

Neurodegenerative Outcomes and Selected Military Exposures

Perspectives on the Impact of Selected Military Exposures on Neurologic Outcomes: Listening Session

May 20 & 21, 2026

Neuromuscular System

Central nervous system (CNS)

Brain

Spinal cord

Peripheral nervous system (PNS)

- Upper Motor Neuron (UMN)**
Originates in the CNS (brain or spinal cord) and descends to the spinal cord
- Lower Motor Neuron (LMN)**
Originates in the spinal cord and travels to the muscles through peripheral nerves

Skeletal muscles innervated by lower motor neurons

Inclusion Body Myositis

Overview

- Chronic inflammatory muscle disease
- Progressive asymmetric weakness
- Estimated prevalence: 1-3/million/year

Symptoms

- Weak grip strength
- Difficulty climbing stairs
- Frequent falls
- Difficulty swallowing



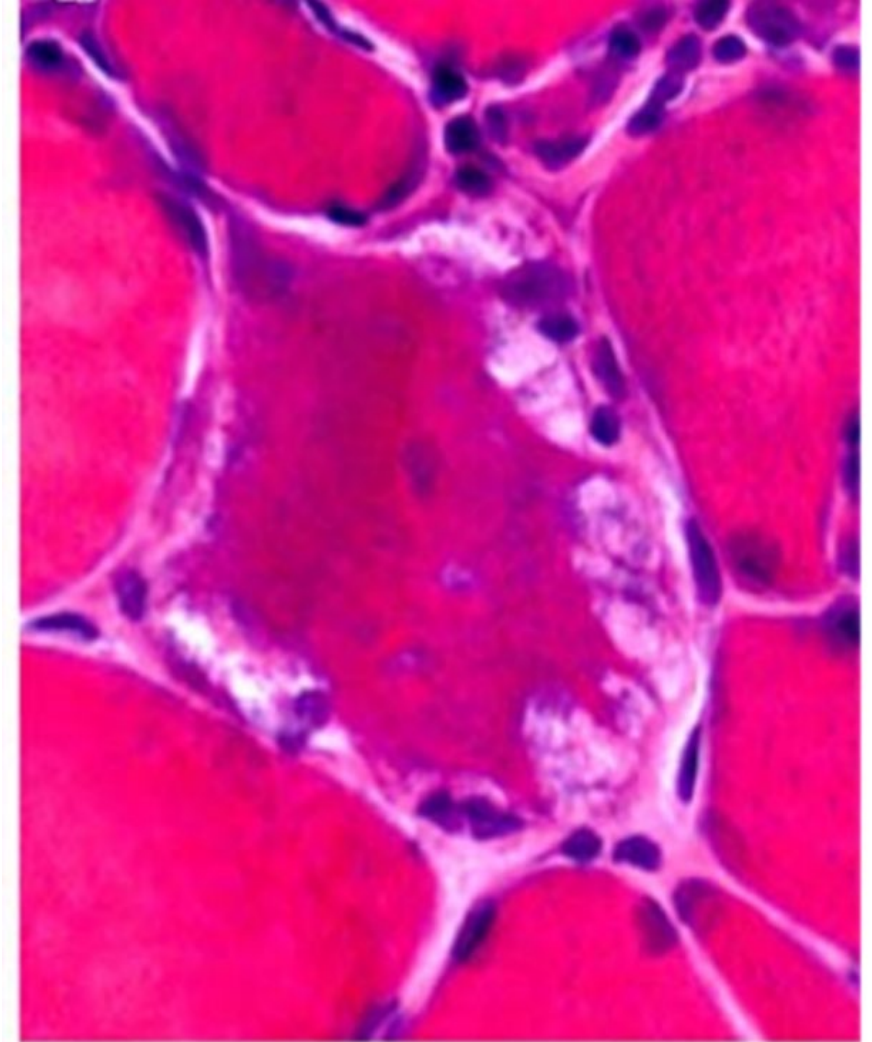
Inclusion Body Myositis

Causes

- Combination of inflammatory processes and degenerative protein accumulation
- Abnormal protein inclusions in muscle fibers

