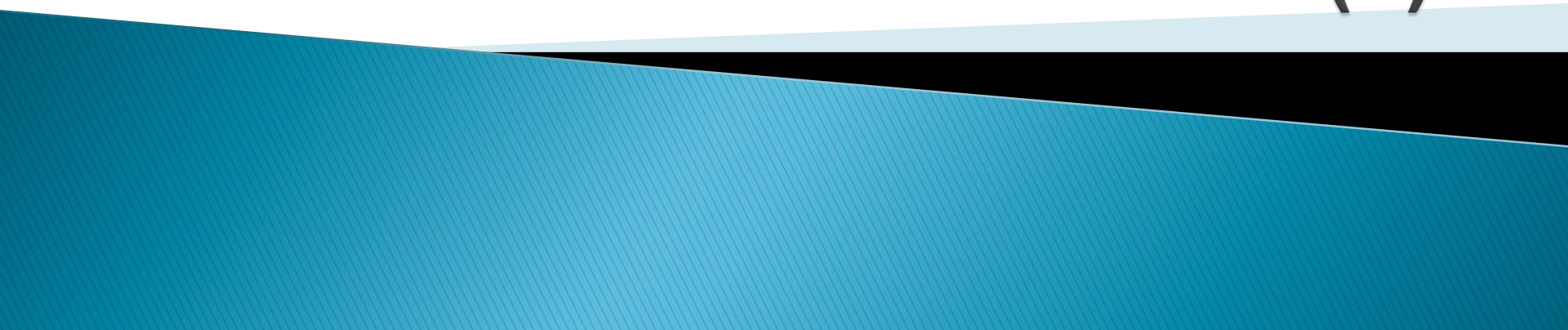


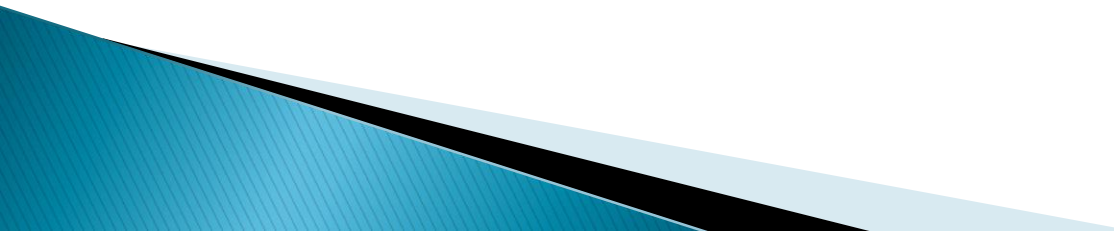
**Disorders of Equilibrium  
or  
Disequilibrium  
Part (1)**



