Financial Relationship Disclosure:
None

Objectives:
1. Review updates in stroke.
2. Identify details involving Vascular Cognitive Impairments.
3. Discuss the data regarding the clinical utility of evaluating cognition.

AHA 2016 Stroke Quick Review
- Prevalence: 795,000/yr in US; 3 in 4 = 1st stroke.
- Occurs every 40 seconds; every 4 minutes someone dies of stroke.
- The fifth leading cause of death, killing 130,000/yr (1/20 deaths).
- Women > men in stroke prevalence, partly due to living longer.
- AA are most impacted by stroke than any other racial group.

Vascular Cognitive Impairment
Brain at risk
- Cardiovascular risk factors with or without imaging features of subclinical brain insult
- No obvious cognitive impairment in ADL
- Cardiovascular risk factors, e.g., hypertension, WM hyperintensity on MRI
- Cognitive functioning remains WNL following cognitive assessment

Vascular Cognitive Impairment
VCI, no dementia
- Impairment in at least one cognitive domain without affectation of ADL in a patient with cardiovascular risk factors
- Neuroimaging features of subclinical brain insult
- Follows the brain at risk but with cognitive impairment
- Cognitive impairment not severe enough to affect ADLs
Vascular Cognitive Impairment

Vascular dementia
Impairment in two or more areas of cognitive domain
severe enough to impair ADL
presence of cardiovascular risk factors
neuroimaging findings of cerebral insults (WM hyperintensities)

Mixed neurodegenerative/vascular dementia
Presence of a neurodegenerative dementia, e.g, AD with superimposed VD

Vascular Cognitive Impairment

• Vascular Cognitive Impairment (VCI) = cognitive impairment caused by or associated with vascular factors.
• 64% of stroke victims have cognitive impairment.
• 1/3 of stroke victims develop frank dementia.

NINDS-CSN

NINDS & CSN creates a workshop comprised of the following groups:
• Clinical/Epidemiology
• Neuropsychology
• Imaging
• Neuropathology
• Experimental Models
• Biomarkers
• Genetics
• Clinical Trials

Vascular Cognitive Impairment

Original Contributions

National Institute of Neurological Disorders and Stroke–Canadian Stroke Network Vascular Cognitive Impairment Harmonization Standards

Vladimir Hachinski, MD; Dug; Costantino Iadecola, MD; Ross C. Petersen, MD, PhD;
Montag M. Broder, MD; PhD; David L. Nyberg, PhD; Sandy E. Black, MD;
William J. Powers, MD; Charles DiCarli, MD; Jose G. Merino, MD; Raj N. Kalaria, PhD, FRCP;
Stuart V. Vinters, MD; David M. Altschuler, MD; Cary A. Rossberg, MD; Andrew Wiltz;
Maria D’Agostino, MD; John R. Martin, MD, Gabriello G. LoBasso, PhD

Vascular Cognitive Impairment

• Postmortem studies show 34% of dementia cases show significant vascular pathology.
• Dementia Dx criteria more sensitive for AD than VCI as VCI often can present without significant memory decline.

Vascular Cognitive Impairment

• Since VCI encompasses a large range of cog deficits, test batteries need to cover all neurocognitive domains.
• Primary emphasis of VCI detection is given to executive dysfunction.
• Three separate protocols created: 60’, 30’, & 5’ test batteries.
Vascular Neuropsychology Screen
(modified 30’ NINDS-CSN VCI Assessment Protocol):
• Clinical assessment & interview
• Wide Range Achievement Test – 4th Edition (WRAT-4) Reading
• Semantic Fluency (Animals)
• Phonemic Fluency (FAS)
• Hopkins Verbal Learning Test-Revised (HVLT-R) Copy subtest
• Trail Making Tests (TMT) A and B
• Wechsler Adult Intelligence Scale-III (WAIS-III) Digit Symbol-Coding
• Geriatric Depression Scale-short form (GDS-15) or Center for Epidemiological Studies-Depression Scale (CES-D)

Utility of VCI Neuropsychological Screen
Provide the stroke team with an efficient but thorough screen of the patient’s current cognitive capacity by domain:
• Memory
• Attention/focus/concentration
• Executive function/problem solving
• Processing speed
• Language
• Visuospatial
• Mood (major depression in 1/3 of stroke patients)
• Each domain can be more thoroughly assessed beyond the screen

Utility of VCI Neuropsychological Screen
Provide the stroke team with an efficient but thorough screen of the patient’s current cognitive capacity by domain:
• Memory
STM < LTM: Today’s breakfast < Childhood memories
Verbal memory: names, stories, conversations, etc.
Visual memory: locations, item descriptions, faces, etc.

