Brain Resource Creation Workshop: Chapter 15 - Neurodegenerative Diseases

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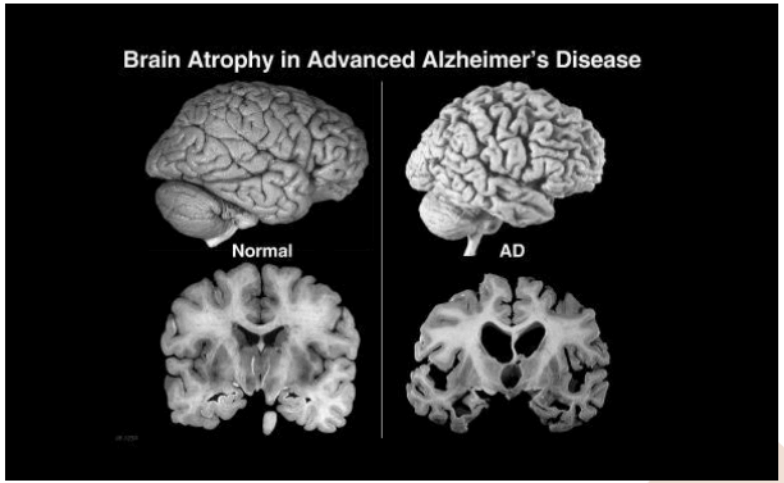
Neurodegeneration

- **Neurodegeneration** - progressive loss of nerve structure and function, which in turn leads to the loss of cognitive abilities such as memory and decision-making.
- **Neurons** - the building blocks of the nervous system, normally do not divide mitotically or replace themselves when damaged or destroyed.
- Neurodegeneration is a key aspect of a large number of diseases that come under the umbrella of "neurodegenerative diseases." Of these different disorders, the most notable are **Alzheimer's Disease**, **Parkinson's Disease**, and **Huntington's Disease**.

Alzheimer's Disease

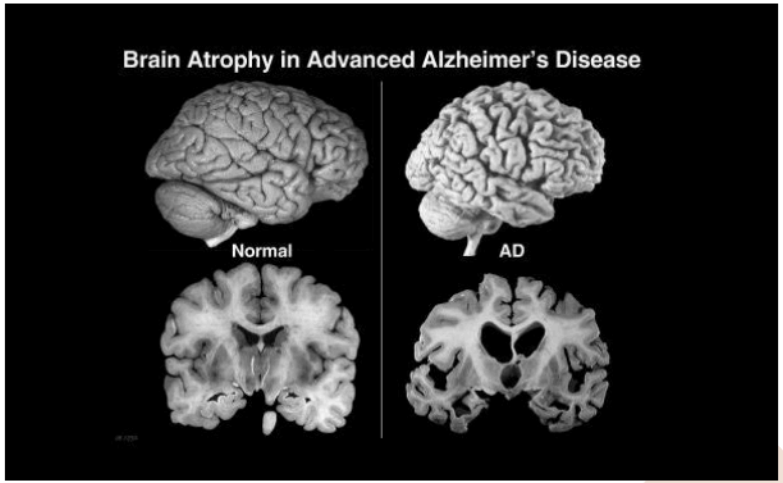
- Alzheimer's disease is a **progressive neurodegenerative disease** that mostly affects patients in their later stages of life. It is also the most common form of dementia.
- Typical symptoms of Alzheimer's include loss of cognitive functions including emotion, learning, and memory processing skills.