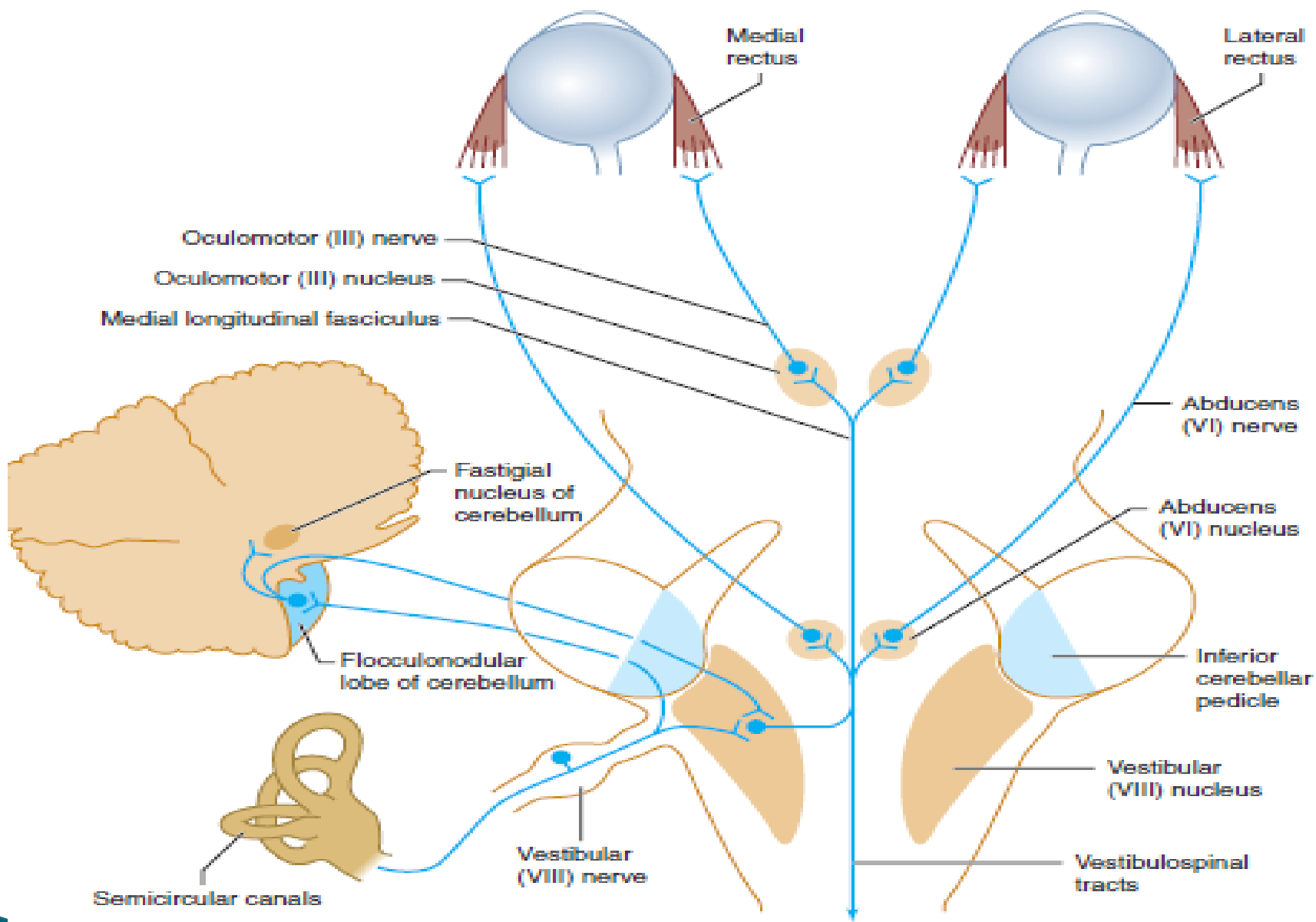
# PreTest

- ▶ Do you know what is the equilibrium ?
- ▶ Which systems or part of body are involved in equilibrium ?

# Equilibrium

- ▶ the ability to maintain orientation of the body and its parts in relation to external space.
  - ▶ It depends on continuous **visual** ,**labyrinthine** , and **proprioceptive somatosensory input** and its integration in the **brainstem and cerebellum**.
- 

- ▶ Disorders of equilibrium result from diseases that affect **central or peripheral vestibular pathways**, **the cerebellum**, or **sensory pathways** involved in **proprioception**.



Peripheral and central vestibular pathways.

# PreTest

- ▶ Do you know the definition of VERTIGO ?
- ▶ What is the different between VERTIGO and ATAXIA ?

▶ **Clinical Presentation of disequilibrium:**

**1)Vertigo**

**2)Ataxia**

# Vertigo

- ▶ the illusion of movement of the body or the environment (**True Vertigo**).

Vertigo must be distinguished from

**-dizziness**

**-presyncope**

**-ataxia**



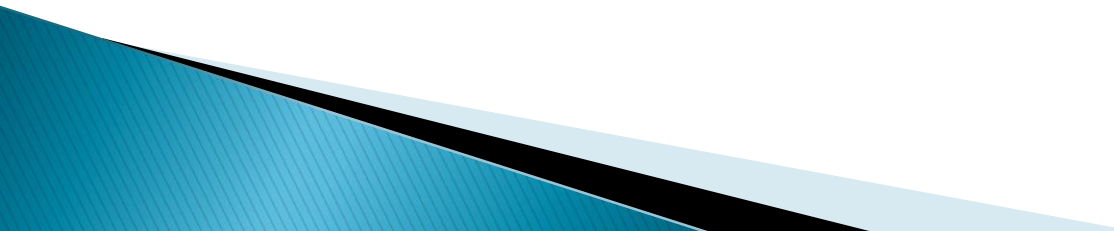
# Types of Vertigo

## 1) **PERIPHERAL VERTIGO** :

**Peripheral** vestibular lesions affect the **labyrinth of the inner ear** or the **vestibular** division of the **vestibulocochlear (VIII) nerve**.

# Characteristics of Peripheral Vertigo

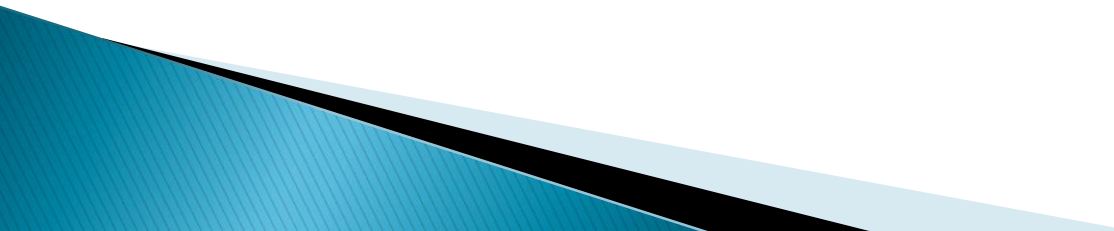
:

- ▶ Intermittent
  - ▶ lasts for briefer periods
  - ▶ produces more distress than vertigo of central origin
  - ▶ Nystagmus (rhythmic oscillation of the eyeballs) is always present and is usually unidirectional and never vertical
  - ▶ hearing loss and tinnitus maybe present
- 

## **2) CENTRAL VERTIGO :**

Central Vertigo usually results from lesions that affect the **brainstem vestibular nuclei or their connections**

# Characteristics of Central Vertigo :

- ▶ Central vertigo may occur with or without nystagmus;
  - ▶ if nystagmus is present, it can be vertical, unidirectional, or Multidirectional
  - ▶ intrinsic brainstem or cerebellar signs, such as motor or sensory deficits, hyperreflexia, extensor plantar responses, dysarthria, or limb ataxia
- 

