Survey Question

What is Multiple Sclerosis (MS)?

- Inflammatory disease of the brain, optic nerve, and spinal cord mediated by the immune system (likely autoimmune)
- Chronic; attacks of inflammation are called relapses or exacerbations
- Damages the myelin sheath of the nerve causing scarring (plaques or lesions)
- Scarring (sclerosis) is found in multiple areas, which gives the disease it’s name
Disease Mechanism

- Attacks of inflammation create scarring on the myelin sheath preventing transmission of nerve impulses along the fibers
- Scarring also causes axonal damage, which is believed to be the major cause of neurologic deficit

Statistics

- Most common inflammatory condition of the central nervous system (CNS)
- Approximately 350,000 – 400,000 people affected in the US; more than 2 million worldwide
- Risk in the general population is 1/750
- Most commonly diagnosed between ages 20 and 50; average age of diagnosis is 32
- Women are affected 2-3 times more frequently than men
- Men are more likely to have an aggressive form of the disease

Causes

- Environmental
  - People who live higher than the northern 40° latitude or below the southern 40° latitude
  - Research shows people who move to a lower risk area prior to the age of 15 acquire the risk level of their new home
Causes

- **Infectious**
  - Possibly due to an unidentified viral or bacterial agent

- **Genetics**
  - MS is not hereditary
  - However, risk is increased to 1/40 with a diagnosed first degree relative
Forms of MS

• Relapsing – Remitting
• Primary Progressive
• Secondary Progressive
• Progressive – Relapsing

Relapsing – Remitting

• Represents approximately 85% of people with MS
• Characterized by relapses / exacerbations that last days to months and followed by a period of remission
• Remission usually involves functional recovery
• Recovery can be to prerelapse level, but generally do not see full recovery

Primary Progressive

• Less common
• Affects 10 – 15% of people with MS
• Slow, gradual progression of disease without remission
• Seen more often in men
Secondary Progressive

• Approximately 50% of people with Relapsing-Remitting form will transition to Secondary Progressive after 10 years, and up to 90% after 25 years
• Relapses gradually decrease over time and convert to a slow progression
• Research shows a greater amount of brain atrophy in SPMS

Progressive – Relapsing

• Least common
• Affects approximately 5% of people with MS
• Starts with a progressive course followed by relapses / exacerbations without remission

MEDICAL DIAGNOSIS
Diagnosis

- No true definitive test for diagnosing
- A diagnosis of MS requires the following:
  - Evidence of plaques in 2 distinct CNS areas
  - Evidence of plaques occurring at distinct points in time
  - White matter plaques that have no other explanation

Medical Testing

- Magnetic Resonance Imaging (MRI)
  - 95% of newly diagnosed people have abnormal MRI
  - T2-weighted MRI images show plaques as hyperintense
  - T1-weighted MRI images show plaques as hypointense
  - Has been known to overestimate clinical relapses

Medical Testing

- Visual Evoked Potential
  - Damage to the optic system is commonly the FIRST symptom in MS (optic neuritis)
  - Demyelination and axonal damage cause a slow signal transmission to an externally applied sensory stimulus
  - Increase in time to respond
Medical Testing

• Lumbar Puncture
  – Cerebrospinal fluid analyzed
  – Identification of oligoclonal bands (bands of immunoglobulin), which indicates the body is attacking itself
  – Not a specific test for MS

SIGNS AND SYMPTOMS OF MULTIPLE SCLEROSIS

Signs and Symptoms

• No person with MS has a “fixed deficit”
• Each person has varying symptoms that change over time
• Symptoms are unpredictable
Signs and Symptoms

- **Fatigue**
- **Sensory Impairments**
  - Optic Neuritis
  - Dysesthesias
    - Tingling
    - Buzzing
    - Vibrations
- **Motor Systems Impairments**
  - Ambulation difficulty
  - Weakness
  - Spasticity
  - Ataxia
  - Tremor
  - Imbalance

- **Bladder Dysfunction**
- **Bowel Dysfunction**
- **Sexual Dysfunction**
- **Dizziness / Vertigo**
- **Cognitive Impairments**
- **Heat Intolerance**
- **Depression**
- **Pain**
- **Speech / swallowing problems**

