Disequilibrium

Miriam P. Garcia, MD
Department of Neurology
Virginia Commonwealth University

Definitions
Equilibrium
- ability to maintain an upright position

Disequilibrium
- difficulty in standing erect and remaining erect

Gait Disorder
- abnormality of walking or locomotion

Clinical Manifestation
- Being off balance
- Staggering
- Walking like a “drunk sailor”
- Running into doors and walls
- Doing worse in darkness and on uneven surfaces
- Walking with feet apart to be steady

Clinical Manifestation
- Unsteady
- Sway when standing, walking or turning
- Wide-based stance and gait
- Turns slowly with several steps
- Veer to one side

Causes of Balance Disorder

Non-neurological:
- mechanical
  - orthopedic
  - arthritic
- antalgic

Neurological:
- motor
- sensory
- coordination
- cortical/subcortical balance/gait disorder
- senile gait
- psychogenic

Sway Direction
Lateropulsion:
- ipsilateral
  - labyrinth
  - vestibular nerve
  - lateral medullary syndrome
  - pontomedullary lesions
  - cerebellum
- contralateral
  - cerebellum
  - pontomesencephalic lesions
  - midbrain
  - thalamic astasia
  - basal ganglia
Sway Direction (continued)

Diagonal:
- vestibular epilepsy
- benign paroxysmal positional vertigo
- ocular tilt reaction

Fore-aft:
- upbeat/downbeat nystagmus
- bilateral vestibulopathy

Repropulsion:
- parkinsonism
- cortical/subcortical imbalance

Causes of Disequilibrium

Proprioceptive System:
- diabetic neuropathy
- vitamin B6 toxicity
- guillain-Barre Syndrome

Clinical Features:
- lateral trunk movement
- unsteady when eyes closed
- wide-based gait
- (+) romberg

(continued)

Causes of Disequilibrium

Visual System:
- correction of errors of refractions
- cataract surgery

(continued)

Causes of Disequilibrium

Vestibular System:
- benign paroxysmal positional vertigo
- vestibular neuritis
- acoustic neuroma
- bilateral vestibulopathy

Clinical Features:
- Acute Unilateral Lesion
  - fall/veer to one side
  - stance wide-based
  - fall sideways

(continued)

Clinical Features

Acute Unilateral Lesion:
- difficulty with tandem
- nystagmus
  - peripheral: unidirectional horizontal/torsional
  - central: gaze evoked or vertical

Bilateral Symmetrical Vestibulopathy (acute or chronic):
- fore-aft or lateral sway
- oscillopsia

Chronic Unilateral Lesion:
- unsteadiness
- vertigo absent

(continued)
Causes of Disequilibrium

Spinal:
- Myelopathy
  - Degeneration
  - Trauma
  - Infarction
  - Tumor
  - vascular

Clinical Features:
- stiff spastic legs

Brainstem:
- Lateral medullary syndrome
- Lateral pontine infarct/hemorrhage
- Midbrain infarct/hemorrhage

Clinical Features:
- festinating gait
- inability to tandem
- tilt contralesionally

Cerebellum:
- Stroke
- Hemorrhage
- Toxic/metabolic
- Infections/inflammatory
- Neoplastic
- Paraneoplastic

Clinical Features:
- ipsilateral drift (hemispheric)
- walking can be slow, halting or lurching
- wide-base
- bi-directional sway (midline lesion)
- ataxia
- truncal titubation antero-posteriorly
- vertigo
- dysarthria
- sway either side

Thalamus:
- stroke
- hemorrhage

Clinical Features:
- unable to sit/stand
- fall backwards and contralesionally (thalamic astasia)
- "pusher syndrome"

Basal Ganglia:
- stroke
- hemorrhage
- degenerative

Clinical Features:
- fall contralesionally
- bradykinesia
- impaired postural reflexes
Causes of Disequilibrium
(continued)

Cortical/Subcortical Balance & Gait Disorders:
- diffuse white matter disease
- normal pressure hydrocephalus
- nonspecific disequilibrium of the elderly
- frontal lesions
- degenerative diseases
- multiple sclerosis
- medical
- psychiatric
- idiopathic