Source: ResearchGate

Alzheimer's Disease

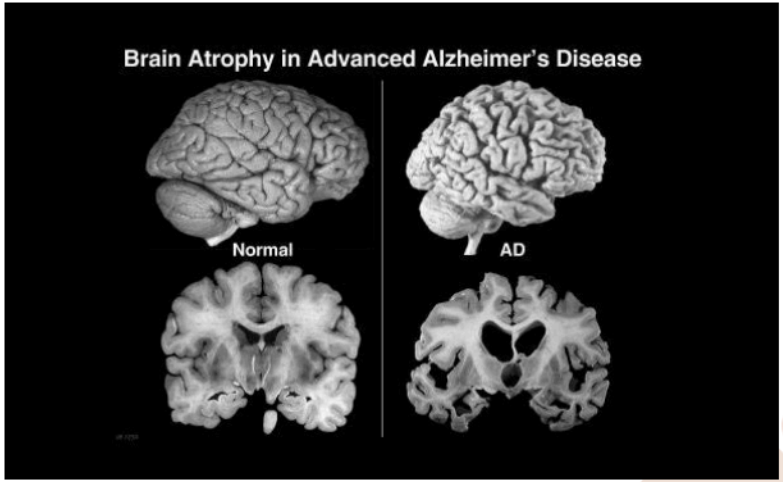
- Approximately 70% of the risk is believed to be genetically-based.
  - Additional risk factors include a history of head injuries, depression, or hypertension.
- The pathological impression of Alzheimer's can be characterised by the deposition of amyloid beta (Aβ) protein plaques in the brain tissue and the accumulation of tau proteins within neurons.



Source: ResearchGate

Alzheimer's Disease

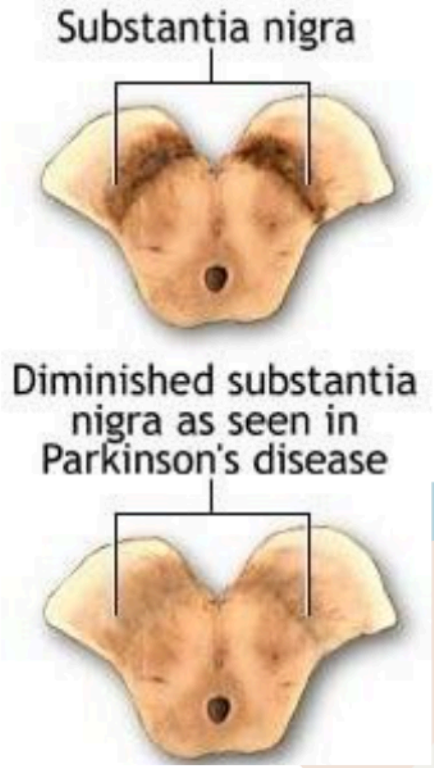
- Amyloid beta protein plaques interfere with **synaptic transmission** and **neuron-neuron communication**, leading to neuronal cell death.
- Tau proteins within neurons form tangles and block the transportation of nutrients and other vital cellular components throughout the cell, consequently resulting in **atrophy**, or cell death.



Source: ResearchGate

Parkinson's Disease

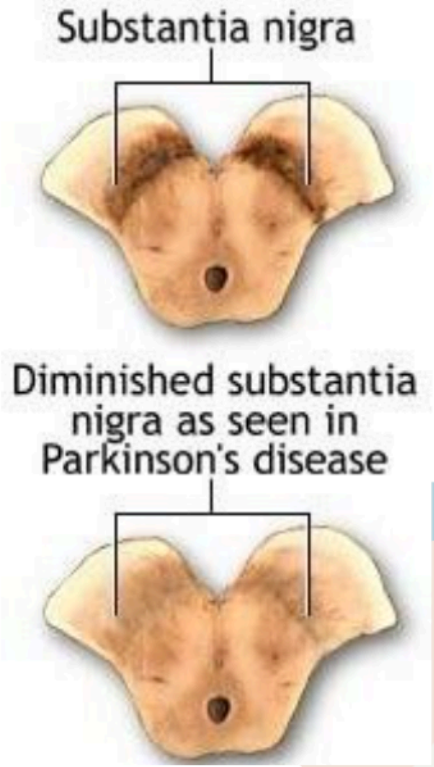
- Parkinson's is considered a chronic, progressive neurodegenerative movement disorder.
- It primarily causes the death of neurons in the *substantia nigra*, which plays an important role in reward and movement.
- Some of the neurons that are affected are tasked with producing **dopamine**, which acts as a messenger to communicate with areas of the brain that control movement and coordination.