Utility of VCI Neuropsychological Screen
Provide the stroke team with an efficient but thorough screen of the patient’s current cognitive capacity by domain:
• Language
1M in US with:
- Wernicke’s aphasia (Comprehension difficulty w/ nonsensical output, e.g., knife=gleeble, cooking when hospital shoes gleeble mo ay ni)
- Broca’s aphasia (Output difficulty)
- Global aphasia (Both difficult w/ poor reading and writing)
Utility of VCI Neuropsychological Screen

Provide the stroke team with an efficient but thorough screen of the patient’s current cognitive capacity by domain:

• Visuospatial
  - Poor interpretation of visual input
  - Poor directions
  - Reach deficits
  - Sense of space impaired

At times, Cortical Blindness (Anton’s)
**Post-stroke Affect**

- 1/3 will experience clinical depression at some point following a stroke (by definition, beyond situationally appropriate).
- 19.3% and 18.5% of stroke survivors have major depression or minor depression, respectively.
- No significant difference of post-stroke depression between hemorrhagic and ischemic strokes.
- Poor functional outcomes: recovery delayed by up to 2 years; reduced QoL & rehab efficacy; increased mortality.

**Vascular Dementia**

- Caused by a series of small strokes.
- Affects memory, thinking, language, judgment, and behavior:
  - Difficulty performing tasks that used to come easily, such as balancing a checkbook
  - Playing games (such as bridge)
  - Learning new information or routines
  - Getting lost on familiar routes
  - Trouble finding the name of familiar objects
  - Losing interest in things you previously enjoyed
  - Flat mood
  - Misplacing items
  - Personality changes and loss of social skills

**Vascular Dementia**

- Third most common type of dementia
- As the dementia becomes worse, symptoms are more obvious and interfere with ADL's:
  - Change in sleep patterns, often waking up at night
  - Difficulty doing basic tasks, such as preparing meals, choosing proper clothing, or driving
  - Forgetting events in your own life history
  - Having delusions, depression, or agitation
  - Having hallucinations, arguments, striking out, or violent behavior
  - Having more difficulty reading or writing
  - Having poor judgment and loss of ability to recognize danger
  - Using the wrong word, not pronouncing words correctly, or speaking in confusing sentences
  - Withdrawing from social contact

Any of the neurologic problems that occur with a stroke may also be present.

**Test examples**
Utility of VCI Neuropsychological Screen

• Track the patient’s cognitive and affective recovery over time.
  – Especially important in f/u care, rehab, and community reintegration.
  – Assessment tools in the screen are evidence-based.

• Assist in differential diagnosis, e.g., pre-existing dementia.

• Provide input as a part of an interdisciplinary team.

Sample Data Display

<table>
<thead>
<tr>
<th>Measure</th>
<th>IQA</th>
<th>Interpretation</th>
</tr>
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<tbody>
<tr>
<td>WRAT-IV Reading</td>
<td>84</td>
<td>Low Average</td>
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<tr>
<td>Phonemic Fluency</td>
<td>75</td>
<td>Borderline Impairment</td>
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<tr>
<td>Semantic Fluency</td>
<td>88</td>
<td>Low Average</td>
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<tr>
<td>HVLT-R Total</td>
<td>75</td>
<td>Mild Impairment</td>
</tr>
<tr>
<td>HVLT-R Delayed Memory</td>
<td>65</td>
<td>Severe Impairment</td>
</tr>
<tr>
<td>WAIS-III Coding</td>
<td>85</td>
<td>Low Average</td>
</tr>
<tr>
<td>CESD</td>
<td>N/A</td>
<td>Unremarkable Mood</td>
</tr>
</tbody>
</table>

Sample: 55 yo RH AA F 12 yrs ed, w/ Hx of LBG hem after I.P. DC, tried to resume normal ADL’s including work and driving (left food on the burner, almost burned down the house)
Recommendations:
• Discontinue driving at least until VS skills improve (repeat testing)
• Discontinue autonomous financial & medication management
• Discontinue cooking (memory decline: burner, oven)
• Pt retired from work

Test Data Set: Time 1 & 2 (Hypothetical for illustration)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Time 1</th>
<th>Time 1</th>
<th>Time 2</th>
<th>Time 2</th>
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<td>85</td>
<td>85</td>
<td>85</td>
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<tr>
<td>Phonemic Fluency</td>
<td>75</td>
<td>85</td>
<td>75</td>
<td>85</td>
</tr>
<tr>
<td>Semantic Fluency</td>
<td>85</td>
<td>75</td>
<td>85</td>
<td>85</td>
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<tr>
<td>VOLT-R Total</td>
<td>85</td>
<td>85</td>
<td>85</td>
<td>85</td>
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<tr>
<td>VOLT-R Delayed Memory</td>
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<td>85</td>
<td>85</td>
<td>85</td>
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<tr>
<td>VOLT-R Discriminability</td>
<td>85</td>
<td>85</td>
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<td>ROCF Copy</td>
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<td>85</td>
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<tr>
<td>Trail Making Test A</td>
<td>85</td>
<td>85</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>Trail Making Test B</td>
<td>85</td>
<td>85</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>WAIS-III Coding</td>
<td>85</td>
<td>85</td>
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<td>85</td>
</tr>
</tbody>
</table>