Fatigue

- Most common complaint
- Affects up to 80% of people with MS
- 40% of people with MS state this is the most disabling symptom
- Primary fatigue (lassitude) is caused by effects of demyelination and axonal degeneration
- Secondary fatigue results from deconditioning, poor sleep, poor nutrition, medication side effects, heat intolerance
Medications

• Amantadine (Symmetrel)
• Provigil (Modafinil)

Ambulation Difficulty

• One of the most common mobility limitations
• Usually a result of ataxia, spasticity, weakness, and imbalance

Ataxia

• Occurs in up to 80% of people with MS at some point in their disease process
• Motor deficits occur as a result of disturbances in the vestibular system or cerebellum
Medications

• Ampyra
  – Approved in 2010
  – Not a disease modifying agent, rather a symptom management medication
  – In clinical trials, it was shown to improve walking speed by 25% in all forms of MS
  – Works by blocking the potassium channels on the nerve, which is shown to improve nerve conduction temporarily
  – Side effects: headache, back pain, sleep disturbance, dizziness, nausea, increased UTI risk

Weakness

• Can be due to damage of myelination and axons of motor and premotor neurons in the CNS
• May also be due to deconditioning and muscle atrophy
• Can manifest as
  – Monoparesis
  – Paraparesis
  – Hemiparesis
  – Quadriparesis

Spasticity

• Reported by 84% of people with MS
• 34% state their spasticity is moderate to severe
• Can cause secondary problems such as skin breakdown, pain, muscle contractures, and sleep disturbance, further limiting physical performance
• Velocity dependent
Medications

• Baclofen
  – Most commonly used for treatment
  – Muscle relaxant that works on nerves in the spinal cord
  – Oral or intrathecal pump
  – Side effects: drowsiness, feeling of muscle weakness

• Zanaflex (Tizanidine)
  – Muscle relaxant that works quickly
  – Side effects: dry mouth, sedation

• Botox (type A)
  – Localized vs systemic
  – Expensive
  – Side effects: muscle weakness, requires additional dosing every 3 months

Imbalance

• 50% of people with MS report falling one or more times per year
• Usually a result of sensory impairments in visual, vestibular, and somatosensory input
• Decreased postural control from reduced motor output and central processing

Dizziness / Vertigo

• Vestibular system involvement affects up to 20% of people with MS
• Can also be due to brainstem inflammation or cerebellum involvement
• May produce nausea
Medications

• Antivert (Meclizine)
  – Antihistamine that reduces motion sickness and nausea
  – Side effects: headache, dry mouth, drowsiness
• Scopolamine
  – Transdermal patch that decreases nerve signals to the stomach to prevent vomiting
  – Side effects: dry mouth, dry /itchy eyes, dizziness, restlessness, and memory problems
• Zofran (Ondansetron Hydrochloride)
  – Blocks the actions of chemicals that cause nausea and vomiting
  – Side effects: diarrhea, headache, fever, dizziness, drowsiness, constipation, blurred vision, and muscle spasms

Depression

• Estimated that up to 50% of people with MS will experience depression at some point during the disease course
• Associated with cognitive impairments, reduced quality of life (QOL), and poor compliance with MS medications
• Risk of suicide is 7.5 times higher in people with MS than in the general population
• Mortality rates are higher among depressed people than other comorbidities

Medications

• Antidepressants
  – Selective Serotonin Reuptake Inhibitors (SSRI)
    • Prozac
    • Paxil
    • Zoloft
    • Side effects: diarrhea, nausea, restlessness / agitation, headache, drowsiness
  – Serotonin and Norepinephrine Reuptake Inhibitors (SNRI)
    • Cymbalta
    • Effexor
    • Side effects: sweating, increased BP, dry mouth, increased HR, restlessness / agitation, headache, drowsiness
  – Norepinephrine and Dopamine Reuptake Inhibitors (NDRI)
    • Wellbutrin
    • Side effects: seizures with high doses, anxiety, agitation / irritability, difficulty sleeping
Pain