**Table 8-1** Characteristics of peripheral and central vertigo.

|  | <b>Peripheral</b>                                    | <b>Central</b>  |
|--|--|---|
| <b>Vertigo</b>   | Often intermittent;<br>severe                        | Often constant; usually<br>less severe                      |
| <b>Nystagmus</b>   | Always present;<br>unidirectional,<br>never vertical | May be absent; uni- or<br>bidirectional, may be<br>vertical |
| <b>Hearing loss or<br/>tinnitus</b>                                | Often present  | Rarely present  |
| <b>Intrinsic brainstem<br/>or cerebellar<br/>signs<sup>1</sup></b> | Absent   | Typically present   |

# Ataxia

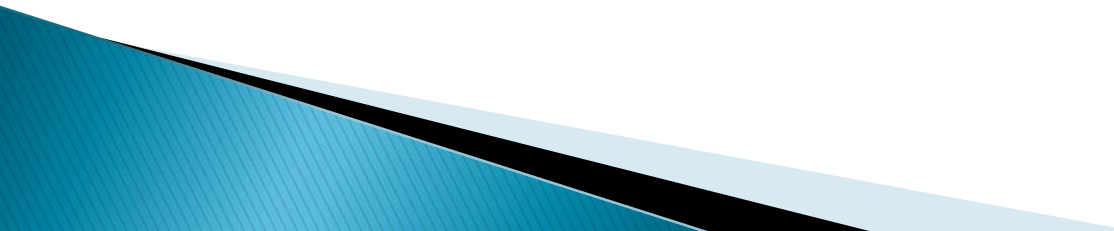
- ▶ Ataxia is **incoordination or clumsiness of movement** that is **not** the result of muscular weakness

Ataxia can affect eye movement, speech (producing dysarthria), individual limbs, the trunk, stance, or gait

# Types of Ataxia

## **1) VESTIBULAR ATAXIA :**

The same central and peripheral lesions that cause peripheral or central vertigo can also produce vestibular ataxia

- ▶ **Nystagmus** is frequently present and is typically unilateral and most pronounced on gaze away from the side of vestibular involvement
  - ▶ Dysarthria is not a component of vestibular ataxia
  - ▶ Vestibular ataxia is **gravity-dependent**:  
Incoordination of the limbs becomes apparent only when the patient attempts to stand or walk
- 



## ▶ 2) CEREBELLAR ATAXIA

Cerebellar ataxia is produced by lesions of the **cerebellum** or its afferent or efferent connections in the **cerebellar peduncles**, **red nucleus**, **pons**, or **spinal cord**

The clinical manifestations of cerebellar ataxia consist of irregularities in the rate, rhythm, amplitude, and force of voluntary movements.

# Characteristics of Cerebellar Ataxia

- ▶ **Hypotonia**
- ▶ **pendular Tendon reflexes**
- ▶ **positive Rebound Test**
- ▶ **Incoordination**( onset, rate, rhythm, amplitude, and force of movements fluctuate, producing a jerky appearance )
- ▶ **terminal dysmetria**
- ▶ **terminal intention tremor**
- ▶ **Eye Movement Abnormalities**(nystagmus, gaze paresis, and defective saccadic and pursuit movement)

