How Can Aerobic Exercise Improve Parkinson's Disease Symptoms?

Aerobic Exercise, Neuroplasticity, and Neuroprotection in Parkinson's Disease.

By Rebecca Comeau

Introduction

What is PD?

- Progressive neurodegenerative disease affecting the DA-ergic cells of the SNc[1].
- Symptoms are motor and cognitive
- Deficits proportional to disease progression[2]

Why Does it Matter?

- 2nd most common neurodegenerative disorder after Alzheimer's Disease[1]; severe impairments to quality of life and ↑morbidity[2]
- Current drug treatment (levodopa)[2] has limited benefit[2]

Why AEx?

- Epidemiological studies show AEx is protective against developing PD[2]
- Treats motor and cognitive symptoms[3]
- No detrimental side effects[3]; found to be safe for PD patients[2,3]
- Potential for sustained effect and progression prevention in animal models[2,4]

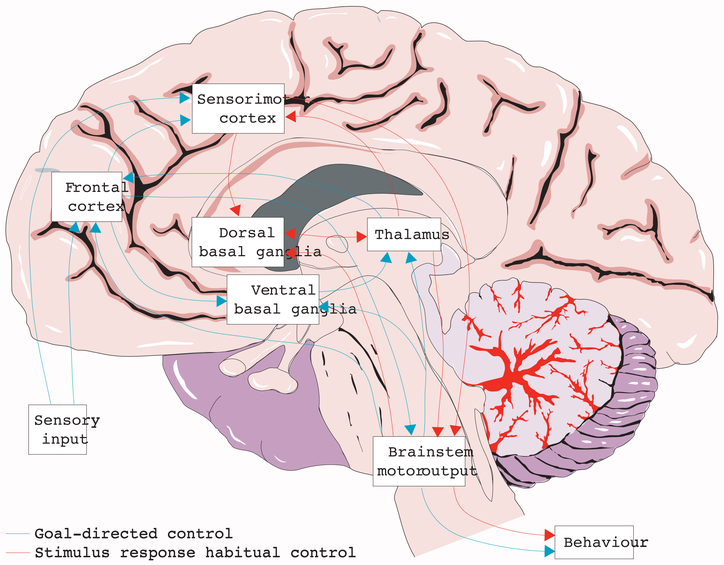

Figure 1. The basal ganglia-thalamic-cortical loops (cognitive and automatic) impaired in PD. From Petzinger *et al.* (2013).

Pathophysiology and Neuroanatomy

What's affected?

- basal ganglia-thalamic-cortical loop[4] --- *see Figure 1.*
- Precise etiology not known[2]
- Oxidative stress[4] and neuroinflammation implicated[5]

How does healthy brain function change?

- BG: ↓motor learning capacity, ↓automatic movement control, ↓cognitive contribution to voluntary control[3]
- SMA: ↓movement initiation, ↓bimanual and antiphase movements; posture[6]; cognitive impairments to mental flexibility and inhibition[2]
- Cortex: ↑ GLU-ergic activity on BG

Is Aerobic Exercise Effective?

Motor and Cognitive

- Tanaka *et al.* (2009): improved PD cognitive function post-intervention; fMRI data suggests improved PD frontal efficiency[7]
- Duschene et al. (2015): 3 week AEx program, improved cognition, automaticity, motor learning[8]

Vs. Medication

- Alberts *et al.* (2016): effects of acute forced exercise (FE) (30% greater than voluntary) --- *See Figure 2.*
- Forced exercise ensures optimal AEx benefits[3]

