Dizziness and Vertigo

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Introduction

- Dizziness or Vertigo: Feeling of rotation or whirling

  Nonrotatory swaying, weakness, faintness, Light headedness

Unsteadiness

Blurring of vision

Feeling of unreality
Introduction

- Four categories:
  1) Vertigo: physical sensation of motion of self or the environment
  2) Near syncope: a sensation of faintness
  3) Disequilibrium: a disorder imbalance of stance or gait
  4) ill-defined light-headedness: a symptom that often accompanies anxiety
Vestibular structure
Vestibular structure

- vestibular system
- utricle
- macula
- saccule
- crista
- ampulla
- cupula
- hair bundles
- nerve fibre
- hair cells
- kinocilium
- Type I hair cell
- nerve fibre
- basement membrane
- stereocilia
- otoconia
- otolithic membrane
- supporting cells
- enlargement of crista
- enlargement of macula

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Vestibular structure: peripheral

- Vestibule of the labyrinth 與五個結構相聯結
- 結構：Utricle, saccule and 三個 semicircular canals
- 結構都藏在membranous labyrinth
- 全部浸在endolymph裡面且都含有sensory neuroepithelium
- Neuroepithelium上有microvilli, 又稱作hair cells
- Hair cells是周邊接受器,由一個較長的kinocilium及一排的stereocilia組成
- 這些纖毛存在Utricle及saccule內的maculae; semicircular canals內的cupule
- Endolymph的流動改變hair cells 的方向造成神經衝動
Vestibular structure: Central connection

- Vestibulocerebellar pathway
- Vestibulospinal pathway
- Vestibulo-ocular
- Vestibulo-cerebral
Vestibulocerebellar pathway

Diagram showing the vestibulocerebellar pathway, including structures such as the III N. nucleus, IV N. nucleus, VI N. nucleus, Uncinate fasciculus, Fastigial nucleus, Juxtarestiform body, Flocculo-nodular lobe, Vestibular nerve, Med. vestibulo-spinal tract, and Lat. vestibulospinal tract.
Vestibulospinal pathway
Vestibulo-ocular

Central connections of the vestibular system
Vestibulo-cerebral cortex
Vestibular reflex pathway

- Vestibulo-oculor reflex
- Vestibulospinal reflex
Vestibular reflex pathway
Vestibular Physiology

- Neural activity in the labyrinths is equal on both sides

- Action of each vestibular system as “pushing” toward the opposite side

- If one side underactive, the eyes, extremitis and body toward the underactive side → vertigo, nystagmus, lateropulsion, nausea and vomiting
Physical Consideration

- **Eyes (視覺)**
  - Labyrinths (內耳迷路)
  - Muscles and joints (本體感覺)
  - Informed us of the position of different parts of the body
  - Adaptive movements necessary to maintain equilibrium are carried out

- Maintenance of a balanced posture

- Awareness of the position of the body in relation to its surroundings
1. 視覺的刺激:
   → Retinae(視網膜) and proprioceptive ocular muscles
     judge the distance of objects from the body
   → 與 labyrinths and neck 有協調作用
     stabilize gaze during movements of the head and body
Physical Consideration

2. Labyrinths (內耳迷路) 的刺激:
Specialized spatial proprioceptors and register changes in the velocity of motion and the position of the body

→ Three semicircular canals, saccule and utricle
Physical Consideration

3. Proprioceptors (本體感覺) of the joints and muscles 的刺激:
与 cerebellar and brainstem 作協調, 提供適合 postural adjustment and maintain of equilibrium

Body reflex, postural and volitional movements
Physical Consideration

- Vision, labyrinthine and proprioception (本體) is simultaneously being stimulated.

If these are conflicting, it's easy to experience vertigo.

EX.: sitting on a boat, taking an elevator, driving on a mountain road.
Clinical characteristics of vertigo and giddiness (pseudovertigo)

- Vertigo
  - Environment spin around or move in one direction
  - A sensation of whirling of the head and body
  - Oscillopsia, illusory (幻覺) movement of the environment
Clinical characteristics of vertigo and giddiness (pseudovertigo)

- Pseudovertigo
  Feeling of swaying, light-headedness, a swimming sensation, faintness, walk on air

  → Common in anxiety state (psychiatric dizziness)

  → Oculomotor disorder (Diplopia—spatial disorientation)

  → Tullio phenomenon (Rare)
    突然有一大的聲音在耳邊出現，而後產生短暫的vertigo (problem in superior semicircular canal)

