EPISODE VI

HEARING LOSS

APPROACH and DIAGNOSIS
Cochlea and Auditory nerve

↓

Pons (superior olive)

↓

lateral lemniscus

↓

Inferior colliculus

↓

Thalamus (median geniculate body)

↓

Auditory cortex
Rinne’s test:
Air Conduction > Bone Conduction = normal or SNHL
Bone Conduction > Air Conduction = CHL or dead ear

Webber’s test:
in CHL heard loudest in the affected ear
In SNHL heard louder in the unaffected ear
CAUSE of HEARING LOSS

Acoustic Trauma (Noise)
Age related
Genetic
Ototoxic Drugs: aminoglycoside, furosemide
Infection: VDRL
Illness (examples)
  – Autoimmune Disease
  – Meniere’s Syndrome
  – Acoustic Neuromas
DIPOLPIA

Supranuclear
- INO 1 1/2

Infranuclear
- Long tract sign

Extraaxial
- Exclude NMJ, muscle
- Ungroup

Intraaxial
- Foramen syndrome
- Subarachnoidal space

Exclude NMJ, muscle

group
SNHL

Unilateral

Bilateral

long tract signs

Intrinsic

Extrinsic

Exclude NMJ, muscle

Pontine lesion

CN8 lesion

Bilateral CN8

Subarachnoid space

bilateral lesion

IMPOSSIBLE

Ungroup

EXACTLY

Group: foramen syndrome

Ungroup: subarachnoid space or base of skull

Isolated CN8: vestibular neuritis, Meniere’s disease
EPISODE VI

ATAXIAS

APPROACH and DIAGNOSIS
Ataxia Approach

1. Weakness?
2. Sensory ataxia:
   failure of proprioceptive information to the CNS
   disorders of spinal cord or peripheral nerves
   can be compensated for by visual inputs
3. Vestibular: vestibular organ, brain stem lesion
4. Cerebellar: cerebella signs/acute or chronic
## Signs of Cerebellar Disorders

<table>
<thead>
<tr>
<th>Deficit</th>
<th>Manifestation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ataxia</td>
<td>Reeling, wide-based gait</td>
</tr>
<tr>
<td>Decomposition of movement</td>
<td>Inability to correctly sequence fine, coordinated acts</td>
</tr>
<tr>
<td>Dysarthria</td>
<td>Inability to articulate words correctly, with slurring and inappropriate phrasing</td>
</tr>
<tr>
<td>Dysdiadochokinesia</td>
<td>Inability to perform rapid alternating movements</td>
</tr>
<tr>
<td>Dysmetria</td>
<td>Inability to control range of movement</td>
</tr>
<tr>
<td>Hypotonia</td>
<td>Decreased muscle tone</td>
</tr>
<tr>
<td>Nystagmus</td>
<td>Involuntary, rapid oscillation of the eyeballs in a horizontal, vertical, or rotary direction, with the fast component maximal toward the side of the cerebellar lesion</td>
</tr>
<tr>
<td>Scanning speech</td>
<td>Slow enunciation with a tendency to hesitate at the beginning of a word or syllable</td>
</tr>
<tr>
<td>Tremor</td>
<td>Rhythmic, alternating, oscillatory movement of a limb as it approaches a target (intention tremor) or of proximal musculature when fixed posture or weight bearing is attempted (postural tremor)</td>
</tr>
</tbody>
</table>
Midline Cerebellar Lesion

- anterior and posterior parts of the vermis
- concerned with posture, locomotion, position of head relative to trunk, control of EOM’s
- cerebellar signs resulting from midline cerebellar disease
  - disorders of stance/gait
  - truncal ataxia
  - postural disturbances
  - rotated postures of the head (titubation)
  - disturbances of eye movements
Hemispheric Cerebellar Lesion

- cerebellar hemisphere and dentate nucleus on each side
- concerned with the planning of movement in connection with neurons in the Rolandic region of the cerebral cortex (fine skilled)
- lesions result in
  - abnormalities of skilled voluntary movements
  - hypotonia, dysarthria, dysmetria, dysdiadochokinesia, excessive rebound (over shoot) and pendulum reflexes
  - impaired check, kinetic and static tremors, past-pointing (dysmetria)
Cerebellar Signs