• Can present in various ways
  – Trigeminal neuralgia: stabbing pain in the face
  – Lhermitte’s sign: brief, stabbing, electric shock-like sensation that runs into upper extremities or back when flexing the neck
  – Dysethesias: tingling, burning, aching; sometimes feels like a constriction around chest or abdomen
    • Can be limited to small patch of skin or an entire extremity
  – Spasticity / Poor posture / Ill-fitting equipment

Medications

• Treated with anticonvulsants, but researchers are not sure how it works
  – Tregetol
  – Lamictal
  – Neurontin
• Can also be treated with antidepressants in some cases, which modify how the CNS responds to pain
  – Elavil
  – Cymbalta

Cognitive Impairments

• Affects 40% - 70% of people with MS
• Dysfunctions include impairments in short and long term memory, verbal fluency and memory, processing speed, attention, executive functioning, and visuospatial learning
• Can lead to unemployment and increased frustration, resulting in depression
Medications

• Aricept (donepezil)
  – Works by preventing the breakdown of acetylcholine in the brain
  – Side effects: nausea, vomiting, dizziness, sleep disturbance, fatigue, loss of appetite

MEDICAL MANAGEMENT

Physician

• It is important for a patient to have access to a specialist for Multiple Sclerosis
• Medications
• Manage relapses

• www.nationalmssociety.org
Medications for MS

• Disease-modifying agents
  – Help reduce disease activity and progression with relapsing forms of MS; includes secondary progressive
  – 3 types: injectable, oral, infused
  – Severe relapses may require 3 – 5 days of high dose, intravenous steroids to control the relapse quicker
    • Intravenous Solu-Medrol (methylprednisolone)
    • Oral Deltasone (prednisone)

Medications for MS

• Injectable
  – Avonex (interferon beta-1a)
  – Betaseron (interferon beta-1b)
  – Copaxone (glatiramer acetate)
  – Extavia (interferon beta-1b)
  – Glatopa (glatiramer acetate – generic equivalent of Copaxone 20mg dose)
  – Plegridy (peginterferon beta-1a)
  – Rebif (interferon beta-1a)

Medications for MS

• Oral
  – Aubagio (teriflunomide)
  – Gilenya (fingolimod)
  – Tecfidera (dimethyl fumarate)

• Infused
  – Lemtrada (alemtuzumab)
  – Novantrone (mitoxantrone)
  – Tysabri (natalizumab)
THERAPY EVALUATION AND TESTING

Subjective Evaluation

- Subjective
  - Hx of Illness / Current form of MS
  - Time of diagnosis
  - Current symptoms / complaints
  - Fall History in last 6 months
  - Limitations in ADL's (if in w/c, how long since they ambulated)
  - Current adaptive equipment
  - Previous Medical History / Comorbidities
  - Previous Medical Testing
  - Current medications

- Information that you get from your subjective evaluation should help determine if your focus will be compensation or restoration

Subjective Tests

- Depression
  - 2 question screen shown to be 98.5% sensitive in identifying major depressive disorder
  - (1) “During the past 2 weeks, have you often been bothered by feeling down, depressed, or hopeless?” (2) “During the past 2 weeks, have you often been bothered by having little interest or pleasure in doing things?”
  - Yes to either of these questions should create a phone call / referral to PCP for further assessment / treatment
Subjective Tests

- Fatigue
  - Modified Fatigue Impact Scale
    - Full length self questionnaire of 21 items; abbreviated version is 5 items
    - Takes approximately 5 – 10 minutes to administer
  - Fatigue Severity Scale
    - 9 item self questionnaire
    - Both determine severity of fatigue and how it interferes with daily function

- Quality of Life
  - Multiple Sclerosis Quality of Life – 54 (MSQOL-54)
    - Based on SF-36 with 18 additional questions specific to MS
    - Takes approximately 15 minutes to administer
    - Reliability is good to excellent in people with MS
  - Multiple Sclerosis Quality of Life Inventory (MSQLI)
    - Composed of 10 components from multiple tests
    - Takes approximately 45 minutes to administer
    - Good test-retest reliability in people with MS and cognitive dysfunction