Treatment

- No effective disease-modifying therapies
- Limited response to disease modifying therapy
- Symptom management



Primary Lateral Sclerosis

Overview

- Rare progressive motor neuron disease
- Affects upper neurons
- Estimated incidence: 1/million/year

Symptoms

- Muscle stiffness
- Slow, effortful movement
- Balance difficulty
- Speech changes



Primary Lateral Sclerosis

Causes

- Mostly sporadic
- Possible genetic contribution
- Mechanism: Upper motor neuron degeneration

Treatment

- No cure
- Symptom management
- Multidisciplinary care



Peripheral Neuropathy

Overview

- Damage to peripheral nerves
- Can affect sensory, motor, autonomic nerves
- Estimated prevalence: 1/1,000/year

Symptoms

- Numbness/tingling
- Burning or shooting pain
- Weakness
- Autonomic dysfunction



Peripheral Neuropathy

Causes

- Metabolic
- Toxic
- Genetic
- Infectious/autoimmune

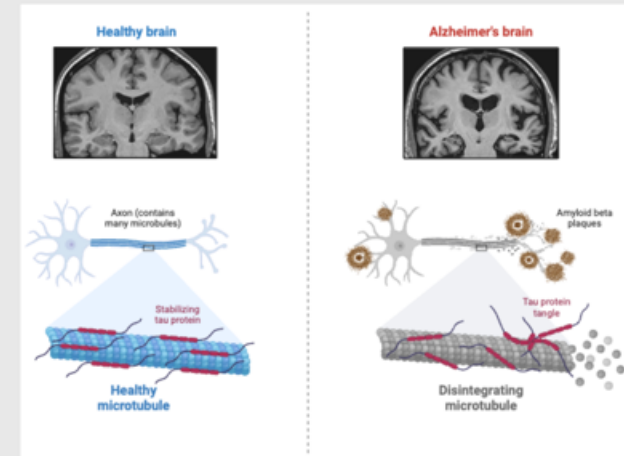
Treatment

- Treat underlying cause
- Pain management
- Lifestyle and physical therapy



Alzheimer's Disease and Other Dementias

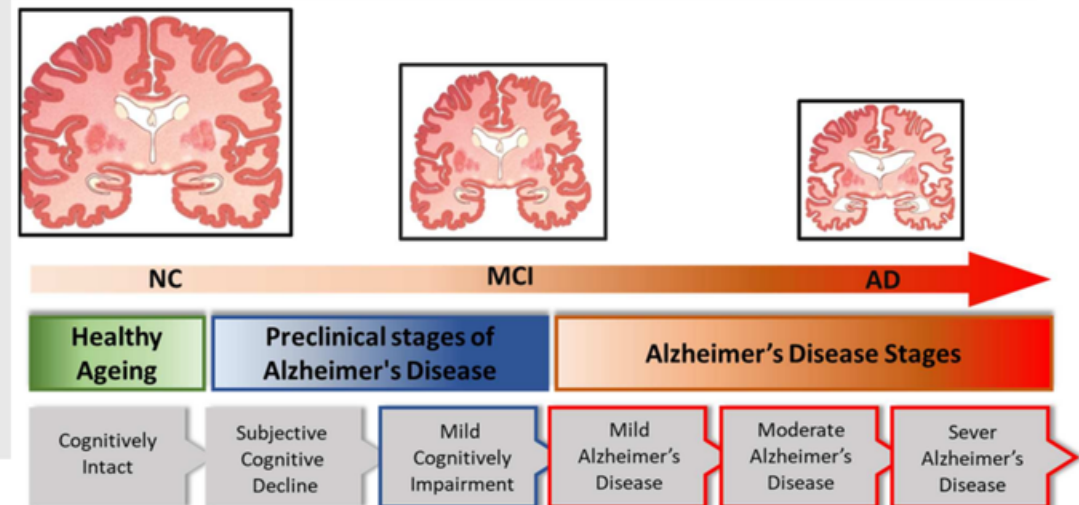
- Dementia:
 - Clinical syndrome associated with decline in memory and other cognitive domains (eg executive functions, visuospatial, language) that are sufficient to impair function
 - Many causes
- Alzheimer's Disease = most common cause
 - Disease state characterized by specific neuropathologic changes with onset in areas of most vulnerability (Hippocampus)
 - Amyloid Plaques
 - Tau Neurofibrillary Tangles
 - Multistage process that can progress across decades
- Other Dementia Variants -
 - Different protein accumulations
 - Different regional vulnerabilities



