Clinical Assessment of Prefrontal Functions

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Disclosures

None related to presentation
Objectives

To discuss bedside assessment of prefrontal function with focus on:

- Cognitive and behavioural processes
- Underlying neuroanatomy

Key Messages

- Prefrontal regions mediate higher cortical functions
- Prefrontal functions are not equivalent to executive functions
Executive function

Task setting
• Left dorsolateral frontal

Monitoring
• Right dorsolateral frontal

Henri-Bhargava, Stuss, Freedman. Continuum 2018
Task Setting

Putting in place a plan in response to a stimulus or demand

eg

- Performing a cognitive task
- Learning how to drive a car
- Planning an event
Monitoring

Process of checking a task over time and adjusting behaviour as needed for successful completion

eg

- Not repeating numbers on clock drawing
- Tapping with a consistent beat
Clinical Examples

History

- Extremely important
- eg difficulty carrying out a novel task suggests problems with task setting

Bedside Mental Status Exam

- Clock drawing
- Multiple loops
- Alternating square and triangular figures
Other Measures of Executive Function

Digit span backward

- Task setting: Repeating digits backwards instead of forwards
- Monitoring: Repeating digits only once
- Working memory also involved (ability to consciously retain and manipulate information in the short term)
Other Measures of Executive Function

 Trails A
• Energization (speed) and some monitoring

 Trails B
• Monitoring and task setting (remembering to shift set)

 Phonemic fluency
• Energization but also task setting (eg don’t use proper names) and monitoring (avoid repeating same word)
Energization

Process of initiating and sustaining a response

Neuroanatomy

• Bilateral superior medial (SM), including anterior cingulate

Henri-Bhargava, Stuss, Freedman. Continuum 2018
Energization (Superior Medial)

Behavioural Observation

• Akinetic mutism at extreme end
• Reduced initiation and drive of motor or cognitive responses (apathy)

Cognitive Testing

• Phonemic word fluency (fewer words later)
• Slow to perform tests in general
Orbitofrontal Function

Important for evaluating outcomes & options for action

Patients with orbitofrontal lesions

- May perform well on neuropsychology tests
- Social cognitive deficits (examples)
  - a) Socially inappropriate
  - b) Poor judgement
  - c) Impulsive
  - d) Excess jocularity
  - e) Obsessions
  - f) Hyperorality
  - g) Personal neglect
56-year-old woman with bvFTD

- School teacher
- Recent change in behaviour

Video
Cognitive Test of Orbitofrontal Function

- Majority of clinical neuropsychological tests are sensitive primarily to dorsolateral frontal lesions
- Need clinical tests that are sensitive to orbitofrontal and medial frontal lesions
Object Alternation

In humans

- Sensitive to ventrolateral-orbitofrontal and medial frontal lesions
- BA areas 10, 24, 32, 47, and possibly 11

Freedman, Black, Ebert, Binns. Cerebral Cortex, 1998
Object Alternation Test

Processes

• Working memory for objects
• Ability to shift set
Frontopolar

Theory of Mind (ToM)
Awareness of
- Content of other people’s minds
- One’s own mental state

Premack & Woodruff. Behavioural and Brain Sciences, 1978
Freedman & Stuss. J of Neurological Sciences, 2011
Conclusions

• Different frontal regions subserve different cognitive functions:
  a) Dorsolateral: Executive (task setting and monitoring)
  b) Superior medial: Energization
  c) Orbitofrontal and Frontopolar: Social Cognition

• Executive dysfunction is determined by the nature of errors on cognitive tasks rather than simple performance on a specific task