Source: MedlinePlus

Parkinson's Disease

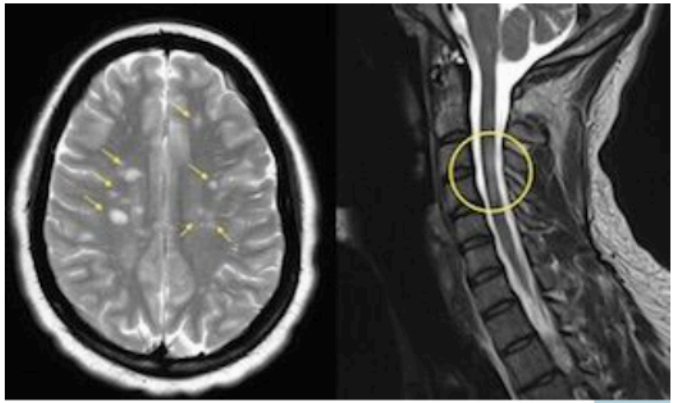
- As Parkinson's progresses, the amount of dopamine produced decreases, leaving the individual unable to control movement normally.
- Non-motor symptoms caused by Parkinson's include depression, sleep disorders, increased sweating, hypotension, difficulty sweating, and respiratory problems.



Source: MedlinePlus

Multiple Sclerosis

- Multiple Sclerosis (MS) is a chronic neuroinflammatory and degenerative disorder of the central nervous system (CNS) characterized by the demyelination of the brain and spinal cord.
- MS mostly affects people between the ages of 20 and 40.
- It is initially triggered by a virus in genetically susceptible individuals.

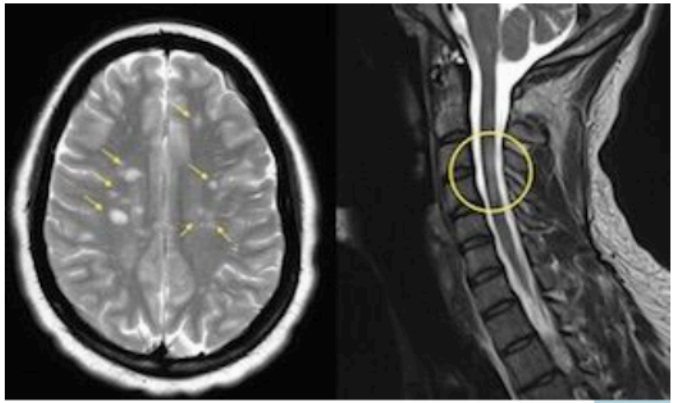


Source: St. Vincent University Hospital

Multiple Sclerosis

Symptoms of multiple sclerosis include:

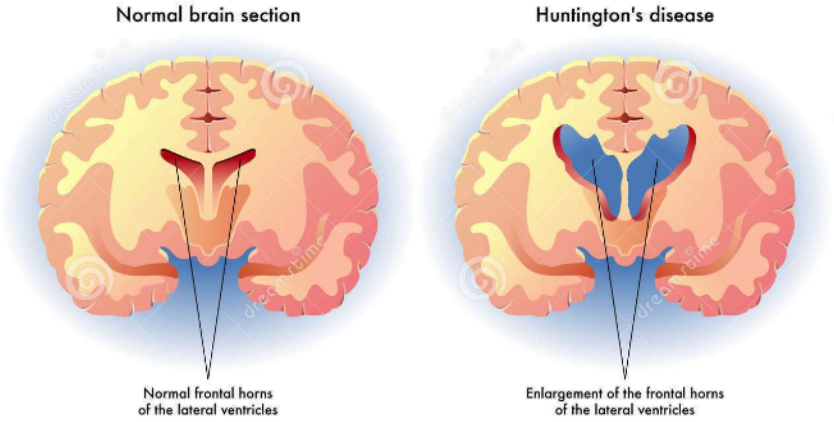
- Fatigue
- Depression
- Weakness
- Dizziness
- Ataxia
- Spasticity/tremors
- Double vision/vision loss
- Speech disturbance
- Bladder/bowel dysfunction



