Parkinson Disease Exercise Prescription

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Learning Objectives

• 1. Participants will become familiar with evidence based exercise interventions to improve balance and gait and transfers in persons with Parkinson's disease
• 2. Participants will learn techniques people with Parkinson's disease can use to compensate for motor impairments
Parkinson’s Disease

• Quick review:
  • 2nd most common neurodegenerative disease
    – US- 50,000-60,000 new cases of PD are diagnosed each year
    – US -one million people who currently have PD
    – Worldwide- 4-6 million people (NPF)

• Clinical dx

• risk factors
  – Greatest is age
    • Median age of onset 62
    • 4-10% occur before 40 years
  – Genetics- Family history
    • Parkin gene (autosomal recessive)
      – Implicated in early onset (50% w/ family history, 15% w/out family history)
    • LRKK2 (autosomal dominant)
  – Environment
  – Men affected greater than women
Parkinson’s Disease

- Most affected cell are in Basal Ganglia
  - Automatic pilot (automatic motion in learned motor tasks)
  - Fewer neurons in substantia nigra leads to less dopamine released in the striatum
  - 50-60% of neuronal loss when motor symptoms first appear
Parkinson's Disease

- Movement disorder
- Decreased cortical excitability and motor cortical output
- Progressive
- Asymmetric
- Cardinal Symptoms
  - Tremor
  - Bradykinesia
  - Rigidity
  - Postural instability
UK PDS Brain Bank Criteria to dx PD

- Step 1. Diagnosis of a parkinsonian syndrome (1)
- Bradykinesia and at least one of the following:
  - muscular rigidity
  - rest tremor (4–6 Hz)
  - postural instability unrelated to primary visual, cerebellar, vestibular or proprioceptive dysfunction.
UK PD Brain Bank Criteria

- Step 2. Exclusion criteria for Parkinson's disease (PD)
- History of:
  - repeated strokes with stepwise progression
  - repeated head injury
  - antipsychotic or dopamine-depleting drugs
  - definite encephalitis and/or oculogyric crises on no drug treatment
  - sustained remission
  - negative response to large doses of levodopa (if malabsorption excluded)
  - strictly unilateral features after 3 years
  - other neurological features: supranuclear gaze palsy, cerebellar signs, early severe autonomic involvement, Babinski sign, early severe dementia with disturbances of language, memory or praxis
  - exposure to known neurotoxin
  - presence of cerebral tumor or communicating hydrocephalus on neuroimaging.
UK PD Brain Bank Criteria

• Step 3. Supportive criteria for PD
• Three or more required for diagnosis of definite PD:
  • unilateral onset
  • excellent response to levodopa
  • rest tremor present
  • severe levodopa-induced chorea
  • progressive disorder
  • levodopa response for over 5 years
  • persistent asymmetry affecting the side of onset most
  • clinical course of over 10 years.

• Reference:
• (1) Parkinson’s Disease. National clinical guideline for diagnosis and management in primary and secondary care. NICE full guideline.2006
# Motor and Non-Motor

**Motor**
- Cardinal Signs
- Masked face
- Flexed posture
- Festination of gait and speech
- FOG
- Dyskinesias
- Falls

**Non-motor**
- Depression
- Fatigue
- Constipation
- Orthostatic hypotension
- Pain
- Sleep disturbance
- MCI/dementia
- Loss of smell
Langston, W. Annals of Neurology Vol 59 No 4 April 2006
Hoehn and Yahr

- Staging of PD
- Higher score = greater impairment
Unified Parkinson’s disease rating scale UPDRS

• The UPDRS- part III – motor section
• The UPDRS-III is a collection of 14 items in which an experienced clinician assigns a numerical score, ranging from 0 (normal or no impairment) to 4 (unable to perform or complete).
• assesses the cardinal symptoms of PD: bradykinesia, postural instability and gait dysfunction, tremor, rigidity and akinesia
• Minimal detectable change 5 points
Functional Gait Assessment

- Reliable and valid
- 10 item test rated 0-3
- Maximum score 30
- Assess walking balance
- Minimal detectable change 4.2 points
- 18/30- optimum predictive for falls in PWP w/in 6 months post hospitalization (Yang et. al. Phys Ther 2014)
Timed up and Go