VCI Neuropsychological Screen in Action

Ambulatory Care Innovation Grant (UWMF & PP)
Round 7: Multidisciplinary Stroke Clinic (MSC)

• Flow reduction
• MSC: months to hours
• Press-Ganey
  • “STAR performer” status post-MSC: patient satisfaction
  • Provider satisfaction
  • Reversed Shared Medical Appointment (SMA) Concept
  • Pilot study at the University of Wisconsin, Madison

Multidisciplinary Stroke Clinic (MSC)

Change Leaders:
- Dong (Dan) Han, PsyD
- Bruce Hermann, PhD
- Jana Jones, PhD
- Justin Satin, MD
- Amelia Anderson, PhD

Team Members:
- UWHC Department of Neurology
- Stroke Service and Neuropsychology Service

Project Start Date: 9/09
Project Status: Finalized
Key Outcomes:
- Needs Assessment Completed
- Structural Changes Implemented
- Quality Improvement Data Collected and Analyzed

Project Aim/Goal and Measures

1. The MSC will achieve improvement in patient appointment wait time
   - by decreasing the wait gap between stroke neurology and neuropsychology outpatient appointments
   - by 50+% within the first quarter of 2009-2010
   - focusing on merging the follow up appointment processes into one protocol, using the resources of the two services
Pt Discharged from Inpatient Care
Outpatient Neurology FU Scheduled
Outpatient Neurology FU (6-12 weeks)
Neuropsych Assessment
Results and Interpretation (2+ weeks)
Cognitive Data Forwarding and Physician
Schedule Follow-up with Physician (additional weeks)
Neuropsych Assessment
Outpatient Neuropsych appt. Scheduled
Outpatient Neurology FU Scheduled
Referral to NP?
End Patient In System  PCP

Problem/Needs Assessment (PLAN)

Changes Implemented (DO)

POST-MSC IMPLEMENTATION

Only hours during 1 st F/U: Total = 1-3 F/U: Discharge (anticipated wait for post-stroke recovery & F/U)

Neurology FU Appt (e.g. 2:00 pm)
Cognitive Data Incorporated into FU and filed
End Patient In System  PCP

Impact on Outcomes/Performance (CHECK/STUDY)

Impact on Outcomes/Performance (CHECK/STUDY)

Impact on Outcomes/Performance (CHECK/STUDY)

Impact on Outcomes/Performance (CHECK/STUDY)

Patient Satisfaction Survey (38% survey response rate)
Key: lower # = negative; higher # = positive

Lessons Learned (ACT)

• Merging different services into one protocol increased:
  – provider satisfaction
  – value added time by 78.08% on average

• Merging different services into one protocol decreased:
  – unnecessary wait time between appointments by 7.26 months on average, which equates to 78.32% improvement in time saved

• Merging different services into one protocol revealed high levels of patient and provider satisfaction.
Sample Data Display
TEST DATA SET: TIME 1 (actual table from screen)

<table>
<thead>
<tr>
<th>Measure</th>
<th>SS</th>
<th>%ile</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRAT-IV Reading</td>
<td>93</td>
<td>32</td>
<td>Average</td>
</tr>
<tr>
<td>Phonemic Fluency</td>
<td>82</td>
<td>12</td>
<td>Low Average</td>
</tr>
<tr>
<td>Semantic Fluency</td>
<td>99</td>
<td>47</td>
<td>Average</td>
</tr>
<tr>
<td>HVLT-R total</td>
<td>97</td>
<td>42</td>
<td>Average</td>
</tr>
<tr>
<td>HVLT-R Delayed Memory</td>
<td>102</td>
<td>95</td>
<td>Average</td>
</tr>
<tr>
<td>HVLT-R Discriminability</td>
<td>115</td>
<td>84</td>
<td>High Average</td>
</tr>
<tr>
<td>Figure Construction</td>
<td>100</td>
<td>50</td>
<td>Average</td>
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<td>Trail Making Test A</td>
<td>&lt;45</td>
<td>&lt;0.1</td>
<td>Severely Impaired</td>
</tr>
<tr>
<td>Trail Making Test B</td>
<td>60</td>
<td>0.4</td>
<td>Moderate to Severely Impaired</td>
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<tr>
<td>WAIS-III Coding</td>
<td>85</td>
<td>16</td>
<td>Low Average</td>
</tr>
<tr>
<td>CESD</td>
<td>19</td>
<td>NA</td>
<td>Mild Depression</td>
</tr>
</tbody>
</table>

