Neuropsychologist’s Role in the Presurgical Workup of Epilepsy: Neuropsychological Assessment and the Wada Test

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Overview

• Introduction - A little bit of history
• Our Role
• Wada
• Case Example
Disclosures

None...
• Resective surgery is the treatment of choice for medically intractable temporal lobe epilepsy

• Surgery is highly successful form of treatment and many epilepsy centers are becoming more and more aggressive in terms of using surgery as a form of treatment

• Minimizing cognitive side effects and producing seizure freedom are the number one priorities for surgical epilepsy programs

• We must understand the potential cognitive impact of epilepsy surgery, as well as the presurgical predictors of positive outcome
A little bit of history

- Isolated cases of temporal lobe resection were performed in Great Britain as early as 1886 (Horsley, 1886).
- Penfield carried out his first temporal lobe surgery in 1931.
- Earliest temporal lobe surgeries avoided resecting the hippocampus, because there was fear the outcome would produce a Kluver-Bucy syndrome.
- Function was unknown at the time.
The use of EEG for epilepsy changed the typical surgical approach.

Surgeons began resecting EEG abnormal tissue.

Those abnormalities were frequently in the mesial temporal lobe region and resections began encroaching upon the hippocampi with some successful results.

Eventually Brenda Milner came across H.M. and began studying the cognitive side effects of temporal lobe (and specifically hippocampal) resections.
Curative

Extratemporal epilepsy
- frontal lobe epilepsy
- parietal/occipital epilepsy

Palliative

Generalized epilepsy
- drop attacks

Lesional epilepsies
- low grade glioma
- cortical dysplasia

Temporal lobe epilepsies
Curative

Palliative

Seizure control

Improved QOL

Enhanced safety
Curative

- Temporal lobectomy
- Amygdalohippocampectomy
- Lesionectomy

Palliative

- Corpus callosotomy
- Vagus nerve stimulation
- Thalamic stimulation

Hemispherectomy

“Nibblectomy”

“Grid/MEG guided best-guessectomy”
Neuropsychologists’ Role

Evaluate potential side effects of AEDs

Monitor changes in cognition and behavior over the course of this chronic condition

Identify focal or lateralized deficits

Assess risk of postoperative cognitive decline

Are there psychological factors that might increase suspicion of PNES Dx?
Factors that contribute to cognitive performance in epilepsy

Underlying cause of epilepsy
Epileptic process
AED side effects
Psychological or emotional issues
Age of seizure onset
Duration of the disorder
### Table 6.3 Cognitive deficits across various seizure history risk factor variables

<table>
<thead>
<tr>
<th></th>
<th>REPEATED GTCS</th>
<th>STATUS EPILEPTICUS</th>
<th>AED LEVELS</th>
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</table>

+, present; +/-, may be present; LT, left temporal lobe; RT, right temporal lobe; F, frontal lobe; GTCS, generalized tonic-clonic seizures

Mean FSIQ values with 95% confidence intervals (95% CIs) of patients with low and high educational attainment for groups with a duration of epilepsy <15 years, 15–30 years, and >30 years. Factors education and duration of epilepsy were significant (p<0.01). Asterisks (* p<0.05; ** p<0.01; one tailed) indicate significant contrasts between adjacent groups adjusted for covariates.
Older AEDs: Dilantin, Tegretol, Depakote, Zarontin, Mysoline, phenobarbital

Topamax & Keppra can lead to irritability and hyperactivity especially in children

Depakote, Topamax, phenytoin have the most cognitive side effects

Lamictal, Neurontin, Keppra have the least cognitive side effects
In the presurgical context, the goal of the neuropsychologist is to identify functions (and thereby regions) that are affected by seizures.

- When there is concordance between EEG, cognitive testing, MRI, functional imaging, etc., we have more confidence.
- More likely to find deficits when lesional on MRI.
- Neuropsychological results more likely to correlate with interictal EEG findings.
Material-Specific Memory in Temporal Lobe Epilepsy: Effects of Seizure Laterality and Language Dominance