- Walking mobility skills
- Used w/ mild to moderate PD
- On command stand and walk at a comfortable and safe speed 3 meter turn and return and sit back down
- Minimal detectable change 3.5 sec in PD
- Score > 7.95 sec high fall risk
Functional Reach Test

- Maximum forward reach in standing w/out taking a step
- MDC 9 cm for PWP
- score <31.75 cm = high fall risk
Freezing of Gait Questionnaire

• Valid
• Self administered survey
• 6 item
• 5 point ordinal scale
• 0-24 (no symptoms to severe symptoms)
Lindop Parkinson’s Disease Mobility Assessment

- All tasks are scored on a 0-3 scale with 3 being the best score.
- Maximum score 30
- 6 tasks for assessing gait mobility
  - Maximum score 18
    - Sit to stand (assist)
    - TUG (timed)
    - Unsupported stand (timed)
    - 180 degree turn right and left (# of steps)
    - Walking through doorway (FOG)
- and 4 tasks for assessing bed mobility
- Maximum score 12
  - Supine to sit (timed and assist)
  - Sit to supine (timed and assist)
  - Rolling right and left (timed and assist)
Falls

- PWP have balance second strategy
- 2x as likely to fall compared to other neurological conditions
- Fall incidence 38-60%
- 60% of falls occur during medication ON phase
- 70% of PWP who fall do so recurrently
- Recurrent fallers reported 4.7 to 67.6 falls per year
Treatment

• Medications/Pharmacology
  – Carbidopa/levodopa (Sinemet®)
  – Dopamine Agonists
    • Bromocriptine
    • Pramipexole (Mirapex)
    • Ropinirole (Requip)
    • Rotigotine (Neurpo)
    • Apomorphine injectable (Apokyn)
  – COMT inhibitors
    • Increase Levodopa “on” time 1-2 hours
    • Entacapone (Comtan)
    • Tolcapone (Tasmar)
Treatments

– Monoamine Oxidase Type B Inhibitors (MAO-B)
  • Selegiline
  • Rasagilint (Azilect)
  • Delay levodopa metabolism
  • Use to help manage levodopa wearing off
  • Monotherapy use for mild symptoms

– Anticholinergics
  • Limited effects for tremor
  • Side effects – confusion, dry mouth, urinary retention, blurred vision, constipation

– Amantadine
  • Usual early in PD
  • Mild antiparkinsonism action
  • Later PD may decrease dyskinesias
  • Side effects dry mouth, confusion, constipation, insomnia, agitation, hallucinations, liver disease
Medication: On/off times

• Need to consider the on and off times of medication when testing, retesting and treating

• Therapeutic window of medication narrows as disease progresses and control of symptoms is difficult w/out causing side effects.

• Exercise can augment the therapeutic window
http://www.wearingoff.eu/wearing-off
Treatments

• Surgery
  – Pallidotomy
  – Thalamotomy
  – Deep brain stimulation
  – Experimental - Neurotransplantation

• Exercise-
Animal studies

- Compared 1, 2, and 3 month training pre saline or MPTP injection
- Significant loss of DA neurons w/ 1 and 2 month training 3 month training provided protection against neurotoxicity
- 1/3 and 2/3 of full running for 3 month group-restricted running had significant loss of DA neurons w/ 2/3 group showing partial protection

Animal Studies

• Mouse study compared saline, saline + EX, MTPT, MTPT + Ex
• Treadmill high intensity
• 6 weeks (5 days/week) to reach duration of 60 min/day and speed of 18–20 m/min.
• Behavior: MPTP plus exercise mice had similar maximal treadmill speeds as saline plus exercise mice in week 5 (MPTP plus exercise: 17.2 ± 3.6 m/min and saline plus exercise: 22.0 ± 1.5 m/min) and week 6 (19.2 ± 1.2 m/min and 22.2 ± 0.9 m/min, respectively)
• MPTP plus exercise mice had 48.8% increase in striatal DA-D2R compared with MPTP mice

LSVT® BIG

• Based on LSVT Loud
• Protocol program
• 16 sessions
• Individual 1 hour sessions
• 4 days a week/4 weeks
• Home exercise program
LSVT® BIG

