### Parkinson Foundation of the National Capital Area Symposium 2021

### "Freezing of Gait in Parkinson disease"

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### Freezing of gait (FOG)



### Outline

- Review the elements of "normal gait"
- Describe how PD might affect gait
- Review the symptoms of FOG
- Explain why some persons develop FOG
- Discuss management of FOG

### Bipedal gait: walking upright on two feet "evolution" or "intelligent design"?



# Evolutionary advantages of "bipedalism" (walking upright on two feet)

Anthropologists have speculated:

### Hands are freed to

- Carry objects
- Make tools
- Self defense

Improved thermoregulation Hunting Greater endurance



# The ability to walk safely without thought is a remarkable skill

- What is needed in order to walk?
- Equilibrium



ability to assume the upright posture and maintain balance

Locomotion

ability to initiate and maintain rhythmic stepping

## **Components of "equilibrium"**

"Righting reflexes"

ability to go from sitting or lying to standing

"Supporting reactions"

once vertical, the ability to maintain stance

- "Anticipatory postural reflexes" prepares body for intended actions
- "Reactive postural reflexes" reactive postural responses to maintain balance
- Rescue and protective reactions reaction to an unexpected perturbation



## **Components of "locomotion"**

- Gait initiation
- Stepping
- Stride
- Base
- Speed
- Turns



### **Brain circuits and gait**



### **Neural circuits for gait**



# How did your physician know you had Parkinson disease ?





#### Normal gait is "automatic": In many persons with Parkinson disease there is decreased "automaticity" of gait





### **Common gait symptoms in Parkinson disease**



- Difficulty arising from a deep chair
- Slower gait
- Involuntary acceleration ("festination")
- Shortened stride and "shuffling"
- Decreased arm swing on the more affected side
- Slightly stooped posture
- Slowed multi-step turning

## In many persons with Parkinson disease there is decreased "automaticity" of gait



### Why does this happen ?

The striatum is affected by Parkinson disease. This is the part of the brain that facilitates "complex sequences of movements"





# What treatment is recommended for every person with Parkinson disease ?



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## **EXERCISE** !

### **Exercise classes for Parkinson disease**



Long-term prognosis is improved in persons with PD who exercise regularly

- Enrollment in classes improves likelihood of compliance
- Significant social as well as physical benefits

### Medication (carbidopa/levodopa) improves gait in Parkinson disease



- Less difficulty arising from a deep chair
- Better speed and stride
- Less shuffling
- Improved sense of balance

## Carbidopa/levodopa does not stop working, and over the years continues to help people walk better.



#### However,

after a number of years some people with Parkinson disease might begin to experience episodes of "freezing of gait"

### What is meant by freezing of gait (FOG) ?

- **Brief episodes of:**
- very short inefficient steps or inability to take a step:
- When initiating gait or sustaining gait
- While trying to turn
- In restricted tight spaces
- "My feet transiently feel like they are magnetized or glued to a spot"



# "Freezing of gait": episodes where effective gait cannot be initiated or sustained.



- In many cases there are infrequent brief episodes of "freezing"
- In severe cases, "freezing" is a daily phenomenon with episodes recurring throughout the day

### When are patients likely to experience "freezing of gait" ?

"freezing" is often noted when:

**initiating gait** ("gait initiation failure") ("start hesitation")



## When are persons likely to experience "freezing of gait" ?

"freezing" is also often noted when:

Turning or changing directions ("turn hesitation")



## **Environmental triggers for FOG**



- Going through a doorway
- Walking in a crowd
- Confronting an obstacle in the path

### **Environmental triggers for FOG:** "restricted tight spaces and time constraints"



Trying to enter or exit an elevator or escalator can be particularly stressful for some patients.

### Freezing of gait hesitations with start / turns / passages



## Emotional triggers for FOG: "motor blocks" – inability to move

"motor blocks" and "freezing of gait" can be triggered by:

- Sudden stress
- Anxiety
- Being startled
- Being told to "hurry up"



## Triggers for gait impairment and "freezing of gait"



### "dual task" triggers:

- Walking and talking
- Distractions
- Carrying packages

Move mindfully – Avoid distractions!

### Concentration and focus will improve gait



Almost every day in the office I hear a care-partner say:

"He never picks up his feet and walks this well at home!"

# Patients with "freezing of gait" are usually able to rhythmically tap their feet while seated



but will be unable to produce rhythmic stepping while standing.

Freezing of gait is <u>not</u> due to weakness or lack of effort !

### What causes some people to develop "freezing of gait" ?



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Malfunction of the "automatic" motor program of gait Impairments in "set-shifting"

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### Freezing of gait is a circuit disorder



- Signals between areas of the brain must be highly synchronized
- Decoupling of cortical-subcortical signals diminishes effective stepping
- Impairment in cerebellar locomotor regions reduces gait automaticity

# Freezing of gait can occur in disorders other than Parkinson disease

If "freezing of gait" is a prominent symptom early in the course of the disorder, an alternative diagnosis should be considered!



# **Shuffling** and **freezing gait** might occur in many disorders besides Parkinson disease:

- Progressive supranuclear palsy
- Corticobasal degeneration
- Multiple system atrophy
- Vascular parkinsonism
- Binswanger's disease
- Drug induced parkinsonism
- Normal pressure hydrocephalus
- "progressive freezing gait"
- "orthostatic myoclonus"


# What are treatment options for freezing of gait in Parkinson disease ?



### In some cases "freezing" is related to "wearing off" or inadequate levodopa effect



### In some cases "freezing" is related to "wearing off" or inadequate levodopa effect:



## If this is the case: optimizing PD medication schedules to reduce or eliminate "off" time can prevent episodes of freezing of gait.

