Cognitive and behavioral aspects of PD

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Overview

I. Cognitive changes in PD
II. Definitions of MCI and dementia in PD
III. Coping with cognitive loss
IV. Cognition and DBS surgery
V. Case presentation
Background

- Historically, PD largely considered a motor disorder
- Cognitive changes are among the most debilitating aspects of PD
- Cognitive changes can start early in the disease
- Lead to reduced job performance and contribute to loss of functional abilities (e.g. driving, cooking safely)
- The cognitive and secondary functional consequences can also create stress for families of affected individuals
Cognitive and behavioral changes in PD directly tied to pathophysiology

- Loss of DA projections → affect cortical-subcortical pathways
- Decrease in other neurotransmitter systems (e.g. widespread cholinergic deficits)
  - In PDD correlates with degree of cognitive impairment
- Development of Lewy Bodies in cortex and limbic structures
- Structural and functional imaging show widespread injury and dysfunction associated with PDD and PD-MCI
  - Correlation with cognitive impairment
- Other neurodegenerative disease of aging
Functional cortical-subcortical loops
Cognitive Deficits found in PD

- Bradyphrenia – slowing of cognitive processes
- Attention and Executive Deficits
- Memory problems
- Visuospatial Deficits
Cognitive functions related to the Prefrontal cortex: Executive Functions

- Planning and organization
- Decision making
- Reasoning and judgment
- Problem solving
- Anticipating consequences
- Knowing when to initiate a behavior and when it is no longer needed
- Divided Attention
- Creative thinking
- Regulation of other basic abilities such as attention, perception, language, and memory
Impairments in executive functions

- Problems with ‘mental flexibility’
  - No longer able to ‘multi-task’
  - Easily distracted by other things in the environment
  - Becoming overwhelmed by new or chaotic circumstances
  - Only seeking something ‘one way’
  - Getting stuck on certain ideas
- Disorganization and poor planning
  - Problems keeping up with finances (loosing important documents)
  - Problems keeping track of one’s schedule (e.g. missing appointments)
  - Difficulty prioritizing and sequencing tasks
- Poor judgment and problem solving
  - Not weighing the consequences
  - Making bad decisions at work, poor financial decisions
Other cognitive problems related to frontal-subcortical dysfunction

- Processing speed reductions
  - It takes longer to do tasks
  - Tasks are more mentally draining than they used to be
- Problems with apathy
  - Difficulty “getting started”
  - Difficulty following through with tasks
  - Watching TV for long periods of time
  - Not keeping up with hygiene
  - Does not = laziness
Language/Communication

• Word finding difficulty
• Increased slowness in responding during conversation due to difficulty organizing thoughts
• Difficulty tracking conversations
• Reduced spontaneous initiation of conversation
Memory

• 67% of pts with PD dementia have reported memory complaints (compared to 97% AD)
• A problem with retrieval rather than storage/consolidation
  • Relative preservation in ‘retention’ (e.g. improved recall with cues or recognition)
• Overall less severe than in AD
Spatial abilities

• Constructional/drawing tasks
• Difficulties with geographic orientation
• Getting lost while driving
• Difficulties with visual tracking and visual attention
The spectrum of cognitive function in PD

- Ranges from normal to severely impaired
- Generally correlated with disease severity but considerable variability
- Even newly diagnosed, untreated patients can exhibit subtle cognitive difficulties
- Ultimately, it is believed that essentially all individuals with PD will develop a dementia
  - Two prospective, long-term cohort studies found at least 80% of PD pts developed dementia
The concept of MCI in PD

- Mild Cognitive Impairment (MCI) originally identified in the context of prodromal AD
- Recent formalized criteria for PD-MCI: (Litvan et al., 2012)
  1. Inclusion criteria
     - Diagnosis of PD
     - Gradual cog decline in the context of PD reported by either pt, informant, or observed by the clinician
     - Cognitive deficits on either formal neuropsychological testing or global cognitive screen
     - Cognitive deficits not sufficient to result in loss of independence, although subtle difficulties on complex functional tasks may be ok
PD-MCI

- Point prevalence 20-30%
- Associated with increased risk of PD Dementia
  - 17-30% progressed to dementia over 5 year period
- Predictors of conversion: older age, non-tremor predominant phenotype, worse motor sxs on UPDRS
Subtypes of MCI in PD

• Four typically defined ‘MCI’ subtypes: single and multiple non-amnestic, single and multiple domain amnestic
• Single domain more common
• Non-amnestic more common
• Cognitive phenotype in PD are heterogeneous
  • Attention/executive may be most common
  • Posterior-cortical type profile common
  • Amnestic profile also possible
• Prognosis:
  • ?Posterior cortical impairment vs executive phenotype
Dementia in PD

• Point prevalence ~30%
• Time from PD dx to dementia average = 10 yrs (wide variability from 3-5 years to 20-30 years)
• Consensus dx criteria for Probable PDD: (Emre et al., Mov Disord, 2007)

Core Features:
1. Diagnosis of PD (motor symptoms clearly proceed dementia*)
2. Dementia syndrome with insidious onset and slow progression
   • Impairment in more than 1 cognitive domain (typical domains: impaired attention, impaired exec fx, visuospatial fx, and impaired memory recall which usually improves with cueing)
   • Represents a decline from premorbid level
   • Deficits severe enough to impair independent fx
• Extended criteria for probable vs possible PDD based on presences of associated neuropsychiatric features, typicality of cognitive profile, etc.

