

Illustrative Teaching Case

Section Editors: Scott Silverman, MD, and Sophia Sundararajan, MD, PhD

Often Overlooked but Critical Poststroke Cognitive Impairment in Right Hemispheric Ischemic Stroke

Stephanie Shatzman, BS; Supriya Mahajan, MD; Sophia Sundararajan, MD, PhD

Case Description

A 37-year-old previously healthy right-handed woman presented with sudden onset of left facial droop, left hemiparesis, and headache after a water park ride. She was evaluated within 3 hours of symptoms and received intravenous tissue-type plasminogen activator. Computed tomographic angiography demonstrated right internal carotid artery dissection, and she underwent emergent carotid stenting. The following day, computed tomography revealed infarction in the right superior temporal gyrus, insula, and caudate head.

At discharge, she had a 4/5 left hemiparesis and left hemisensory loss. She was described as having normal mental status. Subsequent outpatient evaluation showed continued motor recovery but persistent cognitive dysfunction with superimposed depression and anxiety. Neuropsychiatric testing 1 year poststroke showed her performance on the Wechsler Adult Intelligence Scale was in the 47th percentile, mildly reduced attention and executive function, borderline visual construction skills, and abnormal prosody of speech. Depression and anxiety were noted. Vocational and rehabilitation training was recommended with hopes she would return to work with gradually increased responsibility. She declined training and remained unemployed.

During the following years, she complained of persistent cognitive and sensory deficits. Her husband complained of her altered personality and failure to resume her normal activities. Her marriage eventually failed.

Repeat neuropsychiatric testing 3 years later showed worsened attention and executive function scores, including abstract reasoning, weakness in encoding of auditory information, and persistent sensory aposodia. She reported increased psychological stress and anhedonia and was taking an antidepressant and seeing a psychologist. Repeat neuropsychiatric testing in 2010 showed that her Wechsler Adult Intelligence Scale had declined to the 19th percentile. It was felt that her worsening score was because of increased depression in the context of marital and employment stressors. Magnetic resonance image scan at that time showed her remote right middle cerebral artery infarction (Figure).

Discussion

This case was selected to highlight cognitive deficits after right hemispheric stroke that are frequently underrecognized,

such as sensory aposodia, impaired attention, and executive function (Table). The literature on this topic is scant. We will discuss various domains of cognition, as well as assessment tools and their limitations during the acute period. We will focus on the impact of cognitive dysfunction on social interactions, employment, and quality of life, with an emphasis on younger stroke survivors.

Assessment of Poststroke Cognitive Impairment

Poststroke cognitive impairment (PSCI) is a widely recognized phenomenon affecting $\leq 65\%$ of patients with clinically significant stroke and includes impairment with and without dementia. Cognitive dysfunction can result from deficits in language, memory, executive functioning, planning and attention, and visuospatial skills.¹ Assessment of these cognitive domains can be challenging. Acutely, both physicians and families tend to focus on motor deficits, and inpatients generally do not perform complex cognitive tasks so their deficits may go unrecognized. Concurrent medication use, medical complications, and sleep deprivation further complicate assessment and cognitive assessment often fluctuates in the acute period.² Acute evaluation of cognition utilizes quick and easily administered assessments, such as the Mini-Mental Status Examination and The Montreal Cognitive Assessment. The Mini-Mental Status Examination does not test visuospatial skills, executive function, or abstract reasoning and, therefore, The Montreal Cognitive Assessment is more sensitive to cognitive dysfunction in acute stroke.

Comprehensive outpatient neuropsychiatric testing, which may take several hours to conduct, is usually administered several months after stroke and provides evaluation of multiple cognitive domains. Unfortunately, there is no standardized approach to assessment. Lees et al³ reviewed 488 studies from 2000 to 2011 examining mood and cognition poststroke and found that these studies relied on 367 discrete assessment tools. This variability makes it difficult to compare studies or perform meta-analysis to better understand the scope of PSCI. Nonetheless, formal neuropsychiatric testing can be used to target rehabilitation strategies and vocational training and to provide critical information to support disability claims.

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From the Neurological Institute, University Hospitals Case Medical Center, Cleveland, OH.

Correspondence to Sophia Sundararajan, MD, PhD, Neurological Institute, University Hospitals/Case Medical Center, 11100 Euclid Ave, Cleveland, OH 44106. E-mail: sophia.sundararajan@UHhospitals.org

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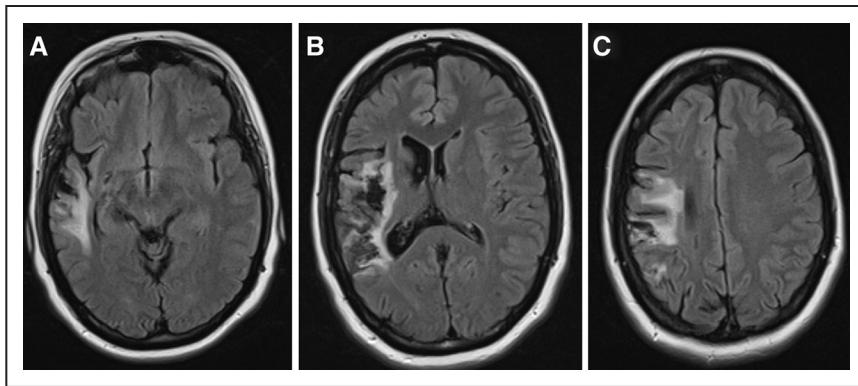


Figure. Infarction within the right middle cerebral artery territory as seen at the level of the inferior temporal lobe (A), insula (B), and frontal-parietal cortex (C).