  → Anemia

  → Unstable vasomotor reflex (姿態性低血壓)

  → 高血壓藥

  → Hypoglycemia

  → Drug intoxication (alcohol, sedatives, antibiotics)
The neurologic and otologic cause of vertigo

- Cortex
  Posterolateral aspects of the temporal lobe or the inferior parietal lobule adjacent to the sylvian

Vertiginous epilepsy
The neurologic and otologic cause of vertigo

- Migraine
  Basilar migraine (usually in children)
  Vertigo followed by headache

- Cerebellum
  
  Cerebellar hemisphere and vermis—may not cause vertigo
  
  Posterior inferior cerebellar artery infarction—cause intense vertigo (Flocculonodular disorder)
The neurologic and otologic cause of vertigo
The neurologic and otologic cause of vertigo

- Upper cervical roots, muscles and ligaments (innervated by cervical root)
  - Cervical vertigo
  - Spasm of the cervical muscles, trauma to the neck, irritation of the upper cervical sensory root
  - 産生 asymmetry spinovestibular stimulation, 造成 nystagmus, prolong vertigo and 失衡
The neurologic and otologic cause of vertigo

- Cortex
- Migraine
- Cervical root, muscles

*Not common*
The neurologic and otologic cause of vertigo

- Vertigo, indicated
  1. Vestibular end organs
  2. Vestibular division of the eighth nerve
  3. Vestibular nuclei in the brainstem and their connection
Some causes of vertigo

- Otologic disorders
  - Benign paroxysmal positional vertigo
  - Ménière disease
  - Vestibular neuronitis
- Neurologic disorders
  - Migraine-associated vertigo
  - Vertebrobasilar ischemia
Ménière disease

- **Vertigo**
  - Recurrent, abrupt and last for several minutes to an hour or longer

- **Nausea, vomiting, low-pitched tinnitus, feeling of fullness in the ear, hearing下降 (500 Hz)**
  - Fluctuating type

- **Nystagmus is present during acute attack, horizontal with rotary**
  - Fast phase 往正常耳的方向

- **Sensation of being pushed or knocked to the ground without warning**
Ménière disease

- Prefer lie with faulty ear uppermost and look toward to abnormal ear

- Recurrent (several times weekly for many weeks or remission of several years)

- Equal sex and frequent in the fifth decade of life

- Sporadic or hereditary
 Ménière disease

- Mechanism
  Endolymph volume increasing and distention (endolymphatic hydrops)
  or
  Membranous labyrinth rupture and potassium-containing endolymph dumping
  →造成vestibular nerve的paralyzing而引起cochlear hair cells的退化
Ménière disease

- **Treatment:**
  1. Bed Rest
  2. Antihistamine
  3. Transdermal scopolamine for protracted case
  4. Promethazine (Phenergan), vestibular suppressant
  5. Low salt diet and diuretics
  6. Surgical means (Very frequent, disabling)
Benign positional vertigo

- Paroxysmal vertigo and nystagmus that occur only with the assumption of certain position of the head, particularly lying down or rolling over in bed.

- Vertigo began in the middle of the night or early morning;

- Nystagmus: direction to the normal ear, 30-40 seconds (tortional);

- Individual episodes last for less than a minute;

- No hearing abnormality or ear lesion.
Benign positional vertigo

- **Otolithic crystal** become detached and attack themselves to the cupula of the **posterior semicircular canal (90%), lateral canal (10%)**

- **Cause:** infection, degeneration or trauma

- **Diagnosis and treatment**
  Dix-Hallpike maneuver, 80% cure
  Drug: poor response
Benign positional vertigo
**Vestibular neuronitis**

- Paroxysmal and a prolong **single attack of vertigo, nausea, vomiting** without tinnitus and deafness
- **Young to middle aged adults**
- Antecedent upper respiratory infection → **Virus infection**
- Superior part of the vestibular nerve trunk, but uncertainty of more precise localization
- Benign disease and symptoms persist 1-2 weeks

**Treatment:**

Antihistamin, promethazine, clonazepam
Toxic vestibulopathy

- Otoxic effects of the aminoglycoside antibiotics
  - Cochlear hair cell, loss of hearing and vestibular labyrinth
  - Prolong exposure, produced bilateral vestibulopathy with no vertigo, but disequilibrium with oscillopsia; troublesome when the patient moves
Other causes of vertigo of vestibular nerve origin