Clinical Features
- slow and cautious gait
- difficulty with initiation of gait
- difficulty with trunk movement
- "magnetic foot"
- upper motor signs present
- less rigidity without bradykinesia/tremors
- fall backwards
- s/sx of frontal lobe dysfunction

Psychogenic imbalance
- conversion disorder
- complex movements with their limbs
- stance and gait variable
- "psychogenic" Romberg
- not organic

Psychogenic imbalance
Clues:
- abrupt onset
- selective disability
- related to minor accident/trauma
- Static
- spontaneous remission
- multiple undiagnosed disorders
- history of psychological disorders

Causes of Disequilibrium by Anatomical Sites

Lowest level:
- mechanical
- proprioceptive
- visual
- vestibular

Causes of Disequilibrium by Anatomical Sites
(continued)

Middle Level:
- cerebellar
- brainstem
- thalamic
- basal Ganglia
Causes of Disequilibrium by Anatomical Sites
(continued)

Highest level:
- suprathalamic/periventricular white matter
- frontal lobe
- epileptic
- psychogenic

Prevention

Simplify medications:
- vestibular suppressants
- benzodiazepines
- aminoglycosides
- vincristine, cisplatin

Prevention (continued)

- avoid sedentary lifestyles
- monitor general medical health
  - cardiovascular risk factors
  - B12 deficiency
  - thyroid disease
  - Orthostasis
  - depressive symptoms
  - prevent falls

Differential Diagnosis
Acute/Subacute Disequilibrium

<table>
<thead>
<tr>
<th>Signs and symptoms</th>
<th>Potential diagnosis</th>
<th>Work up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertigo +/- oto</td>
<td>Peripheral vestibulopathy</td>
<td>ENG, audiogram</td>
</tr>
<tr>
<td>Vertigo +/- central signs</td>
<td>Central vestibulopathy</td>
<td>Brain imaging</td>
</tr>
</tbody>
</table>

Differential Diagnosis
Acute/Subacute Disequilibrium (continued)

<table>
<thead>
<tr>
<th>Signs and symptoms</th>
<th>Potential diagnosis</th>
<th>Work up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propioceptive loss</td>
<td>Peripheral neuropathy</td>
<td>EMG, glucose, cbc, esr, tsh, rpr, B12</td>
</tr>
<tr>
<td>Eye glasses, cataract</td>
<td>Visual related</td>
<td>none</td>
</tr>
</tbody>
</table>

Differential Diagnosis
Acute/Subacute Disequilibrium (continued)

<table>
<thead>
<tr>
<th>Signs and symptoms</th>
<th>Potential diagnosis</th>
<th>Work up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper motor weakness, sensory level, bowel/bladder</td>
<td>myelopathy</td>
<td>Spine MRI, neurosurgical evaluation</td>
</tr>
<tr>
<td>ataxia</td>
<td>cerebellum</td>
<td>Brain imaging, drug screen, EMG, LP, paraneoplastic w/u</td>
</tr>
</tbody>
</table>
### Differential Diagnosis
#### Acute/Subacute Disequilibrium

<table>
<thead>
<tr>
<th>Signs and symptoms</th>
<th>Potential diagnosis</th>
<th>Work up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ataxia +/- diplopia, weakness</td>
<td>brainstem</td>
<td>Brain MRI/MRA Stroke w/u</td>
</tr>
<tr>
<td>Imbalance + sensory loss</td>
<td>thalamus</td>
<td>Brain MRI/MRA Stroke w/u</td>
</tr>
</tbody>
</table>

**Work up**
- Brain MRI, neurological, neurosurgical evaluation
- Cortical/subcortical

**Potential diagnosis**
- Basal ganglia
- Cortical/subcortical
- Brain MRI, neuropsychological, neurosurgical evaluation

**Signs and symptoms**
- Ataxia
- Diplopia
- Unsteadiness
- Difficulty in changing body orientation
- Difficulty in maintaining body orientation