Source: St. Vincent University Hospital

Huntington's Disease

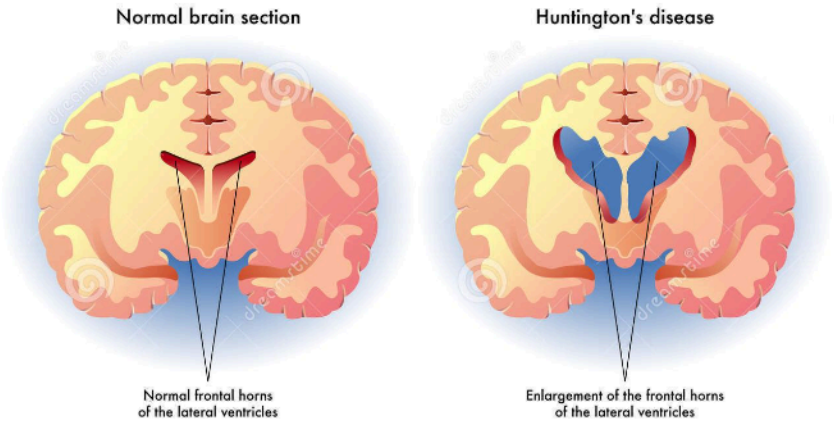
- Huntington's disease is a **rapidly progressive neurodegenerative** disease that leads to dementia.
- It typically presents itself through alterations in mood as well as a change in character and defects in memory and attention.
- It progresses to a movement disorder consisting of rapid involuntary motions.



Source: Healthdirect

Huntington's Disease

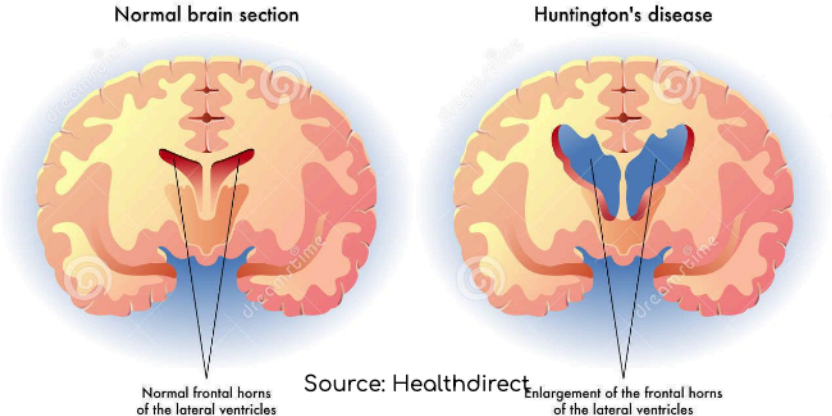
- Huntington's is rarely recognised until the patient has reached their early 30s.
- Huntington's is caused by an autosomal dominant mutation on either one of an individual's two copies of a gene known as Huntingtin, which means that any child of an affected parent has a 50% risk of inheriting the disease.