-Nearly 7M Americans living with AD

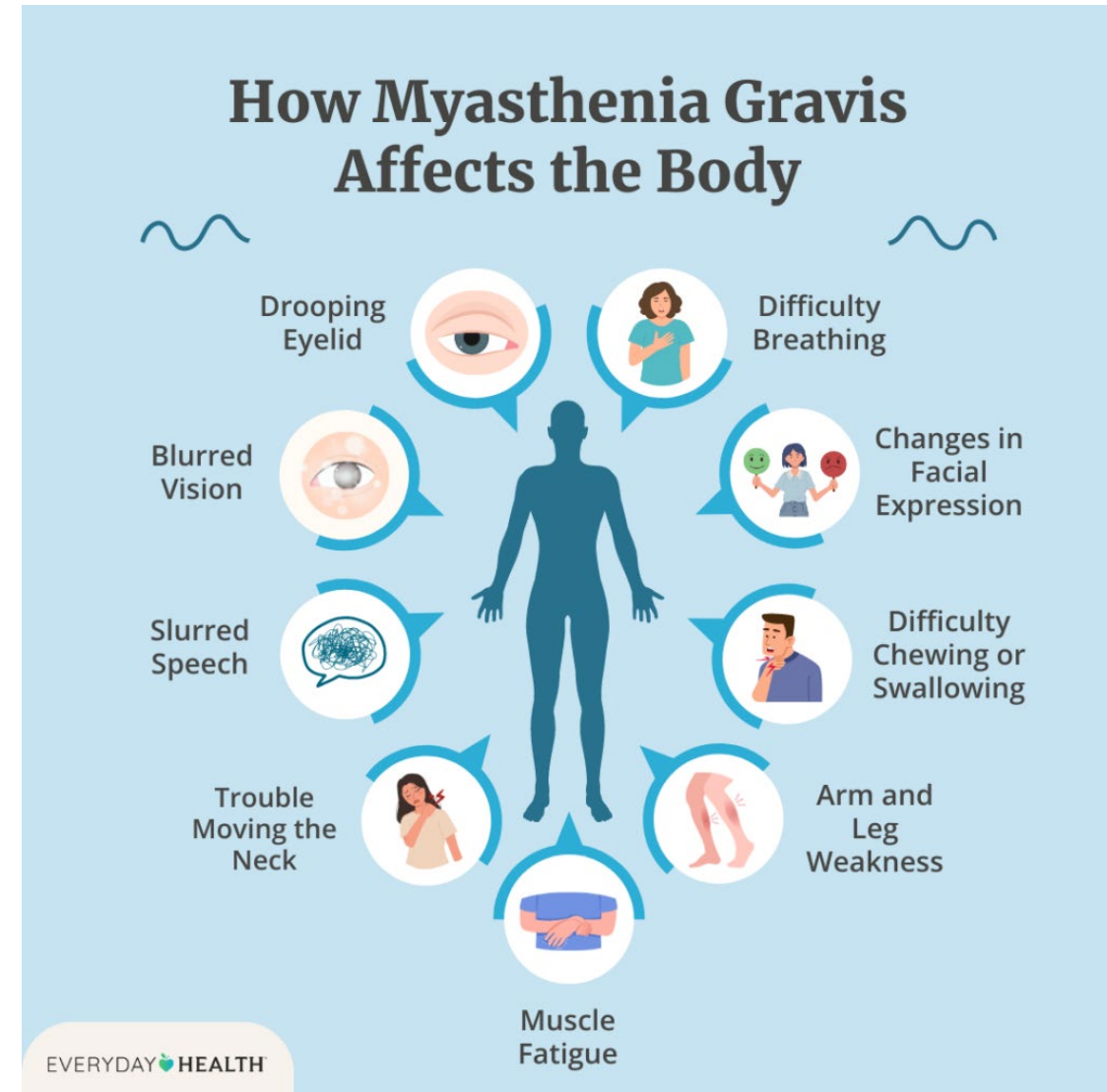
-Incidence doubles every 5 years after age 65
 Ages 65 – 74: 5.
 Older than 85: 32%