“Over shoot”
Cerebellar Ataxia

acute

Stroke or Transient ischemic attack (TIA)
brain stem syndromes, cerebellar
Multiple sclerosis (MS)
Postviral infection (cerebellitis) eg. Chickenpox
uncommon complication, appear in healing stages of the infection and last for days or weeks, resolves completely
Toxic reaction
phenobarbital, benzodiazepines, alcohol, heavy metal (lead or mercury), solvent poisoning (paint thinner)
Cerebellar Ataxia
chronic

Cerebral palsy
Arnold Chiari malformations: type I, II, III
Paraneoplastic syndromes: Anti Yo
rare, degenerative disorders triggered by immune response to tumor
most commonly from lung, ovarian, breast or lymphatic
Tumor: metastasis, hemangioma
Degeneration: alcohol, phenytoin
Genetic disease: SCA, EA
Spinocerebellar ataxias
- labeled 28 autosomal dominant ataxia genes (SCA1-SCA28) according to their order of discovery
- cerebellar ataxia and cerebellar degeneration are common to all types, but other signs and symptoms - age of onset are differ depending on the specific gene mutation

Episodic ataxia
- six types of ataxia that are episodic rather than progressive (EA1-EA6)
- all but the first two are rare.
- EA1: brief ataxic episodes last seconds or minutes, triggered by stress, being startled or sudden movement, associated with muscle twitching
- EA2: longer episodes from 30 minutes to six hours, triggered by stress
- some cases symptoms resolve in later life, not shorten life span
- symptoms may respond to medication, such as acetazolamide (Diamox) or phenytoin
<table>
<thead>
<tr>
<th>SCA Type</th>
<th>Average Onset (Range in Years)</th>
<th>Average Duration (Range in Years)</th>
<th>What the patient experiences</th>
<th>Common origin</th>
<th>Problems with DNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCA1[^4]</td>
<td>4th decade (&lt;10 to &gt;60)</td>
<td>15 years (10–35)</td>
<td>Hypermetric saccades, slow saccades, upper motor neuron (note: saccades relates to eye movement)</td>
<td>CAG repeat, 6p (Ataxin 1)</td>
<td></td>
</tr>
<tr>
<td>SCA2[^5]</td>
<td>3rd–4th decade (&lt;10 to &gt;60)</td>
<td>10 years (1–30)</td>
<td>Diminished velocity saccades areflexia (absence of neurologic reflexes)</td>
<td>Cuba</td>
<td>CAG repeat, 12q</td>
</tr>
<tr>
<td>SCA3[^6]</td>
<td>4th decade (10–70)</td>
<td>10 years (1–20)</td>
<td>Also called Machado-Joseph disease (MJD)[^7] Gaze-evoked nystagmus (a rapid, involuntary, oscillatory motion of the eyeball) upper motor neuron slow saccades</td>
<td>Azores (Portugal)</td>
<td>CAG repeat, 14q</td>
</tr>
<tr>
<td>SCA4</td>
<td>4th–7th decade (19–72)</td>
<td>Decades</td>
<td>areflexia (absence of neurologic reflexes)</td>
<td>Chromosome 16q</td>
<td></td>
</tr>
<tr>
<td>SCA5</td>
<td>3rd–4th decade (10–68)</td>
<td>&gt;25 years</td>
<td>Pure cerebellar</td>
<td>Chromosome 11</td>
<td></td>
</tr>
<tr>
<td>SCA6[^8]</td>
<td>5th–6th decade (19–71)</td>
<td>&gt;25 years</td>
<td>Downbeating nystagmus, positional vertigo Symptoms can appear for the first time as late as 65 years old.</td>
<td>CAG repeat, 19p Calcium channel gene</td>
<td></td>
</tr>
<tr>
<td>SCA</td>
<td>Age Range</td>
<td>Lifespan</td>
<td>Symptoms</td>
<td>Location</td>
<td></td>
</tr>
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</tr>
<tr>
<td>SCA7</td>
<td>3rd–4th decade (0.5–60)</td>
<td>20 years (1–45; early onset correlates with shorter duration)</td>
<td>Macular degeneration, upper motor neuron, slow saccades</td>
<td>CAG repeat, 3p (Ataxin 7)</td>
<td></td>
</tr>
<tr>
<td>SCA8</td>
<td>39 yrs (18–65)</td>
<td>Normal lifespan</td>
<td>Horizontal nystagmus (a rapid, involuntary, oscillatory motion of the eyeball), instability, lack of coordination</td>
<td>CTG repeat, 13q</td>
<td></td>
</tr>
<tr>
<td>SCA10</td>
<td>36 years</td>
<td>9 years</td>
<td>Ataxia, seizures</td>
<td>Mexico</td>
<td></td>
</tr>
<tr>
<td>SCA11</td>
<td>30 yrs (15–70)</td>
<td>Normal lifespan</td>
<td>Mild, remain ambulatory (able to walk about on one’s own)</td>
<td>15q</td>
<td></td>
</tr>
<tr>
<td>SCA12</td>
<td>33 yrs (8–66)</td>
<td></td>
<td>Head and hand tremor, akinesia (loss of normal motor function, resulting in impaired muscle movement)</td>
<td>CAG repeat, 5q</td>
<td></td>
</tr>
<tr>
<td>SCA13</td>
<td>Childhood or adulthood depending on mutation</td>
<td>Depending on KCNC3 (a kind of gene)</td>
<td>Mental retardation</td>
<td>19q</td>
<td></td>
</tr>
<tr>
<td>SCA14</td>
<td>28 yrs (12–42)</td>
<td>Decades (1–30)</td>
<td>Myoclonus (a sudden twitching of muscles or parts of muscles, without any rhythm or pattern, occurring in various brain disorders)</td>
<td>19q</td>
<td></td>
</tr>
<tr>
<td>SCA16</td>
<td>39 yrs (20–66)</td>
<td>1–40 years</td>
<td>Head and hand tremor</td>
<td>8q</td>
<td></td>
</tr>
<tr>
<td>SCA17 (TBP)</td>
<td></td>
<td>CAG repeat, 6q (TATA-binding protein)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCA19, SCA22</td>
<td></td>
<td></td>
<td>Mild cerebellar syndrome, dysarthria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCA25</td>
<td>1.5–39 yrs</td>
<td>Unknown</td>
<td>Ataxia with sensory neuropathy, vomiting and gastrointestinal pain.</td>
<td>2p</td>
<td></td>
</tr>
<tr>
<td>SCA27</td>
<td>15–20 yrs</td>
<td>Unknown</td>
<td>Ataxia with low cognition, dyskinesias and tremor.</td>
<td>FGF14 13q34</td>
<td></td>
</tr>
</tbody>
</table>
Repeats and autosomal dominant ataxias