Objective Evaluation

- Strength
- Range of Motion (ROM)
- Functional Mobility
- Fatigue
- Spasticity
- Dizziness / Vertigo
- Balance
- Gait
Manual Muscle Testing (MMT)

• Focus on gross strength, emphasizing function, to avoid fatigue with testing
• Test specific muscles that are problematic
• Can be difficult with spasticity
• May have proprioception loss

Range of Motion (ROM)

• Be sure to assess all joints in LE and / or UE depending on deficits
• Measure active AND passive ROM
• Limitations can affect functional mobility and treatment

Functional Mobility

• Bed mobility
• Transfers
• Wheelchair Mobility, if non-ambulatory
Fatigue

• Measure subjectively, but also with activity
• Can determine how long before fatigue sets in with testing and activity

Spasticity

• Can be measured with passive ROM
• Tests
  – Ashworth Scale
  – Modified Ashworth Scale
  – Excellent interrater reliability
  – Tests above only measure spasticity at rest, so will need to assess spasticity with movement

Dizziness / Vertigo

• Generally a central problem due to lesions in the pons (vestibular nuclei) or the cerebellum
• Could have lesions at the entry site of the vestibulocochlear nerve (CN VIII)
• Creates significant “spinning” dizziness, nausea, and imbalance
• More rare is Benign Paroxysmal Positional Vertigo (BPPV)
• In cerebellum, will also affect unconscious proprioception and balance
Balance

• 3 most common problems are response to postural perturbations, increased body sway in quiet standing, and inability to move outside base of support (BOS)
• Should assess seated and standing balance, as well as static and dynamic balance
• Individuals with cognitive impairments are 1.28 times more likely to fall than those without impairments
• One study showed up to 63% of people with MS had a fear of falling

Balance Tests

• Berg Balance Scale
• Dynamic Gait Index (DGI)
• Activities-specific Balance Confidence scale (ABC)
• Dizziness Handicap Inventory (DHI)

Berg Balance Scale

• 14 item scale that measures static balance and fall risk
• Excellent test – retest reliability
• Excellent interrater reliability
Dynamic Gait Index

- 8 items assessing gait in various tasks (gait speed, changing speeds, turning head, etc)
- Can be used with or without assistive device (AD)
- Excellent test – retest reliability
- Excellent inter and intrarater reliability

Subjective Tests

- ABC scale
  - 16 item self report measure on balance confidence in various situations
  - Excellent test – retest reliability
- DHI
  - 25 item self assessment inventory designed to evaluate self perceived handicap
  - Excellent test – retest reliability
- One research article showed ABC and DHI were good tools to discriminate between fallers and non-fallers and were good predictors of fall status in people with MS

Balance Tests

- Romberg with eyes open and eyes closed can be used as a basic balance assessment
- Firm surface with eyes closed would assess somatosensory input
- Foam surface with eyes closed would assess vestibular input
- Sensory Organization Test (SOT) is useful in identifying sensory contributions (visual, somatosensory, and vestibular) to static balance and response to perturbations
Gait

• Walking is almost always the primary goal of people with MS
• Observational gait analysis remains the “gold standard” for assessing gait quality
• Speed, distance, and quality should all be assessed
• Great opportunity to measure fatigue

Gait Tests

• 6 Minute Walk Test (6MWT)
• 25 Foot Timed Walk (25FTW)
• Dynamic Gait Index (DGI)
• Timed Up-and-Go (TUG)
• Multiple Sclerosis Walking Scale-12 (MSWS-12)

6 Minute Walk Test (6MWT)

• Recommended by the National Multiple Sclerosis Society (NMSS) as a measure of walking ability that is sensitive to change
• Can be performed with or without AD
• Rest breaks can be taken as needed, though time does not stop
• Score is total distance covered during 6 minutes walking at sub-maximal speed
• Excellent test – retest reliability
• Adequate to excellent intra and interrater reliability (not normed on MS)
25 Foot Timed Walk (25FTW)