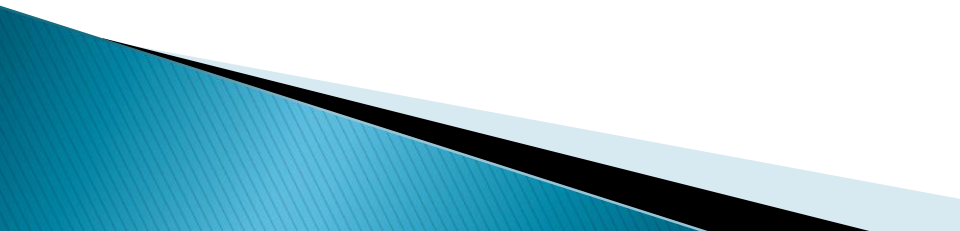
# Midline Cerebellar lesions

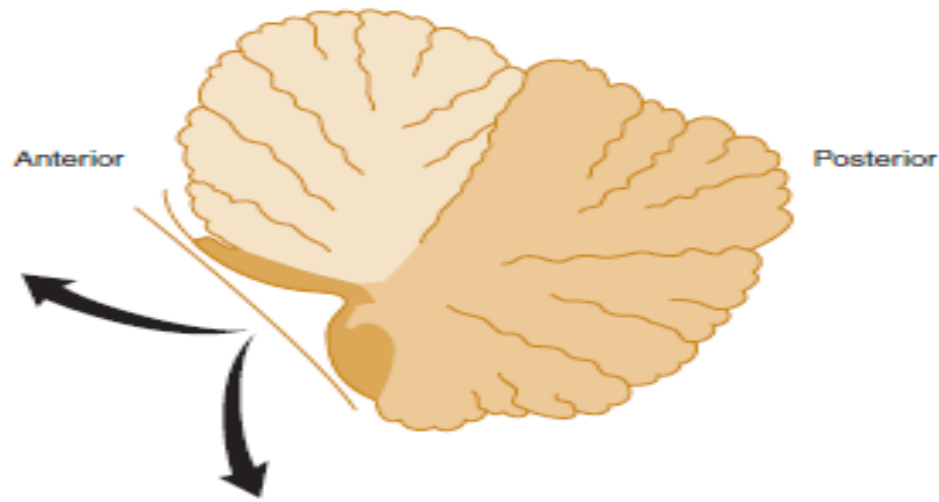
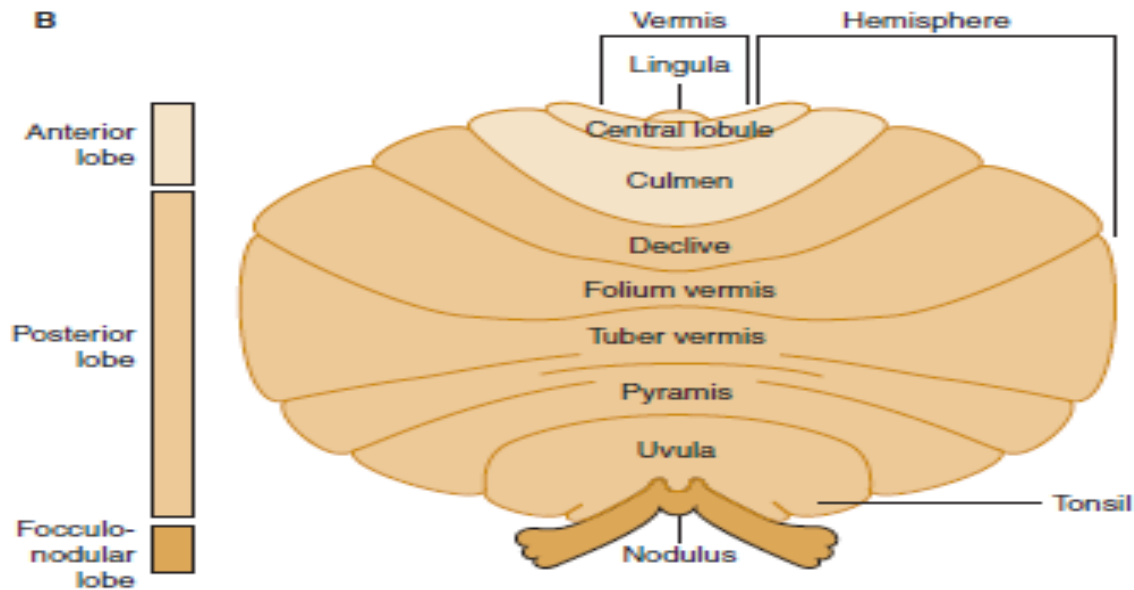
- ▶ vermis and flocculonodular lobe and their associated subcortical (fastigial) nuclei
- ▶ involved in the control of axial functions, including eye movements, head and trunk posture, stance, and gait.
- ▶ So that they are characterized by **nystagmus**, **dysarthria**, oscillation of the head and trunk (**titubation**), instability of stance (**wided base stance**), and **gait ataxia**

# Hemispheric Cerebellar lesions

- ▶ help to coordinate movements and maintain tone in the ipsilateral limbs and a role in regulating ipsilateral gaze
- ▶ Disorders affecting one cerebellar hemisphere cause **ipsilateral hemiataxia** and hypotonia of the limbs as well as nystagmus and transient **ipsilateral gaze paresis** (inability to look voluntarily toward the affected side) and **dysarthria**.

# Diffuse Cerebellar disease

- ▶ Many cerebellar disorders—typically toxic, metabolic, and degenerative conditions—affect the cerebellum diffusely.
  - ▶ The clinical picture in such states combines the features of midline and bilateral hemisphere disease.
- 

**A****B**

Anatomic divisions of the cerebellum in midsagittal view (A), or unfolded (arrows) and viewed from behind (B).