<table>
<thead>
<tr>
<th>Disease Name</th>
<th>Repeat Type/Normal Number</th>
<th>Intermediate Repeat Number</th>
<th>Abnormal Repeat Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCA1</td>
<td>CAG/6-44</td>
<td>36-38</td>
<td>39-91</td>
</tr>
<tr>
<td>SCA2</td>
<td>CAG/ ≤30</td>
<td>---</td>
<td>≥(32)33 - &gt;500</td>
</tr>
<tr>
<td>SCA3</td>
<td>CAG/ ≥47</td>
<td>48-51</td>
<td>53-86</td>
</tr>
<tr>
<td>SCA6</td>
<td>CAG/ ≤18</td>
<td>19</td>
<td>≥(19)20-33</td>
</tr>
<tr>
<td>SCA7</td>
<td>CAG/4-35</td>
<td>28-35</td>
<td>≥36 - &gt;450</td>
</tr>
<tr>
<td>SCA8</td>
<td>CTG/15-50 ⁴</td>
<td>(50-70)</td>
<td>(71)80 - &gt;800</td>
</tr>
<tr>
<td>SCA10</td>
<td>ATTCT/10-22</td>
<td>---</td>
<td>280 - &gt;4500</td>
</tr>
<tr>
<td>SCA12</td>
<td>CAG/7-31(45)</td>
<td>---</td>
<td>55-78</td>
</tr>
<tr>
<td>SCA17</td>
<td>CAG/25-44</td>
<td>---</td>
<td>45-63</td>
</tr>
<tr>
<td>DRPLA</td>
<td>CAG/ ≤35</td>
<td>---</td>
<td>48-93</td>
</tr>
</tbody>
</table>

Anticipation – repeat size expands during transmission, the larger the repeat size the earlier the age of onset and more severe symptoms
Spino-Cerebellar Ataxia Type 3 (SCA 3)  
MJD

