COGNITIVE IMPAIRMENT RECOGNITION, DIAGNOSTICS AND RECOVERY AFTER STROKE

James A. Young , M.D.

Objectives

- Examine the frequency of the condition
- Understanding the anatomy that can contribute to cognitive impairment
- Describe the negative prognostic factors for good recovery
- Explain the treatment options available

Disclosures

- None

Introduction

- Prevalence of stroke in an increasing aging population, mandates a clear understanding of predictors and outcomes months and years after the event
- Effects on patient, family, society
- The shortened lengths of stay, financial constraints, and variability of postacute hospitalizations, suggest a faster and more accurate assessment of the patient

Introduction

- Cognition involves
  - Attention (focusing, shifting or sustaining attention)
  - Executive functioning (abstract reasoning, organization, inhibition, planning)
  - Visuospatial abilities (visual searching, drawing construction)
  - Memory (recall and recognition of visual and verbal data)
  - Language (expressive and receptive)

Introduction

- Cognitive domains and their effect on daily living:
  - Neglect (inattention)
  - Agnosia (object recognition)
  - Apraxia (sequential activities and motor planning)
  - Abstract thinking (higher order informational use)
  - Arithmetic
- Effects of mood and physiology on cognition(fatigue, depression, and apathy)

Introduction

- Age matched groups suggest better and quicker improvements in a younger population
- Tests for "mild cognitive impairment" (MCI)
  - Mini-Mental State Examination (MMSE)
  - Neuropsychological tests
  - Barthel Index
  - Functional Independent Measure
  - National Institutes of Health Stroke Scale
  - Stroke impact Scale
- MMSE better for memory than executive dysfunction, others better for functional cognitive recovery

Introduction

- **Important to recognize the effects of prior strokes, deafness, physical disabilities precluding adequate testing, severe dysphasia, severe concurrent disease, and severe depression, along with pain and sleep interruption**
- Support system information, living arrangements, education, and prior level of independence are helpful markers
- Implications for rehabilitation, driving, and planning future needs and interventions (both medicinal and therapeutic)

Introduction

- It is generally believed that cognitive improvement is the expected outcome for those who do not develop dementia
- Up to 65% of individuals after stroke demonstrate cognitive impairments, but studies have focused on physical over cognitive improvements
- Effects of cognition severely impacted by diabetes (54% improvement with left hemisphere infarct versus 12% if diabetes present)
- Cerebrovascular or neurodegenerative diseases, or additional vascular insults at higher risk for additional decline

TABLE 2. Differences in Cognitive Profile Between Initial Assessments and Follow- Up in People Who Developed Dementia

	Dementia Cases		Significant Change in Dementia Group Between 3 and 15 mo After Stroke,* *P*
	3 mo	15 mo	
Orientation	9.4 (0.5)	8.0 (1.2)	0.02
Language comprehension	8.1 (1.1)	7.9 (0.9)	0.61
Language expression†	14.8 (2.2)	14.0 (2.1)	0.31
Memory total	19.4 (3.7)	16.7 (3.7)	0.015
Attention	4.8 (2.6)	3.3 (2.3)	0.11
Praxis	9.9 (2.6)	8.2 (3.5)	0.15
Calculation	1.6 (0.5)	1.4 (0.5)	0.41
Abstract thinking	4.7 (2.4)	5.5 (2.3)	0.34
Perception	6.5 (1.1)	6.5 (1.4)	1.00
Executive function	10.8 (3.5)	12.0 (3.7)	0.45
MMSE	25.4 (2.6)	20.7 (3.1)	0.004
CAMCOG total	79.2 (11.9)	71.5 (12.0)	0.09
Boston Naming Test	44.3 (8.9)	42.0 (11.5)	0.59
FAS	17.1 (14.3)	15.4 (11.9)	0.88

Values in parentheses are SD.

*Wilcoxon signed-rank test. †Mann-Whitney tests did not indicate any significant baseline differences between dementia and stable cases in baseline scores except for language expression (P=0.01) and number vigilance mean (P=0.032).

