

NOTES AND DISCUSSION

Differential Recovery of Languages in a Bilingual Patient: A Case Study Using Selective Amytal Test

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We performed a selective Wada test on a bilingual patient. While a left middle cerebral artery (MCA) injection produced global aphasia for both (Spanish and English) languages, the patient could only speak Spanish (his mother tongue) 1 min after he started to speak English. No language disturbances were observed after a right MCA amytal injection. These findings suggest that all of a multilingual's languages are stored within the verbal-dominant perisylvian region, and while the second language may be organized within the central Sylvian core, the first language may be better represented in more distal perisylvian areas. © 1990

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INTRODUCTION

A recent issue of *Brain and Language* was devoted to the examination of the representation of multiple languages in the brain (Zatorre, 1989). The consensus was that while bilinguals have a unilateral (mainly left hemisphere) representation for all languages, languages may have a different within-hemisphere localization (Whitaker, 1989). We had the fortuitous opportunity to assess the lateralization for different languages in a bilingual patient who underwent a Wada (amytal) test.

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CASE REPORT

The patient was a 25-year-old right-handed man (Edinburgh Handedness Inventory score of +100), Buenos Aires native Spanish speaking (he thought in Spanish and used this language while at work and for reading, writing, and conversation), who had learned English as a second language during high school. The patient was referred to our Institute for a therapeutic embolization of a right mesial basotemporal arteriovenous malformation. Since the first embolization was only partially successful (a Wada test was not performed), a new procedure was scheduled. Before the second embolization, a neuropsychological evaluation showed a full WAIS IQ of 90 (VIQ 105, PIQ 71), a Wechsler Memory Scale score of 116, and a Western Aphasia Battery score (AQ 96) well above the cutoff score for aphasia.

After informed consent, the amytal test was performed as follows: after a transfemoral catheterization, a control angiogram determined the absence of an occlusion of the internal carotid artery and its major branches and ruled out anomalous vessel patterns other than the malformation itself. A selective technique was used (Jack, Nichols, Sharbrough, Marsh, & Petersen, 1988), the catheter (5 French) was advanced into the M1 section of the left middle cerebral artery (MCA) (which was visualized with digital angiography) (Fig. 1), and 30 mg of diluted amobarbital was injected.

During the first 13 sec after the injection, the patient was globally aphasic and had a right hemiplegia. Fifty-seven seconds later he started to produce guttural sounds, and from there on, the examiner repeatedly asked the patient (in Spanish) to start counting, repeat simple words, name common objects, and follow simple commands. Prior to 2 min, 48 sec after the injection, the patient had not spoken any recognizable words in Spanish nor in English. At 2 min, 48 sec the patient spoke his first words. Although the examiner had addressed the patient only in Spanish, the patient's first words were in English. What follows is a verbatim transcription of the tape-recorded session:

Examiner (2:35) (in Spanish): Please, start to count from 1 to 10.

Patient (2:48 after the amytal injection) (in English): I don't speak clear...How are...are....

Examiner (3:01) (in Spanish): How are you feeling?

Patient (3:07) (in English): So...so....

Examiner (3:12) (in English): Do you feel all right?

Patient (3:20) (in English): What?

Examiner (3:24) (in English): Are you feeling OK?

Patient (3:40) (in English): Well...so so...(first words in Spanish): my mouth is dry.

Thirty minutes later, amytal was injected into the right frontopolar artery. Five seconds after the injection the patient was asked to follow



FIG. 1. Selective digital subtraction angiography of the left middle cerebral artery (the arrow points to the tip of the tracker).

simple commands, name objects, and repeat short sentences, in both English and Spanish, which he did flawlessly. Fifteen minutes later, amytal was injected into the M1 segment of the right MCA. During barbiturization, naming, comprehension, repetition, and verbal output, in both English and Spanish, were correct.

After the embolization procedure, the patient was asked why he started to speak in English after the first amytal injection, and he answered: "I tried to speak in Spanish but could only say ah...ah...with my mouth, and I could not speak. I could hear your voices but I could only hear noises, and when you were speaking loudly, I could only hear shouts and shouts and nothing else. Since I could not speak in Spanish, I started to speak in English and I realized I could do it without problems."

DISCUSSION

While several workers have hypothesized that in bilinguals, the second language is organized in the right (or verbal nondominant) hemisphere, recent studies support the hypothesis that bilinguals may have all of their language in one hemisphere (Ojemann & Whitaker, 1978a). This hemisphere is usually the left, as it is for most unilingual speakers. In rare cases, however, both languages may be located in the right hemisphere (patient 2 in Ojemann & Whitaker, 1978b).

Rapport, Tan, and Whitaker (1983) examined four bilingual patients using Wada tests and cortical stimulation and found that these poliglots were all left hemisphere dominant for the language tested. After the amytal injection, the patients showed a different time course of recovery for various languages, suggesting that languages are organized in different brain areas within the same hemisphere.

Our patient was globally aphasic for both Spanish and English after a left hemisphere amytal injection. He spontaneously started to speak in English, and could only speak Spanish 52 sec later. Since our patient received a *selective* amytal injection in the left MCA, both languages had to be stored within the boundaries of the perisylvian speech region. The fact that the patient recovered his second language first suggests that, similar to Rapport's et al. findings, the second language may have a different organization within the left MCA territory than the first language.

Since the sodium amytal enters the MCA bed in the Sylvian fissure first, and then moves outward to the distal branches of the MCA, the central core of the MCA in the Sylvian fissure should become clear of sodium amytal before the distal branches. Thus, function should first return to the cortex that is immediately around the fissure of Sylvius, and before the cortex of the watershed area (Whitaker, 1983; H. A. Whitaker, personal communication). This would imply that in our patient, English was represented in the central Sylvian core of the left hemisphere, while Spanish was better represented in the more distal perisylvian regions.

Our present findings, as well as Rapport's et al. data, may also imply the presence of higher and lower biochemical thresholds for the two languages (H. A. Whitaker, personal communication). The language with the higher threshold (English in our patient) will be restored first, since after 2 min, 48 sec, the sodium amytal has diluted sufficiently so that responsive neurons may start functioning again. Spanish, having a lower biochemical threshold, may not have returned until the amytal was further diluted beyond this lower threshold.

Future studies using selective amytal injections in branches of the MCA may allow further understanding of the location of languages in multilingual patients.

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