Hongkeun Kim  
Daegu University

Sangdoo Yi and Eun Ik Son  
Keimyung University

Jieun Kim  
Catholic University of Daegu

This study investigated the effects of seizure laterality and language dominance on material-specific memory in temporal lobe epilepsy (TLE). Left TLE (LTLE) patients with left-hemisphere language dominance (LHLD) showed significantly higher nonverbal than verbal memory capacity, whereas right TLE patients with LHLD showed significantly better verbal than nonverbal memory capacity. LTLE patients with non-left-hemisphere language dominance (NLHLD) showed significantly better verbal memory capacity compared with LTLE patients with LHLD. Thus, selective verbal or nonverbal memory deficits that are dependent on side of seizure onset were apparent in patients with LHLD but not in patients with NLHLD. Relative sparing of verbal memory capacity in LTLE patients with NLHLD may reflect interhemispheric reorganization of verbal memory function.
Mean Z scores for two types of material in left temporal lobe epileptic patients with left-hemisphere language dominance (LHLD–LTLE; n 24), right temporal lobe epileptic patients with left-hemisphere language dominance (LHLD–RTLE; n 40), left temporal lobe epileptic patients with non-left-hemisphere language dominance (NLHLD–LTLE; n 24), and right temporal lobe epileptic patients with non-left-hemisphere language dominance (NLHLD–RTLE; n4). Error bars represent the standard error of the mean. KAVLT K-Auditory Verbal Learning Test; KCFT KComplex Figure Test.
Differential Effects of Left Versus Right Mesial Temporal Lobe Epilepsy on Wechsler Intelligence Factors

Hongkeun Kim
Daegu University

Sangdoe Yi and Eun Ik Son
Keimyung University

Jieun Kim
Catholic University of Daegu

This study investigates the effects of left versus right mesial temporal lobe epilepsy (MTLE) on Wechsler intelligence factors. In the left MTLE group, the Verbal Comprehension (VC) factor score was significantly lower than the Perceptual Organization (PO) factor score, whereas in the right MTLE group, the PO factor score was significantly lower than the VC factor score. The VC factor score was significantly lower for the left than the right MTLE group, whereas the PO factor score was significantly lower for the right than the left MTLE group. Thus, left versus right MTLE was associated with relative deficits in verbal versus nonverbal intelligence, respectively. These findings indicate that lateralized cognitive deficits in unilateral MTLE patients are not limited to the learning–memory domain but include more global intelligence functions.
Figure 1: Mean WAIS-R verbal IQ and performance IQ for the left and the right mesial temporal lobe epilepsy (MTLE) groups. Error bars represent +/- 1 standard error of the mean.

Figure 2: Mean WAIS-R Verbal Comprehension (VC) and Perceptual Organization (PO) index scores for the left and the right mesial temporal lobe epilepsy (MTLE) groups. Error bars represent +/- 1 standard error of the mean.
Utility of the Boston Naming Test in Predicting Ultimate Side of Surgery in Patients with Medically Intractable Temporal Lobe Epilepsy

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Summary: Purpose: Confrontation naming tasks have long been presumed to be sensitive to left temporal dysfunction and, consequently, are frequently used in the evaluation of surgical epilepsy patients. Despite wide and frequent use, few studies have examined the utility of confrontation naming tasks in individuals with temporal lobe epilepsy (TLE).

Methods: The current study examined the presurgical Boston Naming Test (BNT) performance of 217 right-handed adult patients with intractable TLE (left, 108; right, 109) to determine the utility of this measure in predicting ultimate side of surgery.

Results: The results support the clinical utility of the BNT in determining ultimate side of surgery and suggest that the BNT has incremental validity over and above presurgical delayed memory and intelligence scores. This relation was found to be moderated by Full Scale IQ (FSIQ), age at seizure onset, and duration of epilepsy. The use of a logistic regression equation to predict side of surgery revealed that prediction of left temporal surgery was best among patients with low BNT scores, high FSIQs, and late age at seizure onset. In contrast, right temporal surgery was best predicted among patients with high BNT scores, low FSIQs, and short duration of epilepsy.

Conclusions: This study supports the clinical utility of the BNT in the preoperative evaluation of candidates for TLE surgery and highlights the importance of examining potential moderating variables when making predictions about side of surgery. This study further provides clinicians with a regression equation that can be used to predict side of surgery in patients with temporal lobe epilepsy. Key Words: Epilepsy—Confrontation naming—Lateralization—Boston Naming Test.
How good are we?

Most studies suggest the lateralizing value for neuropsychological assessment is between 60 and 70 percent.

Wada thought to correctly classify 70 to 80 percent.

Combination of Wada and Neuropsychological testing between 80 and 90 percent (Akanuma, 2003)
Preoperative risk of decline can be predicted by neuropsychological profile and other factors alone.

- **Poor Memory outcome:**
  - Dominant hemisphere resection (60% verbal memory decline)
  - Older age
  - Good preoperative memory scores
  - Absence of MTS

- **Better Memory outcome:**
  - Nondominant hemisphere resection
  - Poor preoperative memory scores
  - Younger age
During the procedure:

- Look for the presence of paraphasic errors and speech arrest to assess language dominance
- Assess memory
  - Functional adequacy
  - Functional reserve
Routine use of the IAT has declined over the last decade, even as the number of epilepsy surgeries has increased.

In one survey, only 12 percent of centers reported that every surgical candidate underwent IAT.

85 percent of centers used the IAT on every patient in 1993 (Raush et al., 1993).

