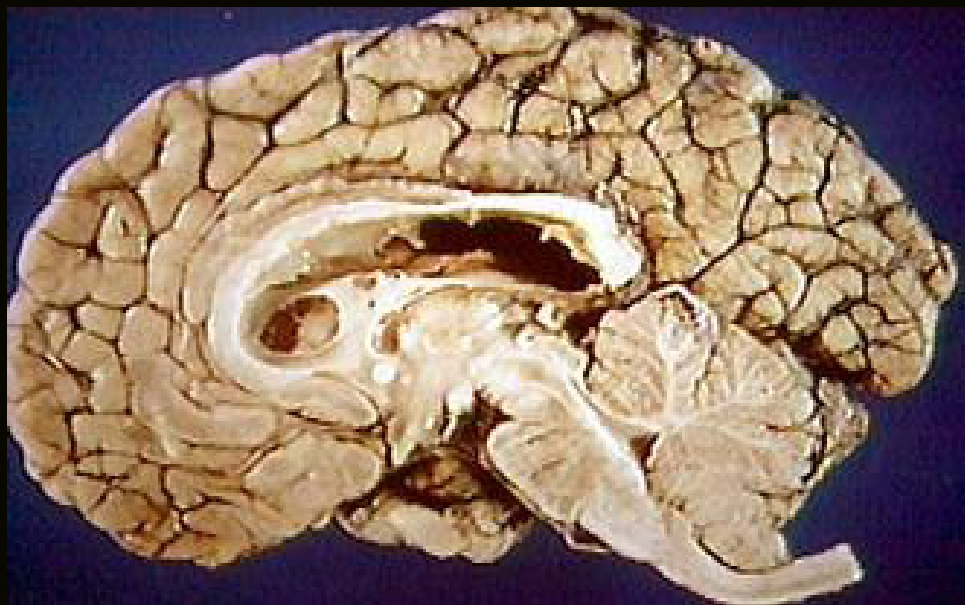
- Chiari malformation
- Basilar impression
- Syringobulbia

