Is the Wada test necessary prior to epilepsy surgery?

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ABSTRACT

The Wada test was initially used to identify the hemisphere of language dominance prior to epilepsy surgery, but was subsequently applied to identify patients at risk of amnesia after temporal resection. The Wada test was later found useful in lateralizing the epileptogenic zone, predicting postoperative memory function, and predicting postoperative seizure control. The Wada test became more widely used, and in many centers became a standard component of the presurgical evaluation of epilepsy. Yet, several problems and disadvantages have surrounded the Wada test, including absence of standardized technique, overestimation of postoperative deficits, and risks and discomforts related to the invasive nature of the procedure. The Wada test may be omitted in patients who have excellent localization of the epileptogenic zone and who do not appear at risk for postoperative memory or language compromise. In addition, there is a promising alternative in functional magnetic resonance imaging (fMRI), which has already demonstrated excellent agreement with the Wada test for language dominance. Progress is being made in memory fMRI as well. The Wada test identifies the capacity of one hemisphere to sustain memory, and language functions while the other hemisphere is inactivated, while fMRI identifies regions activated by language or memory tasks. Some of these activated regions may not be essential for the activating tasks. Before fMRI can fully replace the Wada test it has to specifically identify those activated regions that are essential for memory or language function, and also measure the memory reserves of the hemisphere contralateral to surgery.

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poor baseline memory (documented on centers restrict the Wada test to difficult patients, with discomforts and risks, including risk of arterial injury using different techniques. Finally, the Wada test has makes it difficult to generalize findings across centers. These methodological variations may have an impact on the hippocampal inactivation to regions targeted for resection, selective posterior cerebral artery amobarbital procedure was devised to address this limitation. Despite that determination, the hippocampal inactivation does not seem to be consistent in all patients, which may affect Wada memory results. The specificity of the Wada test in identifying patients at risk of amnesia from temporal lobe epilepsy was also questioned, because of individuals who failed the Wada memory testing yet were not amnestic after surgery. The Wada test may overestimate the postoperative memory deficit, possibly because of anesthetized cerebral structures that are not included in the surgical resection. In order to restrict the inactivation to regions targeted for resection, selective anterior cerebral Wada procedures were devised. These procedures may possibly reduce unnecessary denial of surgery due to exaggeration of the risk of amnesia. Another limitation of the Wada test is the absence of methodological standardization across centers. Methodological differences include the type and dose of anesthetic used, the interval between the testing of the 2 hemispheres, the order of hemisphere injection, the type and number of stimuli used, timing of memory testing, and scoring system. Many of these methodological variations may have an impact on results and result interpretation. These differences make it difficult to generalize findings across centers using different techniques. Finally, the Wada test has discomforts and risks, including risk of arterial injury and cerebral dissection. Because of all the above, some centers restrict the Wada test to difficult patients, with poor baseline memory (documented on neuropsychological testing), likely atypical language representation (for example in left-handed), or unclear localization of the epileptogenic zone (bitemporal independent foci, bitemporal structural or functional abnormalities, or discrepancy between electrographic findings and structural or functional imaging data).

The most promising alternative to the Wada test is functional magnetic resonance imaging (fMRI). Functional MRI can display regions of increased blood flow (reflecting increased neuronal activity) in association with the performance of a task. These regions are presumed to be activated by the task in question. The judicial use of control tasks allows the identification of regions that are specifically activated by linguistic processing or memory encoding, rather than sensory perception or motor activity. Functional MRI has been demonstrated to lateralize language function in agreement with the Wada test in the vast majority of patients. The Wada and fMRI results diverged, the source of disagreement was usually one test indicating bilateral language distribution, while the other indicated unilateral dominance. Improvements in the testing paradigm and control task, as well as use of a combination of tasks promises to further enhance fMRI. Among the advantages of fMRI over the Wada test are its safety, its ability to localize areas with high resolution, and the potential for repeating studies with no added risk. However, much less has been carried out with fMRI memory testing. There have been studies indicating that the fMRI activation during memory items may have a lateralizing value in temporal lobe epilepsy. Functional MRI still has to be refined for testing of memory reserves. Less has been carried out with respect to identification of memory reserves in the contralateral hippocampus and identification of patients at risk of postoperative amnesia.

The Wada test is not always necessary prior to epilepsy surgery, but provides complementary and supportive data that improves the confidence of the presurgical evaluation. However, the Wada test has limitations, risks, and discomforts, and it is likely that in the future, fMRI may become the method of choice for routine preoperative assessment of language and memory, while the Wada test will remain an option for difficult patients.

References

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