### **Options for treating motor fluctuations**

- Redistribute doses and timing of carbidopa-levodopa
- "protein redistribution diet"
- Long-acting carbidopa-levodopa
- Add a dopamine agonist
- Add "levodopa extenders": COMT inhibitor or MAO-B inhibitor

In carefully selected cases:

- "deep brain stimulation surgery"
- Continuous levodopa infusion into the intestinal tract (duopa)







# Brain circuits unrelated to dopamine also affect gait automaticity:



Brain circuits unrelated to dopamine also affect gait automaticity: in this case FOG can occur whether the levodopa effect is "on" or "off".

Unfortunately, when FOG occurs during periods of generally good mobility (the "on" state), medication adjustments or deep brain stimulation are less likely to be helpful.



**"freezing of gait" ("FOG") in PD** In summary:

- FOG sometimes occurs as an "off" phenomenon, and should respond to adjusting medication schedules.
  Unfortunately:
- FOG can also occur during a period of good general mobility ("on" state FOG) which is less likely to improve with medications or deep brain stimulation (DBS).



# Are there any new medicines for treating freezing of gait ?



**CAFFEINE 100mg/day** seems to reduce "freezing" in some cases, particularly those patients with brief "total immobility"

Caffeine and istradefylline are adenosine 2<sub>A</sub> receptor antagonists.

- ? Cholinesterase inhibitors
- ? Threo-DOPS
- ? Atomoxetine / methylphenidate



# Does choice of early treatment of PD alter the risk for developing FOG ?



- In two research studies, persons initially treated with dopamine agonists for PD had a higher risk of developing FOG than those who received levodopa
- Early treatment with MAOb inhibitors might be associated with a lower risk of FOG

## On a practical note, what should you do if your feet feel stuck in place and you cannot start walking?



## You should have a plan!

- Stand still and try to relax
- Count to 3, and then lift one foot higher than usual and try to take a big step (as if you are going to "march")

This usually "unfreezes" people so they can begin to move forward again.



"Festination" is also common in persons with "freezing"

## "propulsive gait"

### "involuntary acceleration"

small fast steps with forward displacement of the center of gravity, and the patient moves too quickly.



If this occurs:

 You must attempt to stop or "slow down"

## What is the next step in treating "freezing of gait"? (no pun intended)



### What is the next step in treating "freezing of gait"?



## **Physical Therapy**

Find a physical therapist with special interest and training in gait disorders and Parkinson disease.

## Physical therapy for freezing of gait

The "big program" (part of the LSVT "big and loud" program) focuses on intensive exercises of high amplitude movements and is a very popular approach.





### Physical therapy for freezing of gait in PD: ARTI: adapted resistance training with instability

ARTI is an intensive program designed using exercises of high complexity simultaneously requiring high cognitive, balance, and motor control performance:

- Dual task exercises
- Unstable devices
- Lunge exercises

Movement Disorders 2020; 35: 1607-1617 Movement Disorders 2021; 36: 152-163





### Physical therapy for freezing of gait in PD: ARTI: adapted resistance training with instability

ARTI was more effective than traditional motor rehabilitation in improving severity of FOG and improving quality of life

"ARTI is an innovative intervention resulting in improved gait automaticity in people with PD who have freezing of gait".

Movement Disorders 2020; 35: 1607-1617



## Physical therapy for freezing of gait

Randomized controlled studies of physical therapy for treating FOG have found benefit from:

- Visual cuing strategies
- Auditory cuing strategies
- Supervised slackline training
- Treadmill training
- Aquatic obstacle training



Visual cues may facilitate processing powers of the brain, and promote improved gait control.







#### There are many "gizmos", but there is no "gizmo" that works for everyone



Mike Tucker, 49, from Raleigh, NC demonstrates the NEXT STEP®

#### There are many "gizmos" but there is no "gizmo" that works for everyone



Laser canes and laser shoes and laser walkers can provide visual cues to reduce freezing of gait for some patients.

# "virtual reality glasses" are being studied as possible aids for persons with FOG



Figure 2. Smart glass for gait-aid and virtual visual pattern through samrt glassed

# Virtual reality glasses to reduce freezing of gait



# Rhythmic auditory cues can improve repetitive motor function and gait in PD



# Canes, walking sticks, standard walkers, or rollators may be appropriate in some cases







## Specialized walking devices might help persons with significant gait impairments.





Light projects from the module as RIGHT and LEFT alternatively.



Patient follows the light projection and walks

# Wearable electronic devices have been developed to monitor motor function in PD



### "wearable technology" might eventually lead to improved motor performance



#### **Novel treatments for FOG**



#### New targets for neuromodulation: the pedunculopontine nucleus



- The PPN modulates several functions, including planning voluntary movements and locomotion
- Deep brain stimulation of this target might improve gait in some patients

### **Experimental non-pharmacologic** treatment for FOG



- Transcranial magnetic stimulation techniques
- Spinal cord stimulation

**Evidence for benefit of these is "questionable".** 

#### What is the goal of treatment?

- To improve gait and mobility to the greatest extent possible
- To keep persons with Parkinson disease in the mainstream of life
- FINISH FINISH

To prevent falls

## **Preventing falls in Parkinson disease**

## Move mindfully at all times!

- Avoid distractions
- Avoid multi-tasking
- Wait for help or use assistive devices if necessary

Falls are more often caused by impulsiveness or lack of proper caution than lack of balance!



# I hope this information was of interest to you!



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If you would like more information about Parkinson disease and a free PDF copy of my "Parkinson Primer", contact me at: howdyweiss@aol.com
## Much has been accomplished, but much still needs to be done: In the near future we will "knock out" Parkinson Disease