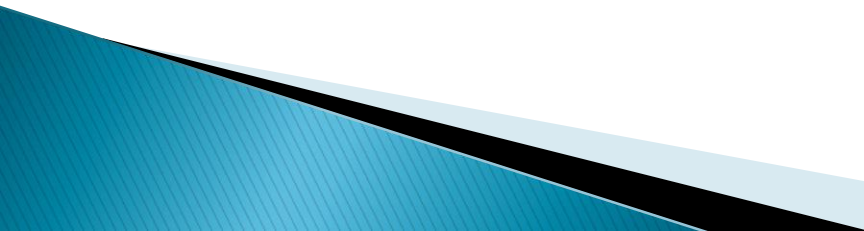
### ▶ **3) SENSORY ATAXIA**

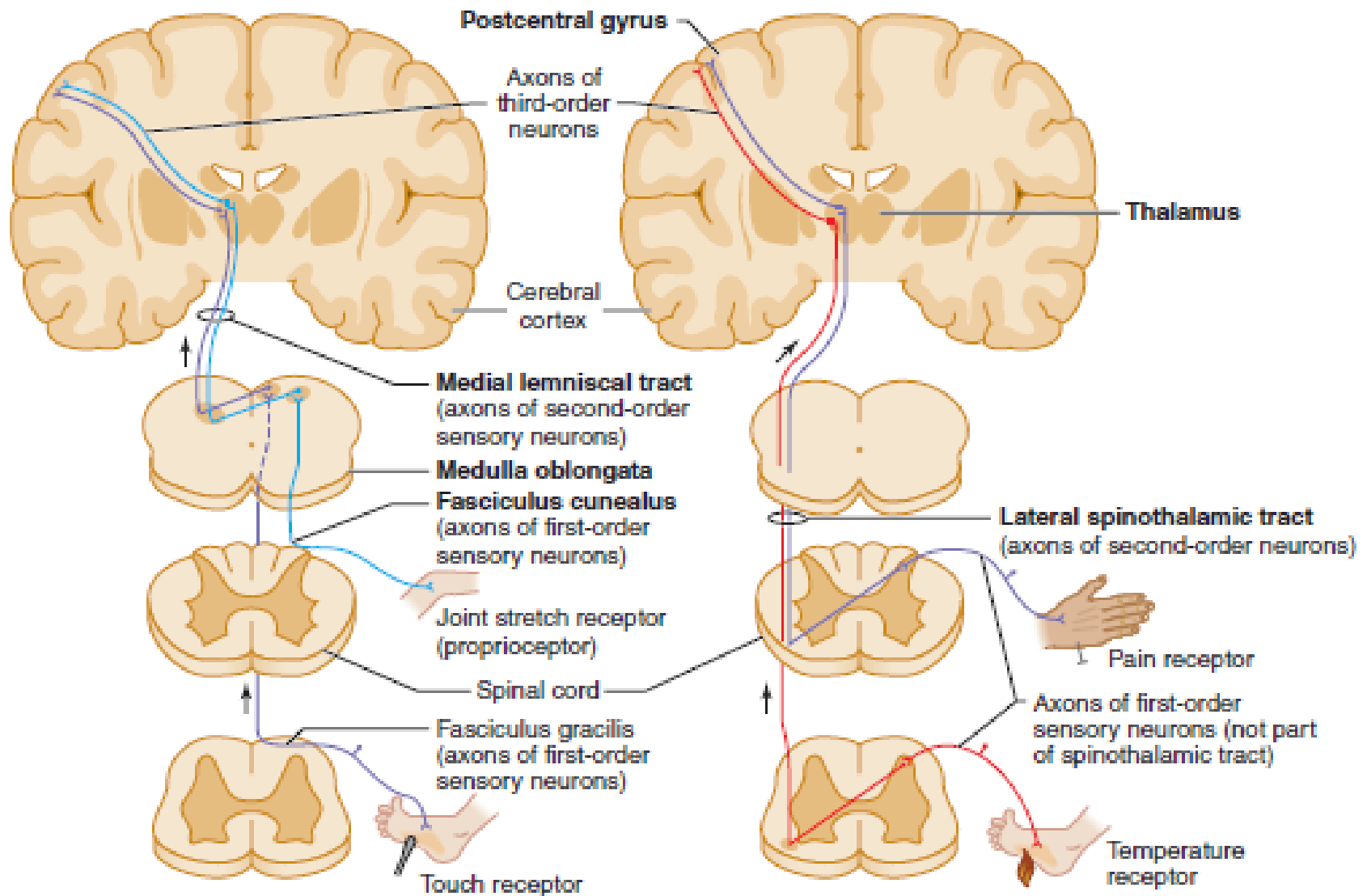
Sensory ataxia results from disorders that affect the proprioceptive pathways in peripheral sensory nerves, sensory roots, posterior columns of the spinal cord, or medial lemnisci.

Thalamic and parietal lobe lesions are rare causes

- ▶ Sensations of **joint position** originate in **pacinian corpuscles** and **unencapsulated nerve endings** in joint capsules, ligaments, muscle, and periosteum.



- 1) Sensory ataxia from **polyneuropathy** or **posterior column lesions** typically affects the gait and legs in symmetric fashion;
  - 2) the arms are involved to a lesser extent or are spared entirely.
  - 3) Examination reveals impaired sensation of **joint position** in the affected limbs, and **vibration sense** is also commonly disturbed.
  - 4) Vertigo, nystagmus, and dysarthria are **absent**.
- 

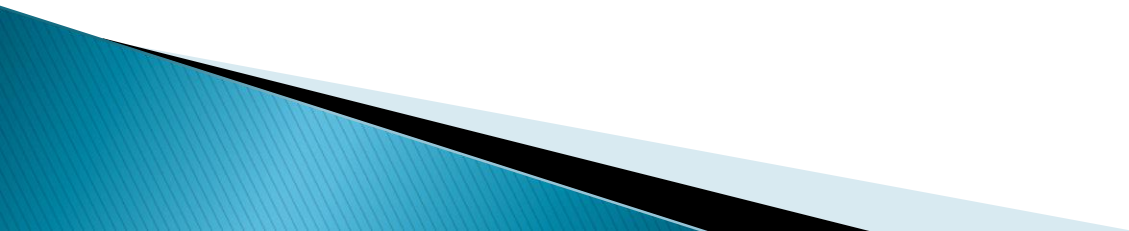


Pathways mediating proprioception (left, light blue) and other somatic sensory modalities (left and right).