* When dx of dementia precedes or coincides with motor sxs → more likely Dementia with Lewy Bodies
Coping with cognitive loss: Compensatory strategies

• Use ‘external aids’
  • Use a daily ‘To Do’ list (helps to ‘getting going’ and what order to tackle things)
  • Break big jobs into little steps
  • Use a calendar (place in highly visible location)
  • Use alarms and reminders on smart phones
  • Keep a routine schedule

• Minimize distractions
  • Do only one thing at a time (limit radio and/or talking while driving, limit conversations and other distractions while cooking)
  • Work in a quiet location
  • One question at a time! (minimize stimulus overload!)

• Allow for extra time
Activities associated with improving or maintaining brain health

- Remain mentally engaged
  - Currently unknown which activities or ‘games’ are best
  - Active ingredients: learning new skills, moderately challenging
- Remain as physically active as possible
  - Many studies demonstrate benefits of physical exercise to brain structure and function
  - Consider physical activities that have a strong cognitive component (e.g. adapted tango class improved spatial cognition in PD, as well as executive function and balance)
- Remain socially engaged
  - Cognitive stimulation
  - Emotional support
All candidates for DBS undergo neuropsychological evaluation

Goal: to minimize risk of significant cognitive (and hence functional) decline after surgery

- Greater cognitive impairment → greater risk of decline

Few ‘absolute’ cognitive/behavioral contraindications

- Moderate to severe dementia
- Uncontrolled and severe psychiatric sx$s$

Each case reviewed individually in the context of the patient’s history
Potential cognitive changes after surgery

- Usually mild
- Most common: verbal fluency (e.g., rapid, fluent verbal output)
- Recent Meta-Analysis (Perestelo-Perez, J Neurology, 2013)
  - Global cognitive scales generally show subtle worse function than medication-only control group
  - No differences across DBS vs medication control in memory or spatial abilities
  - Mood generally improved
- Improvement in motor functions can ‘unmask’ cognitive deficits
- Psychiatric sx can worsen, in part secondary to surgery not meeting pt’s expectations
  - Critical to be clear about what sx the DBS will and will NOT help to improve
Case Presentations: Case 1

- Female, early 70’s
- Hx of PD for approximately 10+ years
- PD sx: Tremor predominant (L>R)
- Education: 16 years
- Primary occupation: teacher
Case 1

<table>
<thead>
<tr>
<th>Cognitive domain</th>
<th>Pre-DBS</th>
<th>Post-DBS</th>
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</thead>
<tbody>
<tr>
<td>Attention (digit span)</td>
<td>85</td>
<td>100</td>
</tr>
<tr>
<td>Processing Speed (Trails A)</td>
<td>86</td>
<td>94</td>
</tr>
<tr>
<td>Story Learning</td>
<td>115</td>
<td>110</td>
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<tr>
<td>Story Recall</td>
<td>100</td>
<td>110</td>
</tr>
<tr>
<td>Verbal fluency (semantic)</td>
<td>104</td>
<td>106</td>
</tr>
<tr>
<td>Verbal fluency (phonemic)</td>
<td>94</td>
<td>106</td>
</tr>
<tr>
<td>Visuospatial fx</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Executive (Trails B)</td>
<td>89</td>
<td>86</td>
</tr>
</tbody>
</table>

Standard scores mean = 100, SD = 15
- ≥110 = above average
- 90-109 = average
- <89 = below average
Case 2

- Mid-60 year-old female
- Hx of PD for about 10 years
- Hx of hallucinations with DA agonist
- PD sx at time of surgery: rigidity, falls, tremor, dyskinesias
- Education: 12 years
- Primary occupation: clerical
## Case 2

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<td>Verbal fluency (phonemic)</td>
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<td>84</td>
</tr>
<tr>
<td>Visuospatial fx</td>
<td>100</td>
<td>100</td>
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<tr>
<td>Executive (Trails B)</td>
<td>95</td>
<td>95</td>
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<tr>
<td>Mood (BDI-II – Raw score)</td>
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<td>0</td>
</tr>
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Standard scores mean = 100, SD = 15

$\geq 110 = \text{above average}$

90-109 = average

$< 89 = \text{below average}$
Case 3:

- Mid 60’s at time of surgery
- Education: master’s degree
- Occupation: High level management/professional
- Hx of PD for almost 10 years
- Primary sxs at time of surgery: tremor predominant
Case 3:

- Some transient confusion after surgery
- Once returning to work noticed some increased difficulty, after attempting some accommodations at work decided to retire

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