• 25 foot walk is performed by walking quickly and safely to 25 foot point (point to point)
• Can be performed with or without AD
• Excellent test – retest reliability
• Excellent intra and interrater reliability

Dynamic Gait Index

• 8 items assessing gait in various tasks (gait speed, changing speeds, turning head, etc)
• Can be used with or without assistive device (AD)
• Excellent test – retest reliability
• Excellent inter and intrarater reliability

Timed Up-and-Go (TUG)

• Combines walking with transfers and turning
• Performed by standing from chair (timer starts when buttocks lift from chair), walking 3 meters, turning around, walking back to chair, and sitting down (timer stops when buttocks touch chair)
• Can be performed with or without AD
• Excellent test – retest reliability
• Excellent intra and interrater reliability
Multiple Sclerosis Walking Scale – 12 (MSWS-12)

- Subjective test of 12 patient rated items that measures perception of MS on walking ability
- Good reliability and validity

Observational Gait

- Relapsing Remitting

Observational Gait

- Primary Progressive
Observational Gait

• Secondary Progressive

THERAPY TREATMENT

Therapy Treatment

• MS varies so much, no one treatment works for every patient
• Must decide if focus is on compensation or restoration
• Compensation includes adaptive equipment to assist with inadequate or absent muscle power and function
• Restoration includes increasing overall function through strength, ROM, balance, and gait
  – Can use adaptive equipment to assist (i.e. bracing, assistive devices)
Therapy Treatment

• Should focus to maximize and maintain function so that the patient can participate fully in all aspects of their lives
• Must take into consideration physical AND cognitive abilities
• Treatment plans should be individualized

Strength and ROM

• Patient will benefit more from more functional exercises vs traditional exercises
• Range of motion is necessary for functional mobility
• One study demonstrated that an 8 week, 24 session, combined exercise program improved muscle strength and balance, while reducing disability

Fatigue

• Primary treatment should include energy conservation education (i.e. sitting while performing activities, frequent rest breaks, avoiding heat)
• Graduated exercise and cardiovascular endurance
  – Research shows energy cost is lower for low to mild levels of disability
  – One study suggests using %HR max as a good criterion for maximal exercise
  – Use of RPE to determine patient’s perceived exercise exertion and fatigue
• Cooling devices
  – Ice vests
  – Cooling wraps for the neck, wrists, and ankles
Spasticity

- People with spasticity have a higher cost of walking
- Many interventions are used widely in PT, but many do not have strong research evidence
- Education is very important in spasticity management

Spasticity

- Treatment options
  - Gentle ROM and stretching
    • MS Council for Clinical Practice Guidelines recommend that stretching occur for 60 seconds or longer, including prolonged stretching
  - Cold therapy
    • Can be applied in baths, towels, or cooling equipment
    • Research does not show any statistically significant difference with use of cooling therapy
  - Electrical stimulation
    • With exercise has been shown to decrease spasticity and improve strength (used FES bicycle)
  - Water therapy
    • Warm therapy pool works best to “relax” muscles

Dizziness / Vertigo

- Central Process (brainstem, cerebellum)
- Repetitive exposure leads to a reduction of symptoms to movement
- Exercises
  - Perform up to 4 movements that increase dizziness 2-3x, twice daily
  - Move fast enough to provoke symptoms
  - May take 4 weeks to 2 months to show improvement
- Must work on balance, as well
  - See Balance Treatment
Balance

• Must be individualized to the patient
• Focus on both motor and sensory strategies
• Balance (postural) strategies
  – Ankle strategy
  – Hip strategy
  – Stepping strategy

Balance Exercises

• To focus on somatosensory (proprioception) balance, then use firm surface
  – Eyes open
  – Eyes closed static
  – Eyes closed dynamic
  – Variable foot positions
    • Feet apart
    • Feet together
    • Semi tandem stance
    • Tandem stance

Balance Exercises

• One foot up on step
  – Static
  – Dynamic
• Touch back onto step
• Improve proprioception
• Mirror for visual cues
Balance Exercises