**Table 8-2** Characteristics of vestibular, cerebellar, and sensory ataxia.

|                              | Vestibular  | Cerebellar  | Sensory  |
|------------------------------|---|---|--|
| Vertigo                      | Present   | May be present  | Absent   |
| Nystagmus                    | Present   | Often present   | Absent   |
| Dysarthria                   | Absent  | May be present  | Absent   |
| Limb ataxia                  | Absent  | Usually present (one limb, unilateral, legs only, or all limbs)   | Present (typically legs)   |
| Stance                       | May be able to stand with feet together; typically worse with eyes closed | Unable to stand with feet together and eyes either open or closed | Often able to stand with feet together and eyes open but not with eyes closed (Romberg sign) |
| Vibration and position sense | Normal  | Normal  | Impaired   |
| Ankle reflexes               | Normal  | Normal  | Depressed or absent  |

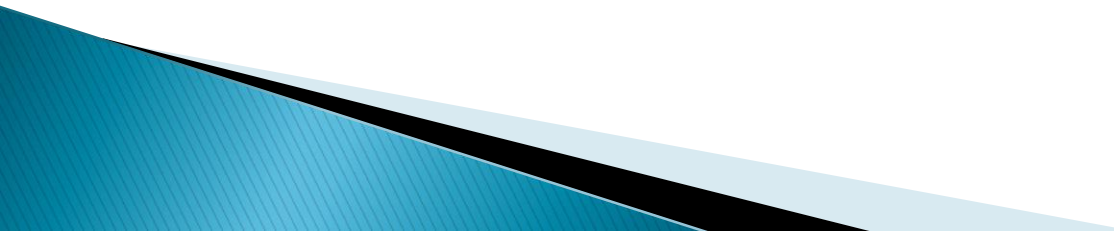
# HISTORY



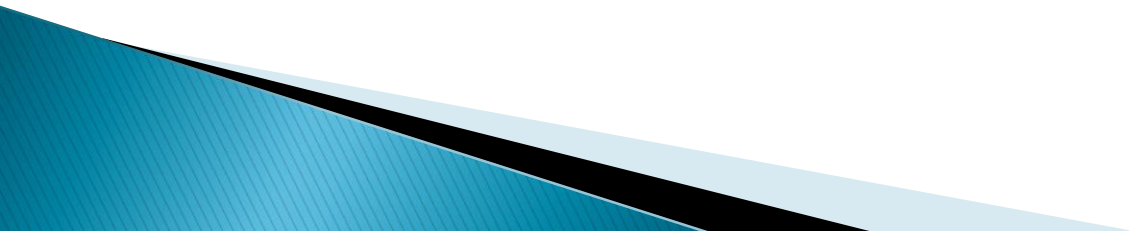
# 1) Vertigo

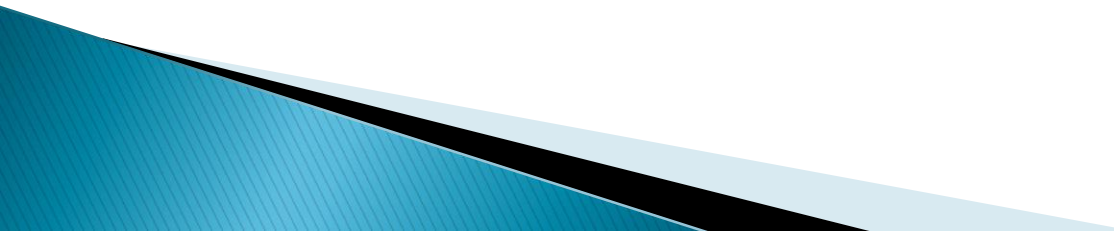
- ▶ Vertigo is a **sense of movement**
- ▶ must be distinguished from a light-headed or presyncopal sensation
- ▶ Associated symptom :
  - Hearing loss or tinnitus(peripheral vestibulopathy)
  - Dysarthria, dysphagia, diplopia or focal or sensory loss affecting the face or limbs(central vestibulopathy)

## 2)Ataxia

- ▶ Vestibular Ataxia is associated with vertigo
  - ▶ Sensory Ataxia is associated with numbness or tingling in the legs and they are much more unsteady in the dark
  - ▶ Cerebellar Ataxia is associated with other cerebellar symptoms and signs
- 

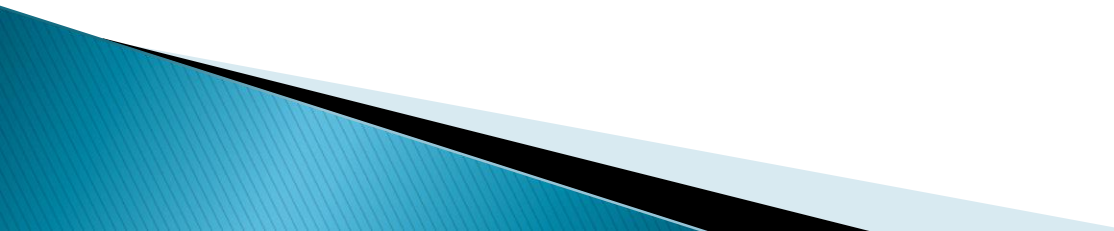
# **ONSET & TIME COURSE**



- 1) **Sudden** onset of disequilibrium : **infarcts** and **hemorrhages** in the **brainstem** or **cerebellum**
  - 2) **Episodic** disequilibrium of acute onset : **transient ischemic attacks** in the **basilar artery** distribution, **benign positional vertigo**, or **Ménière disease**.
  - 3) **Chronic, progressive** disequilibrium : **toxic or nutritional disorder**(eg, **vitamin B<sub>12</sub>** or **vitamin E** deficiency,**nitrous oxide** exposure) and **inherited spinocerebellar degeneration**
- 



