Introduction

The Wada Test

KIM J. BURCHIEL, M.D.

Department of Neurological Surgery, Oregon Health & Science University, Portland, Oregon

There are relatively few innovations in neurological surgery that equal the impact and durability of the Wada test. First described in 1960 by Wada and Rasmussen in the following historical Journal of Neurosurgery article, the method continues to be used today, virtually unaltered, almost one-half century later.

Unilateral intracarotid sodium amobarbital (Amytal) or sodium methohexital (Brevital) injection remains the diagnostic mainstay for localization of the language-dominant hemisphere. Speech arrest concurrent with contralateral transient hemiparesis is a clear end point and, ultimately, the most useful finding of the test. Localization of the language-dominant hemisphere has obvious and strong implications for neurosurgical procedures conducted in this hemisphere, particularly for surgical treatment of seizures originating in the mesial temporal lobe. This, in itself, justifies the continued use of the test and explains its longevity as a diagnostic modality.

The Wada test also has played a role in the determination of memory function. Specialized memory testing is less crisp than language localization in both its implementation and interpretation, and thus its utility remains somewhat debatable. However, there is little doubt that when presented with a transient, but major, memory deficit concurrent with unilateral Amytal infusion, we can infer that the hippocampus contralateral to the infusion is damaged and dysfunctional—the implication being that subsequent surgical resection of the infused hippocampus could yield disastrous memory loss.

In patients with medically intractable partial complex seizures originating in the temporal lobe, the Wada test continues to have vigorous application. In contrast to 1960, today this test also has powerful allies in the diagnostic armamentarium. Mesial temporal sclerosis can be detected by magnetic resonance (MR) images that demonstrate both hippocampal atrophy and an increased signal in the hippocampus on T2-weighted and fluid attenuated inversion recovery images. Combine an MR image showing mesial temporal sclerosis with a surface-recorded electroencephalogram demonstrating partial complex seizures lateralized to the ipsilateral anterior temporal lobe, and localization of the seizure focus is near complete. At many centers the diagnostic scheme is supplemented with neuropsychological studies to demonstrate specific and disproportionate cognitive deficits (for example, the Wechsler Adult Intelligence Scale) for either verbal (dominant hippocampus) or performance (nondominant hippocampus) IQs to confirm the hippocampal injury. Positron emission tomography (PET) studies demonstrating temporal lobe hypometabolism and intracerebral single-photon computed tomography studies complement these other noninvasive techniques. Invasive monitoring involving the use of electroencephalogram strips, grids, foramen ovale electrodes, and depth electrodes may be necessary in some instances.

Newer methods of localization of the language-dominant hemisphere and memory function threaten to replace the Wada test; however, for reasons largely composed of experience, safety, availability, and overall cost, they have not. Both PET and functional MR imaging are studies demonstrating activation; they depict brain areas involved in language but not necessarily critical to language function. The Wada test is a study of inactivation and may more closely mimic the effects of surgical resection. Thus, although both PET and functional MR imaging can provide qualitatively similar information on hemispheric language dominance, these imaging studies have not supplanted the Wada test as the standard tool. Reliable functional MR imaging memory protocols for assessment of mesial temporal lobe activation are not yet readily available.

In 1933 Albert Einstein wrote: “The supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience.” Often paraphrased as “theories should be as simple as possible, but no simpler,” Einstein’s remark may also be used to describe general principles of medical diagnostic testing. Sometimes the simplest tests are the most effective. The fact that the Wada test today continues to be a landmark in the analysis of brain localization is a testament to its simplicity and efficacy.