6th leading cause of death; 5th leading in > 65 years



Myasthenia Gravis: chronic, autoimmune disease

- Caused by abnormal antibodies that target the strength of voluntary muscles
- Specific blood test used to make the diagnosis
- Weakness that worsens with repetitive use
 - Wake up feeling fine, by the end of day eyelids droopy
- ~21 newly diagnosed people per million year
 - Early onset <50 higher in women
 - late onset >65 higher in men
- Risk factors:
 - Other autoimmune diseases
 - Thymoma -10-20% of people with MG
- Excellent treatments are available



Neuromyelitis Optica Spectrum Disease (NMOSD)

- Chronic, relapsing autoimmune disease
- Caused by antibodies that target a specific protein (aquaporin-4) highly concentrated in optic nerves and the spinal cord – optic neuritis and transverse myelitis
- 2-3 newly diagnosed people per million each year
 - Usually starts age 35 and up)
 - Specific blood test to make the diagnosis
- Risk factors:
 - 85% are females
 - highest in Black followed by Asian then Hispanic women
 - Other autoimmune diseases
- Excellent treatments are available

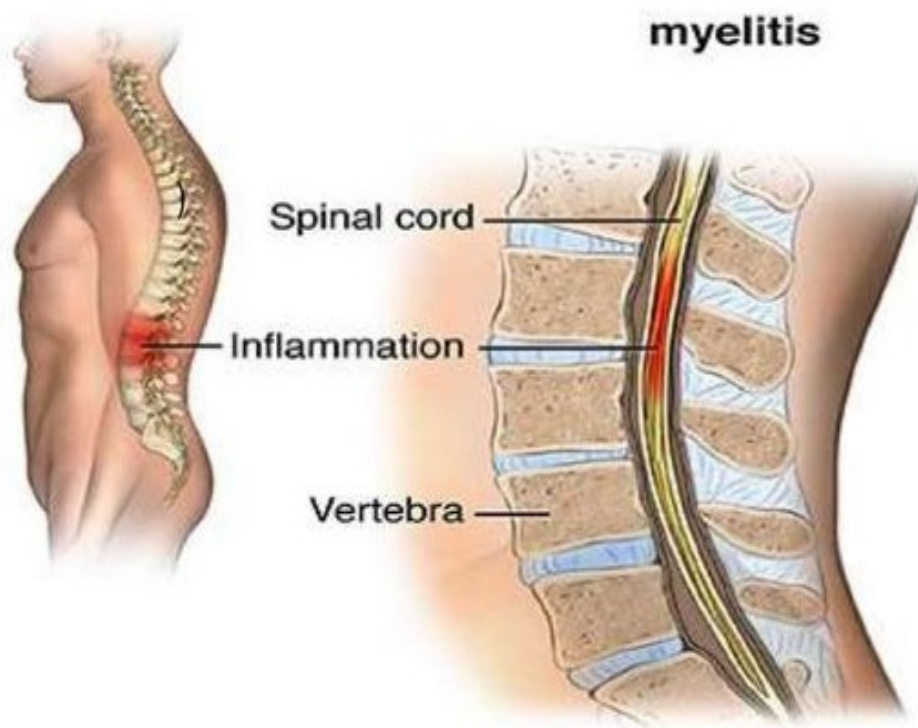
50% with blindness or paralysis and 32% die over 5 years if left un- or under-treated



Transverse Myelitis (TM)