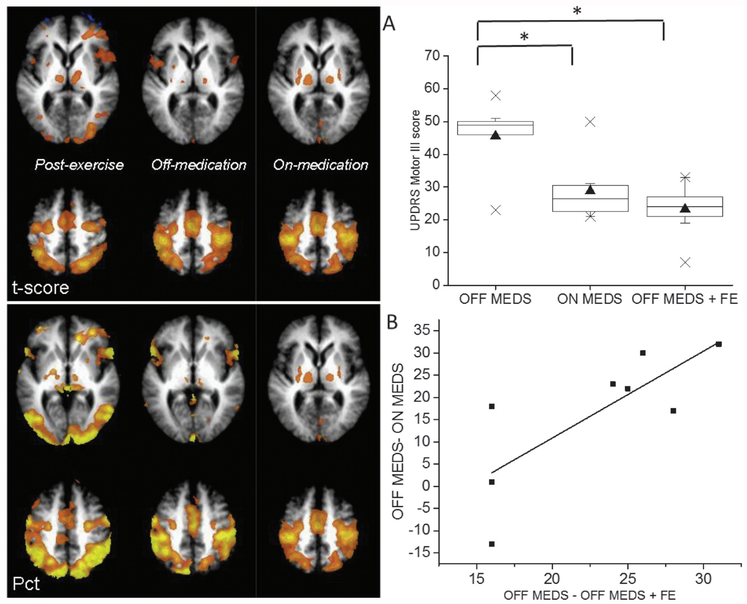

Figure 2. Response of PD patients to FE. From Alberts *et al.* (2016).

Why does Aerobic Exercise Improve PD?

Neuroplasticity

- ↑automaticity and motor learning[2,3,8]

Neuroprotection

- Wu *et al.* (2011): ↑BDNF release protects surviving SNc neurons

Neurorestoration

- Petzinger *et al.* (2010): changes to DA and GLU neurotransmission (availability, reception) improve motor and cognitive symptoms[10]

Inflammatory Response

- Kawanishi *et al.* (2010): pathological immune response cells[11] and cytokines change to anti-inflammatory activity[2]

Improved Brain Health

- ↑blood flow, angiogenesis, vascularization[2]

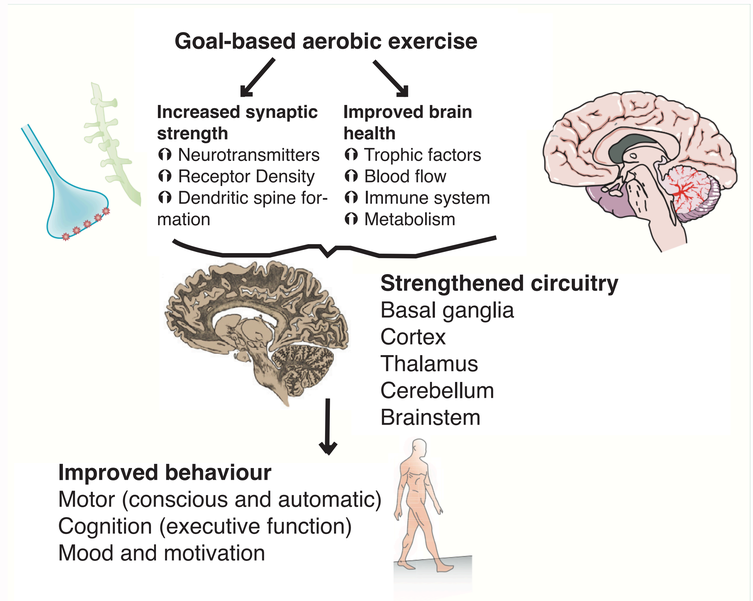

Figure 3. Exercise-induced benefits to PD. Adapted from Petzinger *et al.* (2013).

Conclusion

Summary

- PD affects many people, current treatments do not show sustained improvement or treat cognitive symptoms
- Growing evidence supports that AEx, particularly FE, has the potential to provide benefits drugs alone cannot
- Acute response to AEx is as good or better than medication
- AEx-induced benefits to PD include neuroplastic, neuroprotective, neurorestorative, and global anti-inflammatory processes

Recommendations

- Watch for studies currently underway on FX of chronic / long-term exercise
- FE at 60-85% HR_{max}, 3x/week is a promising treatment option

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