**Brainstem**
- Sensory symptoms
- Dizziness
- Ataxia
- Aphasia
- Motor symptoms
- Oculomotor symptoms

**Thalamus**
- Sensory loss
- Motor loss
- Oculomotor symptoms

**Cerebellum**
- Spasticity
- Dysmetria
- Dysdiadochokinesia
- Hyperpathia

**Basal ganglia**
- Parkinsonism
- Tremor
- Rigidity

**Parkinson**
- Bradykinesia
- Hypokinesia
- Tremor

**Cerebello-pontine angle tumor**
- Unilateral hearing loss

**Spinal cord dysfunction**
- Motor loss
- Sensory loss
- Autonomic dysfunction

**Paraneoplastic syndrome**
- Spinal cord dysfunction
- Cerebellar ataxia

### Differential Diagnosis
#### Chronic Disequilibrium

<table>
<thead>
<tr>
<th>Signs and symptoms</th>
<th>Potential diagnosis</th>
<th>Work up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscillopsia, unsteady</td>
<td>Bilateral vestibulopathy</td>
<td>ENG, audiogram, drug levels, ESR, RPR</td>
</tr>
<tr>
<td>Sensory loss</td>
<td>neuropathy</td>
<td>See acute disequilibrium</td>
</tr>
</tbody>
</table>

**Work up**
- Brain MRI, paraneoplastic, LP
- Spine MRI, neurosurgical evaluation

**Potential diagnosis**
- Brain MRI
- Brain MRI/MRA
- Basal ganglia

**Signs and symptoms**
- Dizziness
- Unsteadiness
- Difficulty in changing body orientation
- Difficulty in maintaining body orientation

**Unilateral hearing loss**
- Cerebello-pontine angle tumor

**Dizziness with movement**
- Vestibulo-ocular reflex dysfunction

**ENG, TSH, B12**
- Unilateral hearing loss

**Spasticity**
- Myelopathy
- Neurosurgical evaluation

**Ataxia**
- Cerebellum
- Brain MRI, paraneoplastic, LP

**Parkinsonism**
- Basal ganglia
- Brain MRI

**Brainstem**
- Motor symptoms
- Sensory symptoms
- Autonomic dysfunction

**Brain MRI/MRA**
- Brain MRI
- Brain MRI/MRA
- Basal ganglia
- Brain MRI
Differential Diagnosis
Chronic Disequilibrium

<table>
<thead>
<tr>
<th>Signs and symptoms</th>
<th>Potential diagnosis</th>
<th>Work up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive symptoms +/- Parkinsonism, +/- urinary symptoms</td>
<td>Cortical/subcortical</td>
<td>Brain MRI, neurological testing, LP</td>
</tr>
<tr>
<td>Cautious gait</td>
<td>Nonspecific disequilibrium of the elderly</td>
<td>Brain MRI</td>
</tr>
</tbody>
</table>

Management

- reverse underlying pathology
- simplify medications
- treat coexisting causes of disequilibrium
- avoid inactivity and deconditioning
- simplify environment
- vestibular rehab
- physical rehab

Peripheral vestibulopathy:
- vestibular rehab
- stop vestibular suppressant
- penicillin
- steroids
- surgery

Peripheral Neuropathy:
- diabetes
  - treat
- Guillain-Barre
  - IVIG or plasma exchange
- B12 deficiency
  - B12 1000mcg

Meniere disease:
- diuretics
- low salt diet
- endolymphatic shunt

Myelopathy:
- neurosurgical intervention
- radiation
- steroids
- antibiotics
Management

Chiari malformation:
- decompression

Cerebellar ataxia:
- stroke
- toxic/metabolic
  - stop offending drug, treat cause
- multiple sclerosis
  - immune modulating treatment
- tumors
  - surgery, radiation

Brainstem:
- stroke management
- multiple sclerosis management

Thalamus:
- stroke management

Basal Ganglia:
- stroke management
- sinemet

Management

Cortical/subcortical:
- stroke
  - stroke management
- hydrocephalus
  - shunt
- periventricular white matter disease
- frontal tumor
  - resection

Prognosis

Good prognosis:
- acute peripheral vestibulopathy
- benign paroxysmal positional vertigo
- visual disequilibrium

Neuropathic causes-permanent
Compressive myelopathy-some reversibility
Myelopathy due to intrinsic lesions-
  permanent
Cerebellar ataxia(medication-related)-
  reversible
Acoustic neuroma-surgery may help balance

Prognosis

Traumatic injuries-variable outcomes
Bilateral vestibulopathy-may improve but can
still be unsteady in dark
Lateropulsion in brainstem, thalamic, basal
ganglia, internal capsule-last days to weeks