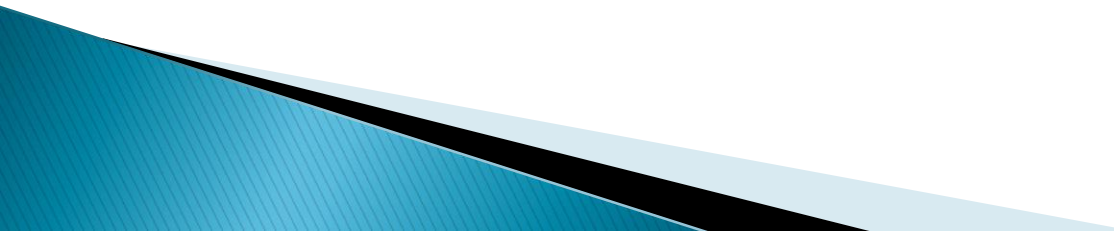
# MEDICAL HISTORY

- ▶ vitamin B 12 deficiency
  - ▶ Syphilis
  - ▶ Hypothyroidism
  - ▶ paraneoplastic syndromes
  - ▶ Tumors
  - ▶ drugs (ethanol, sedative drugs, phenytoin, aminoglycoside antibiotics, quinine, salicylates)
- 

# FAMILY HISTORY

- ▶ **hereditary degenerative disorder :**  
Such disorders include spinocerebellar degenerations, Friedreich ataxia, ataxia-telangiectasia, and Wilson disease

# GENERAL PHYSICAL EXAMINATION

- ▶ **Orthostatic hypotension**
  - ▶ **Skin and Hair**
  - ▶ **Kayser-Fleischer rings**
  - ▶ **Skeletal abnormalities**
- 

# NEUROLOGIC EXAMINATION

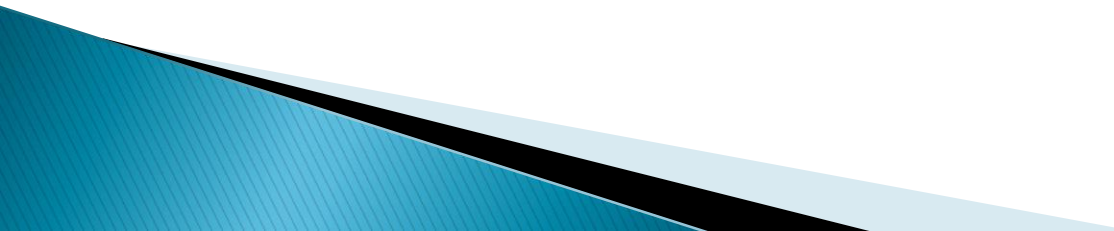
## 1) MENTAL STATUS EXAMINATION

\***Acute confusional state** : ethanol or sedative intoxication

\***Dementia** : Wilson disease, Creutzfeldt-Jakob disease, syphilitic taboparesis or vitamin B<sub>12</sub> deficiency

\***Amnesia** : chronic alcoholism

## 2) STANCE & GAIT :

- widened base stance
  - Romberg sign
  - staggering quality that might suggest drunkenness
  - Tandem (heel-to-toe) gait
  - steppage gait
- 

### **3) CRANIAL NERVES :**

- extraocular (III, IV, and VI)
- vestibulocochlear(VIII)

# Ocular Alignment ?

# Eye Movements ?

-ocular nerve palsy or **gaze paresis** ?

-**Nystagmus** ?

1) **Peripheral**: unidirectional horizontal nystagmus that is maximal on gaze away from the involved side:

2) **Central**: unidirectional or bidirectional horizontal or vertical nystagmus

-**saccades** and **pursuits**



# Hearing ?

- ▶ otoscopic inspection of the auditory canals and tympanic membranes
- ▶ **Weber test**
- ▶ **Rinne test**

# Positional Tests ?

- ▶ Dix–Hallpike maneuver (Positional nystagmus and vertigo are usually associated with **benign positional vertigo** )
- ▶ characterized by **severe distress**, a **latency** of several seconds between assumption of the position and the onset of vertigo and nystagmus, a tendency for the response to remit spontaneously (**fatigue**) as the position is maintained, and attenuation of the response (**habituation**) as the offending position is repeatedly assumed

A



B



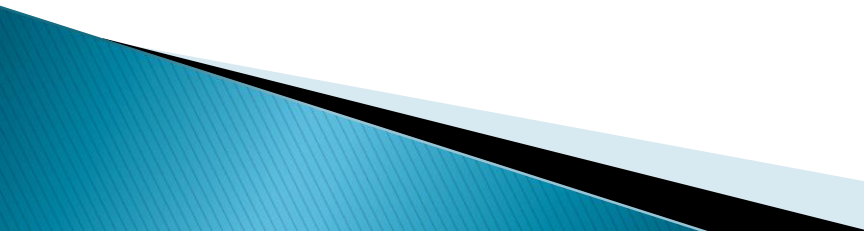
# Caloric Testing ?