- standard whole body exercises - multi-directional repetitive and sustained
- Functional movement and gait
- Maximal amplitude- BIG
- Shaping
- Focus on retraining the motor-sensory disconnect - how big the movements feel
LSVT® BIG

• Addresses bradykinesia
• Improved movement perception
• Recalibration of scaling of movement-
  Training of amplitude
• training of amplitude results in bigger, faster, and more precise movement
Compared LSVT BIG w/ Nordic walking w/ unassisted HEP
LSVT and Nordic walking received same total dose of therapist time (2x/wk x 8 weeks) 4-6 person group
HEP - HOME received a 1-hour
- instruction of training with practical demonstration and training. Exercises included stretching, high-amplitude movements
58 subjects H and Y I-III
Measure UPDRS III, TUG, 10 meter walk, PDQ -39

LSVT® BIG

- LSVT-BIG led to significant improvement in motor performance (UPDRS III score mean 5.05), timed 10 meter walk, and TUG in patients with PD.
- No significant difference in PDQ 39.
- UPDRS motor score did not improve in patients with training in Nordic walking or in patients receiving a single 1-hour-instruction for home training by a therapist.

LSVT® BIG

- 3 person case study H and Y I-III
- Pre and post test
  - FGA, TUG, FRT, FOGQ, UPDRS III, LPA, 9HPT,
- Results
- FGA- increased (did not exceed MDC)
- FRT – increased (2/3 achieved MDC)
- TUG – decreased (did not achieve MDC)
- FOGQ- improved in one subject
- UPDRS III- improved (2/3 achieved MDC)
- LPA (B) – ceiling affect at initial testing
- 9HPT- improved non-dominant hand (2/3 achieved MDC), no change in dominant hand
Video

- 71 year old man
Forced Exercise- Tandem bike

Rational- PD has decreased cortical activation and impaired sensory motor integration

- study compared forced use to voluntary ex. (10 subjects)
  - Comparison of self selected pedaling to forced use pedaling (30% greater than self selected)
  - 1 hour sessions 3x/wk x 10 wk “on medication”
  - 10 min wu and cd w/ 40 min main set ex
  - Intensity set at (60-80% of THR) (ACSM recommendations)

- Total work:
  - PWP- 25-30% of total work
  - Trainer 75% of total work

- UPDRS part -III motor @ baseline groups equal

Forced Exercise – Tandem Bike Results

- VO2 Max increased in both groups – exercise improves fitness improved
- UPDRS III score:
  - end of treatment FE significant improvement (35%) compared to baseline, self selected no change
  - End of treatment + 2 wks FE significant improvement (28%) compared to baseline
  - end of treatment + 4 wks FE non significant 5% improvement compared to baseline
- the grip-load relationship also tested (bimanual task)
  - Pre test - irregular and inconsistent from trial to trial.
  - Self selected pace exercise did not improve coupling of grasping forces for either limb.
  - FE after 8 wk - grip-load coupling of patients with PD became more linear,
  - Improved coupling of grasping forces persisted for the FE group 4 wk after exercise cessation.

Forced Exercise –Tandem Bike/Results

- MRI- blood flow activation patterns
- off meds, on meds, post FE off meds
- 9 subjects studied
- Areas examined: bilateral putamen, globus pallidus, thalamus, primary motor, and supplementary motor area
- Imaging data indicate a significant correlation between FE and medication for regions in the basal ganglia and cortex.
- UPDRS-III ratings decreased 35% after FE and 32% on medication compared with off medication
Forced Exercise-Tandem bike

• Results:
  – Forced-exercise group pedaled 30% faster and produced 42% less work compared to the voluntary exercise group
  – Tremor and handwriting had short term improvement
  – Improved sense of smell reported

• Albert, J., Exerc Sport Sci Rev. 2011
Recommendations for forced exercise

- Consult cardiologist and movement disorders specialist
- Ex at 65-85% of VO2 max HR or age determined
- Reduce resistance and increase rate
- Augment don’t replace voluntary effort
Treatment w/ Exercise