• To focus on vestibular balance, then use foam surface
  – Eyes open
  – Eyes closed
    • Static
    • Dynamic
    – Variable foot positions
• Ambulate with head turns
  – Eyes open and closed
  – Level and unlevel surfaces

Gait

• Exercise, in general, tends to improve gait
• Adaptive equipment and assistive devices may be used to improve functional gait
• However, research in elderly people showed an increase energy expenditure when using assistive devices
• Use of assistive devices can increase risk for falls if not used properly

Gait

• Adaptive equipment, such as AFO’s are beneficial to provide motion limited by weakness and ROM
• Many factors must be considered when using AFO’s or other bracing
  – Cognitive abilities
  – Assistance at home
  – Weight of brace
  – Ease of use
  – Cost
Gait

• Types of bracing
  – Ankle-Foot Orthosis (AFO)
    • Rigid
    • Gel hinged
    • Double adjustable
    • Functional Electrical Stimulation (FES)
  – Knee-Ankle-Foot Orthosis (KAFO)
    • Free swinging
    • Stance control

Rigid AFO

Semi-rigid AFO (posterior leaf)
  – very light, easy to don

Rigid AFO – limits ankle motion

Gel-hinged AFO

• Thick band of gel that allows ankle motion
• Many have a posterior stop to limit plantarflexion
Secondary Progressive Gait

• Gait with gel hinged AFO

Double adjustable AFO

• “Double” chambers to adjust dorsiflexion and plantarflexion assist or stop
• Heavy, and requires a certain amount of hip strength to lift and clear during swing
• Difficult to don, as ankle strap is generally needed to prevent slip in heel
FES
• Uses electrical stimulation to dorsiflex and evert foot, allowing for clearance
• Can be used with any shoe, and easy to don
• Requires some sensation
• Very expensive and rarely covered by insurance

Adjustments
• It’s helpful to have an orthotist that you work closely with
• Adjustments may need to be made regularly

KAFO
Free swinging
• No locking mechanism and requires patient ability to control stance

Stance Control
• Locking mechanism to control stance and prevent buckling of knee
Gait

- There are documented benefits to using body weight supported treadmill training
- Requires expensive equipment
- Can be modified with LiteGait over ground
- If bracing is required, use during treadmill training

Functional Activities

- Remember to focus on bed mobility, transfers, and functional activities along with strength, balance, and gait
- Train patients to assess skin and avoid pressure ulcers with reduced sensation
- *Education* is *KEY* in treating MS

“Other” Treatments

- Yoga
  - Good for flexibility and strength
  - Modify for limitations
- Water
  - Increased buoyancy to allow for improved mobility
  - Helps with spasticity
- Tai Chi
  - Excellent for balance and overall mobility
“Other” Treatments

• Group Exercise Programs
  – Multiple studies have shown that group exercise (strength, balance, stretching, and functional activities) benefits patients
  – Time frames from 8 – 12 weeks, 2 – 3 times per week, and moderate intensity
  – Improved flexibility, balance, fatigue, and strength
  – Some studies showed improved gait and stair climbing with ambulatory MS people
  – Reduced depression and improved quality of life

Goals

• Short term goals should be patient driven
• But…should be functionally focused, realistic, and attainable

Prognosis

• Factors predicting favorable outcome
  – Female
  – Onset prior to age 35
  – Single area of CNS involvement
  – Complete recovery after exacerbation
**Prognosis**

- Factors predicting unfavorable outcome
  - Male
  - Onset after age 35
  - Multiple areas of CNS involvement
  - Brainstem symptoms
    - Nystagmus
    - Tremor
    - Ataxia
    - Dysarthria
  - Poor recovery after exacerbation
  - Frequent attacks

**Documentation**

- ICD-10 codes
  - Multiple Sclerosis
    - G35
  - Muscle weakness
    - M62.81
  - Other abnormalities of gait
    - R26.89
  - Dizziness
    - R42

- CPT Codes
  - Therapeutic Exercise
    - 97110
  - Neuromuscular Reeducation
    - 97112
  - Gait Training
    - 97116
  - Therapeutic Activities
    - 97530
QUESTIONS??