Sample 2: 58 yo RH M w/ 18 yrs ed w/ unremarkable Med Hx
5/09 moderate L hemiparesis w/ facial droop & hemisensory disturbance; MR: multi foc R hemispheric infarcts. 70% short segment stenosis in the RICA. Complains of fatigue but upon Sx resolution, reported "feeling 100% back" to baseline by DC 3 days later.

Recommendation: Discourage work and driving at least until f/u (repeat testing).

Sample Data Display
TEST DATA SET: TIME 1 & 2

<table>
<thead>
<tr>
<th>Measure</th>
<th>TIME 1</th>
<th>TIME 1</th>
<th>TIME 2</th>
<th>TIME 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRAT-IV Reading</td>
<td>93</td>
<td>32</td>
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<tr>
<td>Phonemic Fluency</td>
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<td>Semantic Fluency</td>
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<tr>
<td>HVLT-R total</td>
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<td>HVLT-R Delayed Memory</td>
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<tr>
<td>HVLT-R Discriminability</td>
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<tr>
<td>Figure Construction</td>
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<td>50</td>
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</tr>
<tr>
<td>Trail Making Test A</td>
<td>&lt;45</td>
<td>&lt;0.1</td>
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<tr>
<td>Trail Making Test B</td>
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<td>WAIS-III Coding</td>
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<tr>
<td>CESD</td>
<td>19</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sample 2: 10 days after DC, Pt returns to ED w/ L hemiparesis while jogging 20'. MR: R posterior parietal hemorrhagic stroke. Now acknowledges some cognitive changes, mostly reduced proc speed.

Recommendation: No work and driving at least until f/u (TIME 3 repeat testing).
Sample Data Display

**Neurocognitive Performance by Domain**

**TEST DATA SET:** Time 1, 2, & 3

<table>
<thead>
<tr>
<th>Measure</th>
<th>TIME 1 %ile</th>
<th>TIME 2 %ile</th>
<th>TIME 3 %ile</th>
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<td>WMS I.R. Immediate Recall</td>
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</tr>
<tr>
<td>WAIS III Coding</td>
<td>85</td>
<td>16</td>
<td>95</td>
</tr>
</tbody>
</table>

Sample 2: 7/09 R Carotid Endarterectomy. 11/09 MSC F/U. Took time off work since last ED visit and now reports feeling "90-95% back to baseline."

**TAKE HOME MSG:** Self-report, collateral-report, & appearance of high functioning can ALL be deceptive!!!
NINDS-CSN VCI Protocol Bottom Line

- Incorporation of international standards: care model
- Streamlining and increased coverage of neuropsychological evaluation
- Increased contribution to stroke treatment planning
- Facilitation of appropriate referrals

NINDS-CSN VCI Protocol Bottom Line

- Significantly decreased wait time for patients between services (by 4-7 month)
- Serial data to track recovery over time
- Track functional outcomes beyond localization
- Care model, replicable to other services

NINDS-CSN VCI Protocol Bottom Line

- A HOOK FOR THE TX TEAM TO HANG YOUR HAT ON! THE PROTOCOL ASSISTS TO VALIDATE CLINICAL JUDGMENT
  OR (conversely)
- MAINTAIN SCIENTIFIC SKEPTICISM! THE PROTOCOL ASSISTS TO SHINE A LIGHT ON DECEPTIVE CLINICAL PRESENTATIONS

NINDS-CSN VCI Protocol Bottom Line: From This [14 values]
NINDS-CSN VCI Protocol

Bottom Line: To This (values)

- Pt Discharged from Inpatient Care
- Schedule MSC Appt (6-12 weeks)
- Pt Arrives for MSC Neuropsych Appt (e.g. 1:30 pm)
- Preliminary Results and Interpretation (e.g. 1:45 pm)
- Neurology FU Appt (e.g. 2:00 pm)

Cognitive Data incorporated into FU and stored in HealthLink

End Patient In System → PCP w/ sig; increased pt & prov satisfaction

Preliminary Results and Interpretation (e.g. 1:45 pm)

Refer for further NP evaluation if necessary

Model (in modified form) utilized by:

- UK Stroke Program
- UK TBI Services
- UK Movement Disorder Program
- UK ALS Program
- UK Memory Disorders Program
- UK Ped Hem-Oncology Service
- UK Transplant Program

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