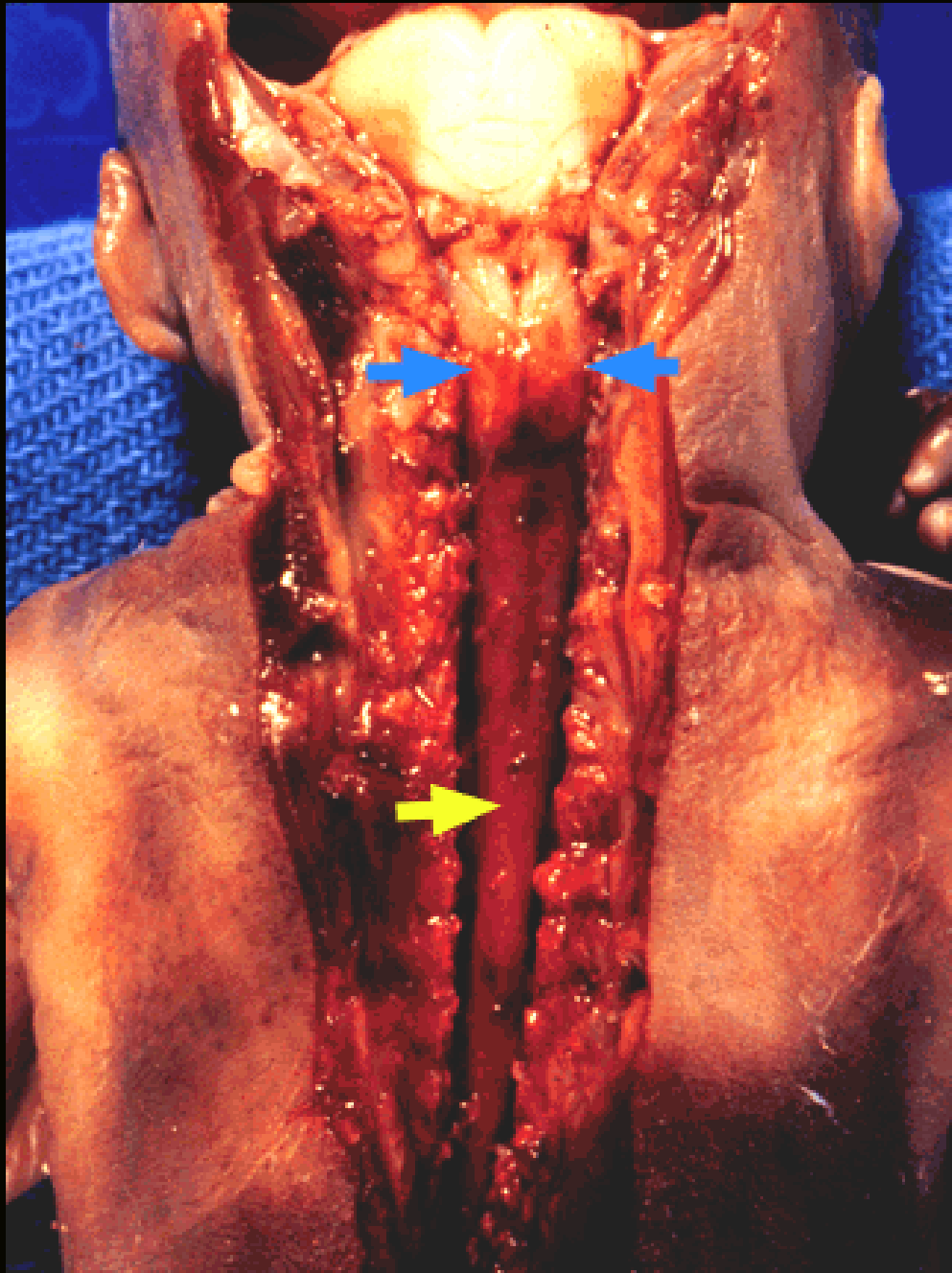
# Chiari malformation

- Group of craniocervical junction abnormalities.
- Chiari I malformation,
  - 5 mm caudal displacement of cerebellar tonsils through foramen magnum
  - 50% Syringomyelia
  - Suboccipital headaches
  - S/S of vertebrobasilar ischemia (4Ds )
    - Lower CN Dysphagia, dysphasia, dysarthria, drop attack
    - Dizziness, or dysequilibrium and gait instability
    - Worsen with neck extension
    - Downbeat nystagmus
    - **Vertigo**, tinnitus, and hearing loss are uncommon









# 1896 Hans Chiari

- German pathologist
- Relatively small posterior fossa

## Types

- Chiari type I

cerebellar tonsils that are displaced into the upper cervical canal through the foramen magnum.