TABLE 3. Comparison Between Initial Assessments and Follow-Up Among Patients With Cognitive Improvement

	Improvers		Significant Change in Improvers Group Between 3 and 15 mo After Stroke,† *P*
	Baseline	1 y	
Orientation†	8.8 (1.2)	9.5 (1.2)	0.02
Language comprehension	8.1 (1.0)	7.8 (1.7)	0.60
Language expression	15.5 (3.0)	17.1 (1.6)	0.025
Memory total	20.3 (3.5)	21.3 (3.7)	0.05
Attention†	4.9 (1.7)	5.9 (1.6)	0.045
Praxis	10.3 (1.5)	10.3 (1.7)	0.78
Calculation	1.7 (0.5)	1.7 (0.5)	0.66
Abstract thinking	3.5 (2.3)	5.7 (2.1)	0.002
Perception	7.0 (1.4)	6.3 (1.6)	0.046
Executive function	10.8 (3.9)	14.22 (4.7)	0.01
MMSE	23.1 (2.5)	26.9 (2.8)	0.00
CAMCOG total†	79.1 (9.3)	85.7 (7.5)	0.00
Boston Naming Test	45.9 (6.8)	46.7 (9.4)	0.12
FAS	21.6 (11.1)	23.2 (12.7)	0.56

Values in parentheses are SD.

*Wilcoxon signed-rank test.

†Mann-Whitney tests did not indicate any significant differences between improvers and stable cases in initial scores except for attention (P=0.02), orientation (P=0.03), and total CAMCOG (P=0.04).

learning memory (z=2.2, P=0.027), CAMCOG memory

MMSE and hence were considered to remain stable. Both

Study Outcomes (Auckland five-year study)

- Most common deficits (30-50% below average)
  - Executive functioning
  - Information processing speed
  - Visual perceptual abilities/construction abilities
  - Visual memory
  - Depression (30% at 6 months)
- Associated with "handicap, disability, and health-related quality of life"

Study Outcomes

- Early studies after stroke (at 2 months) show 70% with impaired information processing speed, and 40% with memory visuospatial language and arithmetic problems
- 6-10 months abstract reasoning and language were most common (Nys, et al., 2005)
- 3 years demonstrated motor speed, visual spatial memory and verbal fluency difficulties
- Overall greatest impact on **attention and executive** functioning over memory

Common problems after stroke

- Delirium
- Dementia
- Agitation/Psychosis
- Anxiety
- Apathy
- Psychomotor slowing
- Impulsivity
- Depression
- Fatigue
- Insomnia
- Disinhibition
- Pain

Difficulty predicting behaviors and cognition

- Right and left sided syndromes
- Frontal lobe syndromes are rarely specific
- Cortical and sub-cortical connections
- Neuro-anatomy and Neuro-psychology partly help

- Behaviors can begin at any stage after stroke, from the ICU to months and years later.

Difficulty predicting behaviors and cognition

- Understanding the injury is the key to predicting all behavioral and cognitive problems.
- Radiographic studies grossly underestimate the extent of damage (structural not functional exams)
- "When all else fails, examine the patient".

Cognitive Contributors

- Causes need to be investigated through a differential
  - Neuroanatomic
  - Traumatic
  - Infectious
  - Psychiatric
  - Metabolic
  - Environment
  - Pain

Neuroanatomic

- More left anterior and posterior cerebral artery infarcts than vertebrobasilar artery infarcts
- More cortical (74%) than subcortical or infratentorial (>50%)(Nys, et al., 2007)
- More aphasia and neglect after cardioembolic stroke than large vessel or small vessel involvement (Hoffman, 2001)
- More dementia noted after hemorrhagic strokes, left hemispheric infarcts and stroke recurrence (Pendlebury, et al.,2009)
- Diffuse cognitive syndromes at the genu of the internal capsule; white matter lesions and silent infarcts do worse than those without (Tatemichi, et al.,1995)

Neuroanatomic

- Anterior Temporal (Memory)
- Dominant Frontal (Depression)
- Special senses (hearing, tactile, olfactory, taste)
  - Lack of ability
  - Abnormal or hypersensitive
- Apraxia
- Vestibular