- Early intervention is important
- Pre-clinical phase – Neuro-protection
- Early to moderate phase – Neuro-repair
- Late phase – compensation
- Progressive aerobic training should be encouraged
- PD physical therapy programs should include structured, graduated fitness
- PD medication should be used to maximize the PWP ability to participate in physical activity and maximize physical fitness

Ahlskog JE. Neurology 2011;77:288-294
Sparx study

- Currently underway
- Funded by NIH
- Multicenter study – University Pitt, Chicago, Colorado
- To determine correct exercise intensity
- Comparing 60-65% max HR, 80-85% max HR to no exercise
- 4x/wk x 6 mos.
- Subjects: recent PD dx w/ no medication
  - Moore et al. Study in Parkinson Disease of Exercise (SPARX): Translating high-intensity exercise from animals to humans. Contemporary Clinical Trials
Compensation techniques

• Rhythmic Auditory Cues
  – Use rhythm to set cadence
  – Rhythm is interval perception
  – Rhythm allow for anticipation
  – Music
  – Metronome
  – Enhance and entrain a rhythmic movement pattern
  – Activate motor cortex and premotor cortex
  – Bypass the basal ganglia
  – Have to listen to beat while simultaneously performing the – difficult for dual task
Rhythmic Auditory Stimulation

- Thaut, Mov Disorders, 1996
  - 3 week training
  - No training, self paced, experimental
  - Experimental group improved step length and cadence
- McIntosh et. al. Move. Disorders 1998
  - Measured velocity pre, post and f/u
  - Decline in progress made at 4 wks
  - H and Y stage- 2-4
  - RAS : with prototype device
  - 3 week w/ device compared to no device
  - Cross over design w/ 6 week f/u testing
  - Cadence increased by 10% to 112-116 /min
  - Decrease freezing, step length increased by 4 cm, fall efficacy improved
  - Effects significantly decreased at 6 week f/u testing
Compensation techniques

• **RAS assessment**
  – Determine current cadence
  – Start rhythm at baseline step rate
  – Increase rate and observe gait quality, may need to decrease

• **Visual Cues**
  – Tapped lines in door way
  – “x” on floor
  – Laser pointer
  – Care partner foot to step over
Compensation techniques

• Tactile
  – Tap foot w/ cane
  – Care partner taps patient
Equipment

- Hiking Poles/Nordic walking
  - Increases energy expenditure by 30%
  - Reciprocal arm swing
  - Can help with joint pain
  - 6 wk program showed improved walking, balance and QOL scores
    - Movement disorder, 2008
- Buddy
  - Cues PWP when posture is excessively bent forward
  - Contains a metronome select audio and/or vibrate feedback.
- U-step walker
  - Heavy frame
  - Reversible brake
  - Laser pointer
  - Coded differently than other walkers/may not also cover W/C
- Theracycle
  - Motorized bicycle
  - Based on tandem bike forced exercise studies
www.theracycle.com
Other programs

• Artful Actions Movement and voice exercises are adapted from theater and dance – John Argue

• Parkinson’s Wellness Recovery (PWR)-research-based exercise techniques to target the specific motor and nonmotor symptoms of PD. Becky Farley, PT

• Help PD- constraint-focused agility exercise program Fay Horak PT
Resources

• NPF- http:www.parkinson.org
• Michael J. Fox Foundation- www.michaeljfox.org
• Parkinson Disease Foundation- www.pdf.org
• Davis Phinney Foundation- www.davisphinneyfoundation.org/
Happy Thanksgiving
Questions?


• Allen, N., Schwarzel, A., Canning, C., Recurrent Falls in Parkinson’s Disease: A Systematic Review. Hindawi Publishing Corporation Parkinson’s Disease 2013, article ID 906274, 16 pages http://dx.doi.org/10.1155/2013/906274


• Farley, G., Fox, C., Ramig, L., McFarland, D., Intensive Amplitude-Specific Therapeutic Approaches for Parkinson’s Disease Toward a neuroplasticity-principled Rehabilitation Model. Topics in Geriatric Rehabilitation. 2008;24:99-114.


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• PD workbook- The WEMOVE clinician’s Guide to Parkinson’s Disease, 2008