- Chiari type II

medulla, fourth ventricle, and cerebellum into the cervical spinal canal

- Chiari type III

Displacement +cervical spina bifida

- Chiari type IV

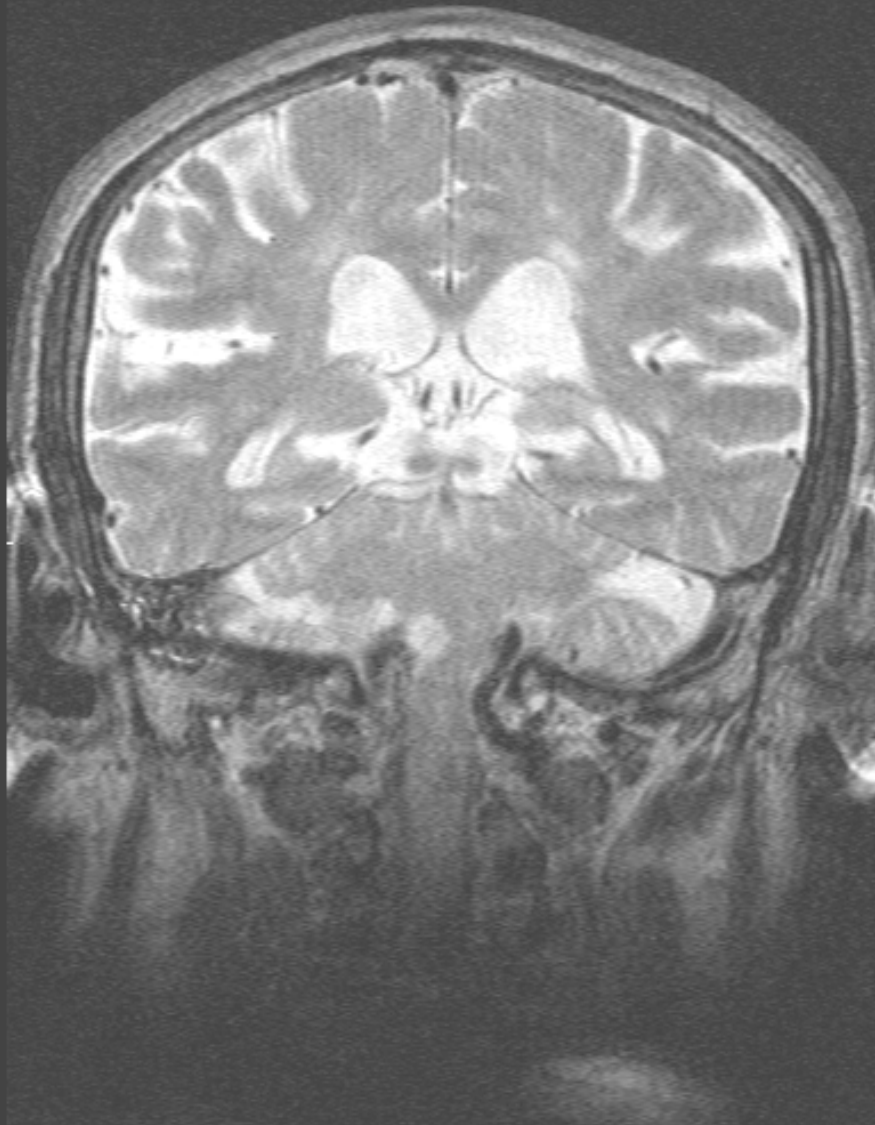
severe cerebellar hypoplasia without displacement of brain through the foramen magnum

# Positional nystagmus

- No latent period
- persist as long as the head position is maintained.
- Pure vertical positional nystagmus
- Down beating with respect to the head
- large-amplitude nystagmus
- more than one head position
- Other neurologic signs or symptoms.

# Case

- 50 y male
- HTN, DM
- Sudden Vertigo
- Rt Hearing loss
- Ataxia- falling to Rt
- Hoarseness. Dysphagia. Dysarthria
- Loss of pain / thermal sensation in Lt



**Lateral medullary syndrome**

	<b>Central</b>	<b>Peripheral</b>
<b>Imbalance</b>	<b>Severe</b>	<b>Mild to moderate</b>
<b>Neurologic symptoms</b>	<b>Frequent</b>	<b>Rare</b>
<b>Nystagmus</b>	<b>Changes direction in different gaze positions; no change with visual fixation</b>	<b>Unidirectional in all gaze positions; decreases with visual fixation</b>
<b>Hearing loss</b>	<b>Rare</b>	<b>Frequent</b>
<b>Nausea</b>	<b>Variable, may be absent</b>	<b>Severe</b>
<b>Recovery (central compensation)</b>	<b>Slow</b>	<b>Rapid</b>

The background of the image features a dense pattern of autumn leaves in various shades of orange, yellow, and brown, set against a dark red background. The leaves are stylized and layered, creating a textured, seasonal feel. The text "Thank You" is centered in a large, elegant, yellow serif font with a black outline, giving it a classic and formal appearance.

*Thank You*



*The End*