Neuroanatomic

- Basal ganglia
  - Bradykinetic, 'apathetic' (memory, attention, visuospatial, language)
- Hypothalamus
  - Anger, fearful, pleasure reactions
  - Autonomic patterns
- Thalamus–memory, executive functioning, and attention
- Pseudobulbar Palsy
  - Corticobulbar involvement above pons
  - Extremes of lability

Cognitive Contributors

- Metabolic
  - Secondary medical problems (chemistries, endocrine, specific organ systems)
- Environmental
  - Situational conflicts (family, employer, roommate, therapist, nurse), changes in career or dreams
- Others-Pain, Spasticity, Seizures, Sleep

Neglect-Definition

- Failure to report, respond, or orient to meaningful or novel stimuli that occur on the side contralateral to a hemisphere lesion
  - If can be accounted for by either an elementary sensory or motor defect, then the failure is not considered to be neglect

Neglect

- At least 5 studies – predict poor recovery in everyday life functioning
- Presence of neglect a mean of 53 days post-stroke was the only significant predictor of ADL functioning (Denes, et al.,1982)
- Rehabilitation improves the effect of neglect although correlation with independence for ADLs unclear (Cochrane Review, 2007)

Different terms have been used

- Hemineglect
- Hemispatial neglect (right inferior parietal)
- Unilateral spatial neglect
- Visuospatial Neglect
- Visual neglect
- Auditory neglect
- Motor neglect (R dorsolateral prefrontal-visuomotor)
- Inattention

Goals to be achieved

- Sleep improvement
- Pain control
- Behavioral improvements
  - Agitation
  - Depression
  - Psychosis
- Perceptual improvements
  - Visual
  - Auditory
  - Somatosensory

Treatment options

- Targeted therapy based on stroke territory
  - Medicines
  - Psychological assistance and testing
  - Targeted therapies
  - Preventative strategies
  - Environmental and caregiver considerations
  - Exercise and listening to music

Neurobehavioral Treatment Principles

- Elements of behavioral modification
  - Control of the environment
  - Control of reinforcement
  - Control of incentive
  - Survey and continuous measurement of behaviors
  - Selection of 'target behaviors'
  - Generalization to outside settings
  - Weaning from strict contingent reinforcement

Practical Applications for Treatment

- Always assist with sleep.
- Give medicines that can be used for multiple purposes.
- Better to have a sitter than use of meds.
- The sitter is ultimately cheaper (length of stay, medicine uses, complications, labs, family responses/criticisms).

Problems with medication studies

- Involve small numbers of patients
- Medication dosing varies widely
- Duration and timing of meds
- Concerns about changes in blood pressure, heart rate and seizures
- What drugs for what use
- Duration of meds and rehabilitation

Dosing of the Medicine

- Timing and dosing crucial
  - One hour prior to therapy
  - Inform the various disciplines and report changes
  - Change dosings every day in hospital and every week outside
  - Start low and gradually increase

Categories of meds used after neurological injury

- Antipsychotics (typical and atypical)
- Antidepressants (Old SSRIs and new SSRIs)
- Analgesics and 'muscle relaxants'
- Anti-parkinson's meds
- Hypnotics
- Neurostimulants
- Opioid analgesics
- Antinausea/emetic meds

Potential indications for neurostimulants

- Attention
- Impulsivity
- Distractibility
- Concentration
- Memory
- Neglect and agnosia
- Fatigue

Stimulant medicines

- D-Amphetamine
- Methylphenidate
- Amantidine
- Levodopa
- Bromocriptine
- Modafinil
- Memantine

Effects of Stimulants on Stroke

- Cochrane Review in 2003
  - Martinsson et al reported
    - No evidence of amphetamine treatment reducing death or dependence
    - Imbalances with regards to baselines (mild-severe strokes)
    - Better relative changes in motor function acc. to Fugl-Meyer motor scale
    - Suggestion of better change in language function
    - No evidence of significant ADL changes
  - Too few patients "to draw any definite conclusions about the effects of amphetamine treatment on recovery from stroke" "It is not possible to give the full detail of analyses on the 27 outcomes studied"