Source: Healthdirect

Huntington's Disease

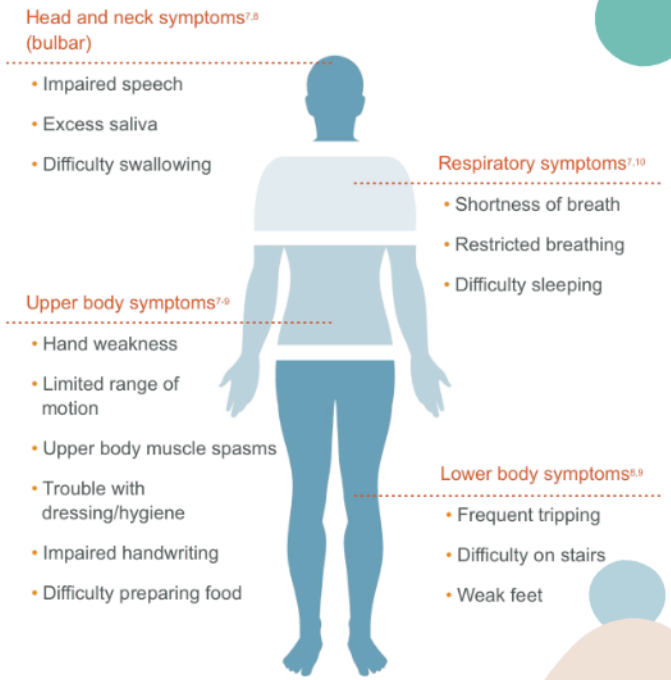
- As Huntington's disease progresses, it becomes difficult to concentrate.
- Individuals may have difficulty driving, keeping track of things, making decisions, answering questions, and may lose the ability to recognize familiar objects.
- Over time, judgment, memory, and other cognitive functions begin to deteriorate.



Source: Healthdirect

Amyotrophic Lateral Sclerosis

- ALS is a progressive, neurodegenerative disease characterized by weakness, twitching, cramping, and in advanced stages, paralyzation, dyspnea, and dysphagia.
- There are two categorizations: Sporadic (90% of cases) and Familial (10%)
  - The causes for sporadic are unknown
- Due to the death of the upper and lower motor neurons

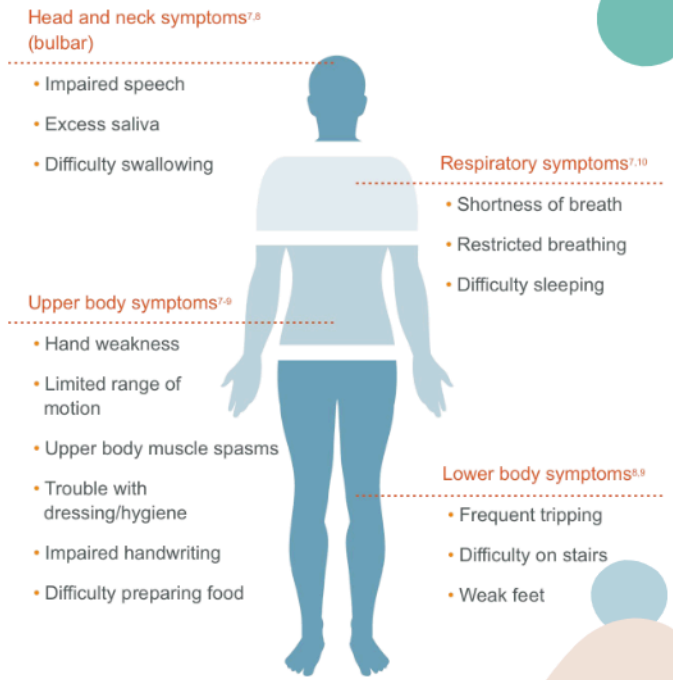


Source: ALSPathways

Amyotrophic Lateral Sclerosis

Two most common causes of familial ALS (FALS): overexpression of C9orf72 and the misfolding of the superoxidase dismutase (SOD1) protein.

- A healthy individual has C9orf72 expressed 2-23 times. In a FALS patient, it can be expressed thousands of times.
  - We don't know what C9orf72 does, which makes it difficult to treat
- When SOD1 is misfolded, they aggregate in the brain and kill motor neurons.



Source: ALSPathways

Diagnosis Activity

You'll be given a person and their symptoms. Your goal is to figure out which condition they have!

Patient #1

Case File

Name: James
Age: 30 years old
Symptoms: James has been experiencing some vision loss, and has been complaining about the dizzy spells he has been having. In addition, he has been having some speech disturbances along with weakness in his overall body.

Answer: Multiple sclerosis

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We hope you enjoyed the workshop!

Any questions?

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