A recent world wide survey of 92 epilepsy surgery centers from 31 countries showed that nearly half of all epilepsy surgery centers utilize the IAT during presurgical workups (Baxendale 2008).

Almost half of all epilepsy surgery centers in the United States conduct the IAT on 75 percent or more of their patients.
Predicting Memory Decline Following Epilepsy Surgery: A Multivariate Approach

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Department of Clinical and Experimental Epilepsy, Institute of Neurology, London, United Kingdom

Summary: Background: While some patients experience a decline in memory function following an anterior temporal lobe resection, there is considerable individual variation in the extent, nature, and direction of postoperative memory change. Patients with surgically remediable temporal lobe epilepsy differ in etiology, the extent and type of underlying pathology, and on demographic and epilepsy-related variables, all of which may have an impact on their pre- and postoperative neuropsychological functioning. This study examined the relationship between these variables and postoperative memory decline.

Methods: Logistic regression was used to examine the effects of age, laterality of surgery, age of onset of epilepsy, underlying pathology and preoperative level of memory function on postoperative verbal learning in 288 patients who had undergone an anterior temporal lobe resection. One hundred twenty-five patients underwent a right temporal lobe resection (RTL), 163 patients underwent a left temporal lobe resection (LTL).

Results: In the group as a whole, 25% of the patients demonstrated a significant postoperative deterioration in verbal learning. Postoperative deterioration in verbal learning was significantly associated with higher levels of preoperative function in both the RTL and LTL groups. Older age at the time of the operation and a lower verbal IQ were additional significant predictors for the RTL group. The presence of cortical dysgenesis was a significant predictor of postoperative decline in the LTL group. The logistic regression models accurately identified 3/4 of those who experienced a postoperative decline in memory, using a cutoff of 0.25 or above to identify high risk.

Conclusions: Our analyses suggest that the majority of patients with a high risk of significant postoperative memory decline can be reliably identified preoperatively. These models are valuable tools helping patients make an informed decision regarding surgery.

Key Words: Memory—Temporal Lobe—Prediction Surgery—Postoperative decline.
Case example

- 38 year old woman.
- 16 years of education.
- s/p right selective amygdalohippocampectomy.
- Previous neuropsychological assessment showed large PRI < VCI difference & visual memory impairment.
- 6 events on the EMU all with right temporal lobe onset.
• Wada
  • Right injection patient passed 16/16.
  • Left injection patient failed 5/16.
  • Left hemisphere language dominance.
• Depth electrodes showed right amygdala and hippocampal seizures.
Case example continued...

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<th>S-IV:</th>
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<tr>
<td>Visual Puzzles</td>
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<table>
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<th>Task Scores:</th>
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<tr>
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<td>Spelling Proficiency:</td>
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<tr>
<td>Scale:</td>
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<td>91</td>
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- A 19-point difference between VCI and PRI was statistically significant and has a base rate of 1.5% in the normative sample. There was no significant intellectual decline compared to her previous evaluation in 2011.
Verbal learning and memory were evaluated with the RAVLT. The patient recalled 8, 12, 11, 11, and 10 of 15 possible words over successive learning trials (T = 20). He recalled 11 words from the list after a brief distraction and 9 words after a 20-minute delay. In the recognition portion of the measure, the patient produced a raw score of 15 of 15, without a positive error. Previously the patient produced an immediate total recall score of 59 (z = 1.00) and a delayed recall score of 13 (z = -1.31; p > 0.10).

BVMT-R, a measure of visuospatial learning and memory, the patient’s performance yielded scores of 4, 3, and 4 of 12 possible points over 3 trials (T < 20). After a 25-minute delay, the recall was 6 of 12 (T = 28). The patient correctly recognized 6 of 6 objects and made 1 false positive. She previously scored a total immediate recall score of 16 (z = -1.18; p > 0.10), and had a delayed recall score of 6 (z = 0.00; p > 0.10).
Case example continued…

Language function: She generated a total of 22 words on a semantic fluency task (T = 44). On the animal category, the patient earned a score of 58 of 60. The patient generated 21 animals on the semantic fluency task in 2011 (z = 0.11; p > 0.10) and produced a raw score of 54 on the BNT (z = 1.45; p > 0.10).

Executive functioning: The patient completed Trails B in 92 seconds with 1 error (T = 31). She repeated the same task in 80 seconds in 2011 (z = 0.44; p > 0.10). On the FAS the patient generated 47 words (T = 49), which is the same score she achieved in on previous testing (z = 0.00).
Summary

- The role of neuropsychological assessment in presurgical epilepsy is not only to help define seizure focus, but to determine postoperative risk of cognitive decline.

- It is very important to understand the strengths and weaknesses of neuropsychological testing in terms of lateralizing cognitive deficits.

- The use of the Wada test has declined in recent years/neuropsychological test performance can reliably predict outcome.