Means by which to study changes

- fMRI
- DTI
- EEG
- PET
- Magnetoencephalography
- Changes in FIM, LOS in hospital, ADLs, DRS
- Neuropsychological measures
  - Processing speed, attention, memory, distractibility, mood, useful field of view

Conclusions

Most common deficits:

- Executive functioning
- Information processing speed

Timing and dosing crucial for meds

Behaviors start at any point after injury, from the times in the ICU, to months or years later

Radiographic studies are structural, not necessarily, functional

Targeted therapies based on territory and functional deficits

References

- Ballard, C, Rowan, E, Stephens, S . Perspective follow-up study between 3 and 15 months after stroke. Stroke 2003; 34:2440-2444.
- Patel, M, Rudd, AG, Wolfe, CDA, Natural history of cognitive impairment after stroke and factors associated with his recovery. Clinical Rehabilitation 2003; 17:158–166.
- Sachdev, PS, Franzcp, B, Franzcp, F, Valenzuela, M ,Lorentz, LM, Koschera, A, Progression of cognitive impairment and stroke patients. Neurology 2004; 9:1618–1623.
- Donovan, NJ, Kendall, DL, Heaton, SC et al., Conceptualizing functional cognition in stroke. Neuro rehabilitation and Neuro repair 2008; 22:122–135.
- Marinsson, L, Hardemark, H et al., Amphetamines for improving recovery after stroke. Cochrane Database Systems Review 2007: Wiley Online Library.
- Denes, G, Unilateral spatial neglect and recovery from hemiplegia: A follow-up study. Brain 1982.
- Tatemichi, TK, Paik, M, Bagiella, E, Desmond, DW, Pirro, M, Hanzawa, LK,Dementia after stroke as a predictor of long-term survival. Stroke 1994; 25:1915–1919.
- Barker-Collo, S, Feigin, VL, Parag, V, Lawes, CMM, Senior, H, Auckland Stroke Outcomes Study. Neurology 2010; 75: 1/6/08–1616.
- Bowen, A. Lincoln, N, Cognitive rehabilitation for spatial neglect following stroke. Cochrane Database Systemic Review 2007 :2; CD 003586.
- Nys, GMS, Van Zandvoort, MJE, De Kort, PLM et al.,Domain–specific cognitive recovery after first ever stroke: Follow-up study of11 cases. Journal of International Neuropsychological Society 2005; 11:795–806.
- Cumming, TB, Marshal, RS, Lazar, RM, Stroke, cognitive deficits, and rehabilitation: still an incomplete picture. International Journal of Stroke 2013:8; 38–45
- Nys, GM, van Zandvoort, et al., Cognitive disorders and acute stroke: prevalence and clinical determinates. Cerebrovascular Disease 2007; 23:40 8–16.
- Hoffman, M, Higher cortical function deficits after stroke: analysis of 1000 patients from a dedicated cognitive stroke registry. Neurorehabilitation and Neurologic repair 2001; 15:113–127.
- Pendlebury, ST, Rothwell,PM, Prevalence incidence and factors associated with pre-stroke and post-stroke dementia: a systemic review and met analysis. Lancet Neurology 2009; 8:1006-1018.
- Tatemichi, TK Desmond, DW, Prohovnik, Strategic infarcts and vascular dementia. A clinical and brain imaging experience. Arzneimittelforschung1995:45; 371–385.
- Hochstenback, J, et al., Cognitive deficits following stroke in the basal ganglia. Clinical Rehabilitation 1998; 12:514-520
- Van der Werf, YD, et al., Deficits of memory, executive functioning and attention following infarction in the thalamus: a study of 22 cases with localized lesions. Neuropsychologia 2003; 41:1330–1344.
- Quaney,BM Boyd, LS, McDownd, JM et al., Aerobic exercise improved cognition and motor function post stroke. Neurorehabilitation and Neurological repair 2009; 23: 879-885.
- Sarkamo,T, Tervaniemi, M, Laitinen, S et al.,Music listening enhances cognitive recovery and mood after middle cerebral artery stroke. Brain 2008; 131 (Pt 3): 866–876.
- Desmond, DW, Moroney, JT, Sano, M, Stern, Y Recovery of cognitive function after stroke. Stroke 1996; 27:1798–1803.