- ▶ Careful otoscopic examination
- ▶ patient is placed supine with the head elevated 30 degrees
- ▶ cold (33°C) or warm (44°C) water for 40 seconds, with at least 5 minutes between tests

**1) Normal, awake patient**

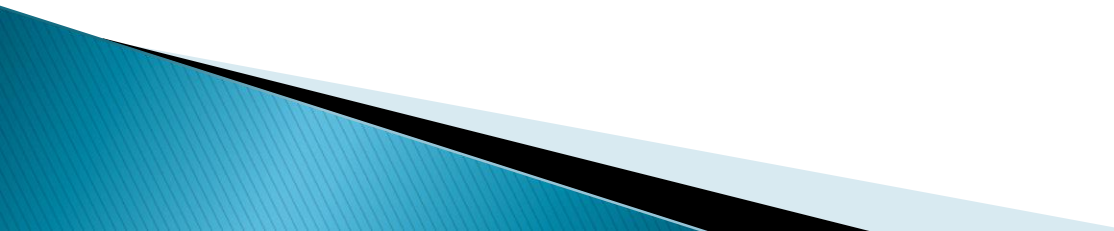
**2) unilateral labyrinthine, vestibulocochlear (VIII) nerve, or vestibular nuclear dysfunction**

# Other Cranial Nerves ?

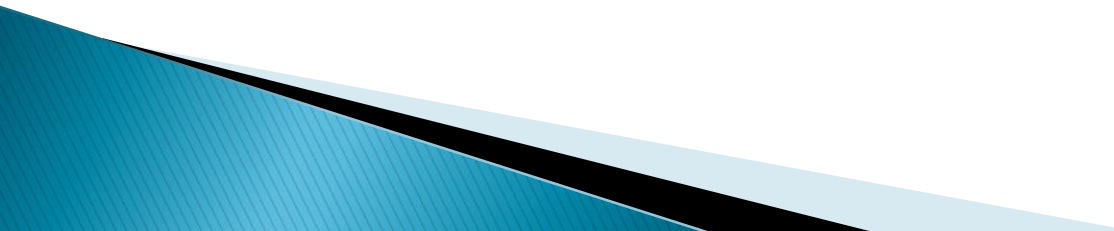
- Papilledema (intracranial mass lesion, usually in the posterior fossa)
  - Optic neuropathy (multiple sclerosis, neurosyphilis, or vitamin B<sub>12</sub> deficiency)
  - depressed corneal reflex or facial palsy ipsilateral to the lesion (cerebellopontine angle tumor)
  - Weakness of the tongue or palate, hoarseness, or dysphagia (lower brainstem lesions)
- 

# 3) MOTOR SYSTEM

## Muscle Tone?

- 1) **Hypotonia** ( cerebellar hemispheric lesion )
  - 2) **Rigidity** (disorders that affect both the cerebellum and basal ganglia eg, Wilson disease )
  - 3) **Spasticity** (conditions that affect both the cerebellum and upper motor neuron pathways  
eg, multiple sclerosis )
- 

# Coordination ?

- ▶ Titubation
  - ▶ Truncal ataxia
  - ▶ Intention tremor
  - ▶ Rebound Test
  - ▶ Ataxia of the legs
  - ▶ Ataxia of any limb
- 

## **Weakness ?**

**No weakness** : Pure vestibular, cerebellar, or sensory disorders

**Distal weakness** : sensory ataxia, such as polyneuropathies and Friedreich ataxia

**Paraparesis** : vitamin B<sub>12</sub> deficiency, multiple sclerosis

**Quadriparesis, hemiparesis** : brainstem lesions



# SENSORY SYSTEM ?

- ▶ **Joint Position Sense**
- ▶ **Vibration Sense**

# REFLEXES ?

- ▶ **hypoactive**, with a **pendular** quality : in cerebellar disorders
- ▶ **Hyporeflexia of the legs** : sensory ataxia
- ▶ **Hyperactive reflexes** and **extensor plantar responses** : multiple sclerosis, vitamin B<sub>12</sub> deficiency, focal brainstem lesions

# INVESTIGATIVE STUDIES

**BLOOD TESTS** : vitamin B12 levels, TFT, LFT, ceruloplasmin and copper concentrations and...

**CEREBROSPINAL FLUID** : it's not routine but in some conditions like MS(OCB), tabes dorsalis(VDRL), Creutzfeldt–Jakob disease (14–3–3 protein)

## **BRAIN IMAGING :**

- 1)** Brain CT Scan in cerebellar infarction or hemorrhage, and cerebellar atrophy
- 2)** Brain and Spinal MRI in posterior fossa lesions, cerebellopontine angle tumors, multiple sclerosis

## **EVOKED POTENTIALS : VEP and ABR**

in MS and Brainstem lesions

## **CHEST X-RAY & ECHOCARDIOGRAPHY :**

in Friedreich ataxia (cardiomyopathy)

## **AUDIOMETRY**

## **ELECTRONYSTAGMOGRAPHY**