- Eighth nerve: Acoustic neuroma
- Vascular irrigation or compression by a small branch of the basilar artery
- Labyrinthine infarction by Anterior Inferior Cerebellar Artery infarction
  - hearing loss, cerebellar ataxia, tinnitus, abrupt vertigo, nausea, vomiting
- Head trauma
  - lossening or dislodgement of the otoconia in the otoliths
Acoustic Neuroma

- Cerebellopontine angle (acoustic neuroma)
  -> Vertigo rarely initial symptom
  -> Sequence: Deafness, mild chronic imbalance, impaired caloric test and additional cranial nerve palsies (fifth/seven/ninth/tenth nerve palsy)
  -> Cerebellar Ataxia and falling ipsilateral
  -> Nystagmus: Gaze paretic, positional, coarse to side of lesion
  -> Lab data: Brain image: abnormal
  Vestibular paresies on caloric test
  BAEPs abnormal
Cervical Vertigo
Vertigo of Brainstem Origin

- Vertigo as the **SOLE** manifestation of brainstem disease is **rare**
Peripheral vertigo

- Labyrinths (postural vertigo, trauma, Meniere disease, aminoglycoside)
  - No neuroloific finding
  - 身體軀幹會有傾向往異常耳的移動
  - Nystagmus: Horizontal or rotary to side opposite lesion, positional and position changing; 会因为凝视而渐渐减小
  - Hearing: Normal to conduction or sensorineural deafness with recruitment
  - Lab data: Vestibular paresis by caloric test
Peripheral vertigo

- Vestibular nerve and ganglion (Vestibular neuritis)
  - neurolofoic finding: seven/eighth nerve palsy
  - 身體軀幹會有傾向往異常耳的移動
  - Nystagmus: Unidirectional positional
  - hearing: Sometimes sensorineural deafness
  - Lab data: Brain image: may normal or abnormal
    Vestibular paresis on caloric test or abnormal BAEP
Brainstem and cerebellum (infarction, tumor)

- Multiple cranial nerve, brainstem tract signs, cerebellar ataxia
- Ataxia present with eyes open
- Nystagmus: Horizontal and vertical, gaze-paretic, fast phase
  方向往病灶側, 不會因為注視物體 nystagmus 會消失
- Hearing: normal
- Lab: CT/MRI, BAEP abnormal
Cortex

- Higher (cerebral) connection
  - Aphasia, visual field, hemimotor, hemisensory, other cerebral abnormalities, seizure
  - Equilibrium: No change
  - Nystagmus: absent
  - Hearing: normal
  - No change in caloric response
  - Brain CT: abnormal
<table>
<thead>
<tr>
<th>Sign or Symptom</th>
<th>Peripheral (Labyrinth)</th>
<th>Central (Brain Stem or Cerebellum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction of associated nystagmus</td>
<td>Unidirectional; fast phase opposite lesion</td>
<td>Bidirectional or unidirectional</td>
</tr>
<tr>
<td>Purely horizontal nystagmus without torsional component</td>
<td>Uncommon</td>
<td>Common</td>
</tr>
<tr>
<td>Vertical or purely torsional nystagmus</td>
<td>Never present</td>
<td>May be present</td>
</tr>
<tr>
<td>Visual fixation</td>
<td>Inhibits nystagmus and vertigo</td>
<td>No inhibition</td>
</tr>
<tr>
<td>Severity of vertigo</td>
<td>Marked</td>
<td>Often mild</td>
</tr>
<tr>
<td>Direction of spin</td>
<td>Toward fast phase</td>
<td>Variable</td>
</tr>
<tr>
<td>Direction of fall</td>
<td>Toward slow phase</td>
<td>Variable</td>
</tr>
<tr>
<td>Duration of symptoms</td>
<td>Finite (minutes, days, weeks) but recurrent</td>
<td>May be chronic</td>
</tr>
<tr>
<td>Tinnitus or deafness</td>
<td>Often present</td>
<td>Usually absent</td>
</tr>
<tr>
<td>Associated central abnormalities</td>
<td>None</td>
<td>Extremely common</td>
</tr>
<tr>
<td>Common causes</td>
<td>Infection (labyrinthitis), Meniere’s, neuronitis, ischemia, trauma, toxin</td>
<td>Vascular, demyelinating neoplasm</td>
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</tbody>
</table>
Thanks for your attention!