- Clinical features: Adult (after 40) onset gait ataxia, Parkinsonian signs, ophthalmoparesis or nystagmus, leg areflexia, Babinski signs, nystagmus, mild cerebellar tremors, diabetes
- Inheritance: Autosomal dominant
- About 40% of dominant ataxias in one study
- Chromosome: 14q24.3-q32
- Mutation: CAG repeat expansion in ATXN3 gene
- Testing: Gene testing available
Friedreich's ataxia:
- involves damage to cerebellum, spinal cord and peripheral nerves
- Progressive limb and gait ataxia usually beginning before 25
  - rate of disease progression varies (wheelchair within 15 years)
  - axonal polyneropathy: absent DTR but BBK (+)
  - muscles weaken, waste and deformities (pes clavus)
  - slow-slurred speech fatigue
  - death from cardiomyopathy and heart failure
  - GAA trinucleotide repeat expansions in frataxin gene (9q13)

Ataxia-telangiectasia

Congenital cerebellar ataxia:
- type refers to ataxia that results from damage to the cerebellum
  - that's present at birth

Wilson's disease
<table>
<thead>
<tr>
<th>Disease Name</th>
<th>Population Frequency</th>
<th>Onset (range in yrs)</th>
<th>Duration in Years</th>
<th>Distinguishing Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friedreich ataxia (FRDA)</td>
<td>1-2:50,000</td>
<td>1st - 2nd decade (4-40)</td>
<td>10-30</td>
<td>Hyporeflexia, Babinski responses, sensory loss, cardiomyopathy</td>
</tr>
<tr>
<td>Ataxia-telangiectasia (A-T)</td>
<td>1:40,000 to 1:100,000</td>
<td>1st decade</td>
<td>10-20</td>
<td>Telangiectasia, immune deficiency, cancer, chromosomal instability, increased alpha-fetoprotein</td>
</tr>
<tr>
<td>Ataxia with vitamin E deficiency (AVED)</td>
<td>Rare</td>
<td>Age 2-52 yrs, usually &lt;20</td>
<td>Decades</td>
<td>Similar to FRDA, head titubation (28%)</td>
</tr>
<tr>
<td>Ataxia with oculomotor apraxia type 1 (AOA1)</td>
<td>Unknown</td>
<td>Childhood</td>
<td>Decades</td>
<td>Oculomotor apraxia, choreoathetosis, mild intellectual disability, hypoalbuminemia</td>
</tr>
<tr>
<td>Ataxia with oculomotor apraxia type 2 (AOA2)</td>
<td>Unknown</td>
<td>Age 10-22 yrs</td>
<td>Decades</td>
<td>Cerebellar atrophy, axonal sensorimotor neuropathy, oculomotor apraxia</td>
</tr>
<tr>
<td>IOSCA</td>
<td>Rare (Finland)</td>
<td>Infancy</td>
<td>Decades</td>
<td>Peripheral neuropathy, athetosis, optic atrophy, deafness, ophthalmoplegia</td>
</tr>
<tr>
<td>Marinesco-Sjögren syndrome</td>
<td>Rare</td>
<td>Infancy</td>
<td>Decades</td>
<td>Intellectual disability, cataract, hypotonia, myopathy</td>
</tr>
<tr>
<td>Autosomal recessive spastic ataxia of Charlevoix-Saguenay (ARSACS)</td>
<td>Rare</td>
<td>Childhood</td>
<td>Decades</td>
<td>Spasticity, peripheral neuropathy, retinal striation</td>
</tr>
<tr>
<td>Refsum disease</td>
<td>Rare</td>
<td>1st-6th decade</td>
<td>Decades</td>
<td>Neuropathy, deafness, ichthyosis, retinopathy</td>
</tr>
<tr>
<td>CoQ₁₀ deficiency</td>
<td>Rare</td>
<td>Childhood</td>
<td>Decades</td>
<td>Seizures, cognitive decline, pyramidal signs, myopathy</td>
</tr>
<tr>
<td>Cerebrotendinous xanthomatosis (CTX)</td>
<td>1:50,000</td>
<td>Childhood to young adulthood</td>
<td>Decades</td>
<td>Thick tendons, cognitive decline, dystonia, white matter disease, cataract</td>
</tr>
</tbody>
</table>