Describes a condition that is caused by different things

- Specific autoimmune diseases like multiple sclerosis or NMOSD
- Triggered by infections
- Idiopathic Transverse Myelitis – when there is no clear cause – 1/3 of all TM patients
 - Usually a one-time event
 - 8 newly diagnosed people per million per year
- Common causes of misdiagnoses
 - failing to exclude other causes of spinal cord damage (i.e. not inflammatory etiologies)
 - Toxin exposures
 - nutritional deficiencies (vitamin B12, folate, copper, vitamin E)
 - Abnormal blood vessels, spinal cord strokes



Symptoms include

- Weakness
 - Impaired bowel and bladder function
 - numbness
 - Abnormal sensations like tingling, pain
- can be severe and leave permanent paralysis and/or bladder impairment

Parkinson Disease

- Parkinsonism refers to Motor Symptoms

Parkinson's Disease Symptoms



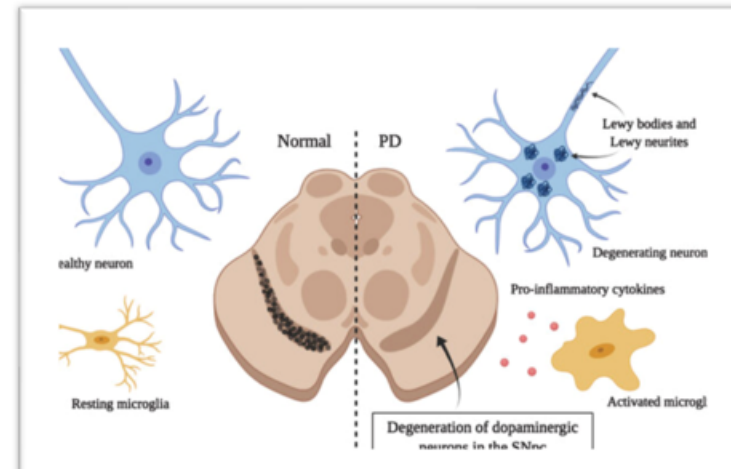
Figure from American Parkinson Disease Association

Can Also Have Variety of Associated Non-Motor Symptoms-
REM Behavior disorder, Constipation, Autonomic
Dysfunction, Anosmia, Cognitive,
Neuropsychiatric, Others



Varieties of Parkinsonism

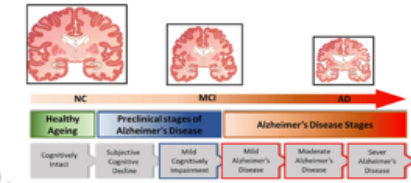
- Drug/Toxin-induced Parkinsonism
 - Eg Antipsychotics, MPTP, Manganese
- Vascular Parkinsonism
- Neurodegenerative Syndrome
 - Synucleinopathies
 - **Parkinson Disease (most common)**
 - Lewy Body Disease
 - Multiple System Atrophy
 - Tauopathies
 - Corticobasal Syndrome
 - Progressive Supranuclear Palsy



Pathology:
Degeneration of
DA cells in the
substantia nigra
due to
accumulation of
alpha-synuclein
into Lewy bodies

Figure Citations

- Healthy vs Alheimers:
Malik, Isra & Iqbal, Ahmed & Gu, Yeonghyeon & Al-antari - Aisslab, Mugahed A.. (2024). Deep Learning for Alzheimer's Disease Prediction: A Comprehensive Review. Diagnostics. 14. 1281. 10.3390/diagnostics14121281.



- Alheimers Pathology Image:
Team, B. (2026). **Pathology of Alzheimer's Disease 2**. <https://app.biorender.com/biorender-templates/details/t-5d8bcbc4cf5c120082948d64-pathology-of-alheimers-disease-2>
- Parkinson Pathology Image: Castonguay AM, Gravel C, Lévesque M. **Treating Parkinson's Disease with Antibodies: Previous Studies and Future Directions**. J Parkinsons Dis. 2021;11(1):71-92. doi: 10.3233/JPD-202221. PMID: 33104039; PMCID: PMC7990466.