Recognition of cognitive consequences of stroke is further confounded by physician reluctance to address these issues. Cognitive assessment in the office is relatively time-consuming and often uncomfortable, as are addressing the consequences of dysfunction, including living independently and driving. In addition, many vascular neurologists are uncomfortable evaluating and treating cognitive impairment, feeling it falls outside the realm of their expertise.¹

Impact of Poststroke Cognitive Impairment

Despite not being well recognized, cognitive impairment can be as disabling as motor and language deficits. PSCI is associated with decreased quality of life at 6 months poststroke⁴ and reduced long-term survival.⁵ Cognitive dysfunction is also challenging for patients without hemiparesis who may not be recognized as disabled by the government or family, resulting in serious financial burden and accelerating anxiety and depression. Impaired cognition is an independent risk factor for depression, which affects 11% to 63% of stroke patients.^{1,4} Our patient's cognitive decline between 2007 and 2010 illustrates worsening cognitive performance secondary to psychiatric dysfunction.

Schaapsmeerders et al⁶ provided one of the first studies investigating long-term cognition in younger stroke patients. Their study included 277 patients aged 18 to 50 years who experienced a single ischemic stroke and underwent cognitive testing done at baseline and again after 11 years. Results showed up to 50% of patients performed <1 SD below the age-adjusted mean of controls 11 years poststroke.⁶ The high incidence of cognitive impairment in younger stroke survivors is significant because PSCI impacts the ability to return

to work.⁷ Lost earnings are the single largest contributor to overall stroke costs. Estimates of the future economic burden of stroke in the United States using Medicare reimbursements find that younger patients account for approximately half the total stroke costs, largely because of lost earnings.⁷ Despite the fact that younger patients have a better prognosis than older patients, their high lifetime costs related to lack of employment underscore the importance of addressing all the factors that prevent them from working, including PSCI.

Sensory aposodia, or the inability to interpret and generate emotional intonation of speech, is an important cognitive function localized in the temporal lobe of the nondominant hemisphere. Blonder et al⁸ examined facial and prosodic processing and marital satisfaction in 12 patients with right hemisphere damage from stroke. They showed correlation between the ability to accurately recognize affect via facial expressions and the ability to match facial expression by voice tone and rhythm with marital satisfaction in patients with nondominant damage. The authors conclude that inability to recognize cues in a partner's speech may lead to marital dissatisfaction. Although this study is limited by sample size, it highlights the importance of sensory aposodia on the social relationships of stroke patients.

Treatment

Unfortunately, the role of cognitive rehabilitation remains unproven. Although data indicate that some therapies may have short-term benefit, several meta-analyses have examined various aspects of cognitive impairment after stroke, including attention, neglect, and executive dysfunction, and found no statistical long-term effect of rehabilitation on PSCI.⁹ Future

Table. Localization of Cognitive Deficits in the Nondominant Hemisphere

Cognitive Domain	Localization of Lesion	Lesion Manifestations
Attention	Parietal association cortex, posterior frontal lobe, uncommonly cingulate gyrus, thalamus, basal ganglia	Sensory neglect, motor-intentional neglect, conceptual neglect
Visual-spatial memory	Right hippocampal formation and right mesial temporal lobe	Inability to draw a design from memory
Visual-spatial analysis/constructional abilities	Parietal association cortex adjacent to temporal and occipital lobes	Impaired analysis of motion and location of objects in space, inability to copy a design, impaired big picture thinking with respect to end point of construction tasks
Geographic orientation	Right hippocampus, right retrosplenial cortex	Impaired navigation of known routes and difficulty learning new routes
Sensory prosody	Posterior temporoparietal cortex	Seem to lack empathy toward others in their actions and responses and can seem bland

research is needed to explore cognitive rehabilitation on end points relating to social interaction and employment.

Lateralization (or Lack of) and Cognitive Impairment

Although the traditional view is that dominant hemispheric injury is worse than nondominant, PSCI, quality of life, and functional outcomes are not statistically different. Even with malignant MCA infarction requiring decompressive hemi-craniectomy, there is no statistically significant difference in quality of life between left-sided and right-sided infarction.¹⁰ Thus, although laterality impacts prognosis in language and motor dysfunction, clinicians should be mindful that both right-sided and left-sided strokes impact cognition and quality of life and include this in their discussions on prognosis.

Conclusions

Although increasingly recognized, PSCI remains underappreciated, and data with respect to the economic impact, rehabilitation strategies, and efficacy are limited. Additional awareness may result in increased identification, vocational retraining, and accommodation, as well as counseling and social support programs for patients and families.

TAKE-HOME POINTS

- Right hemispheric lesions impair multiple facets of cognitive function, including attention and prosody and disrupt essential social relationships.
- Although comprehensive neuropsychiatric testing is a powerful tool in identifying the poststroke cognitive impairment, limitations exist in assessment.
- Poststroke cognitive impairment, is associated with increased depression and anxiety, which can further complicate assessment.
- Cognitive rehabilitation is available, but the extent of benefit remains unclear.

None.

Disclosures

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KEY WORDS: cognition disorders ■ dementia ■ dementia, vascular ■ depression ■ stroke