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Basal Temporal Language Area: Evidence from Cortical Stimulation and Surgical Ablation

Rima Abou-Khalil, Robert T. Wertz, Bassel W. Abou-Khalil, Larry W. Welch, and Bennett Blumenkopf

Reports by Luders et al. (1986, 1991) and Burnstine et al. (1990) imply the presence of a basal temporal language area—the BTLA, shown in Figure 1. It is located in the fusiform gyrus in the basal temporal lobe; however, it may extend into the inferior temporal gyrus and the parahippocampal gyrus.

The initial observation by Luders et al. (1986) was made during electrical stimulation of a patient being evaluated for surgical ablation to relieve intractable seizures arising from the left temporal lobe. Stimulation of the fusiform gyrus resulted in disruption of auditory and reading comprehension, naming, and writing. Subsequently, Burnstine et al. (1990) stimulated the BTLA in five patients being evaluated for epilepsy surgery. All five experienced language dysfunction during stimulation of the BTLA. During surgery, only one had resection of the BTLA. This patient experienced postoperative dyslexia that was resolved 1 year postsurgery. The other four patients did not experience postoperative language deficits.

In 1991 Luders et al. reported on stimulation of the left hemisphere BTLA in 22 patients with intractable complex partial seizures. Stimulation produced speech and language disturbances in eight patients. Subsequent surgical resection spared the BTLA in five patients and involved the BTLA in three patients. Postsurgical language deficits were observed in all patients, and the severity of these deficits was similar in patients who had BTLA resection and those who had not.

The evidence is enigmatic. There appears to be no direct, consistent relationship between language disturbance during electrical stimulation of the BTLA and language disturbance following surgical resection of the BTLA. Moreover, the basal temporal cortex does not appear to be important for language in all patients that have been examined with electrical

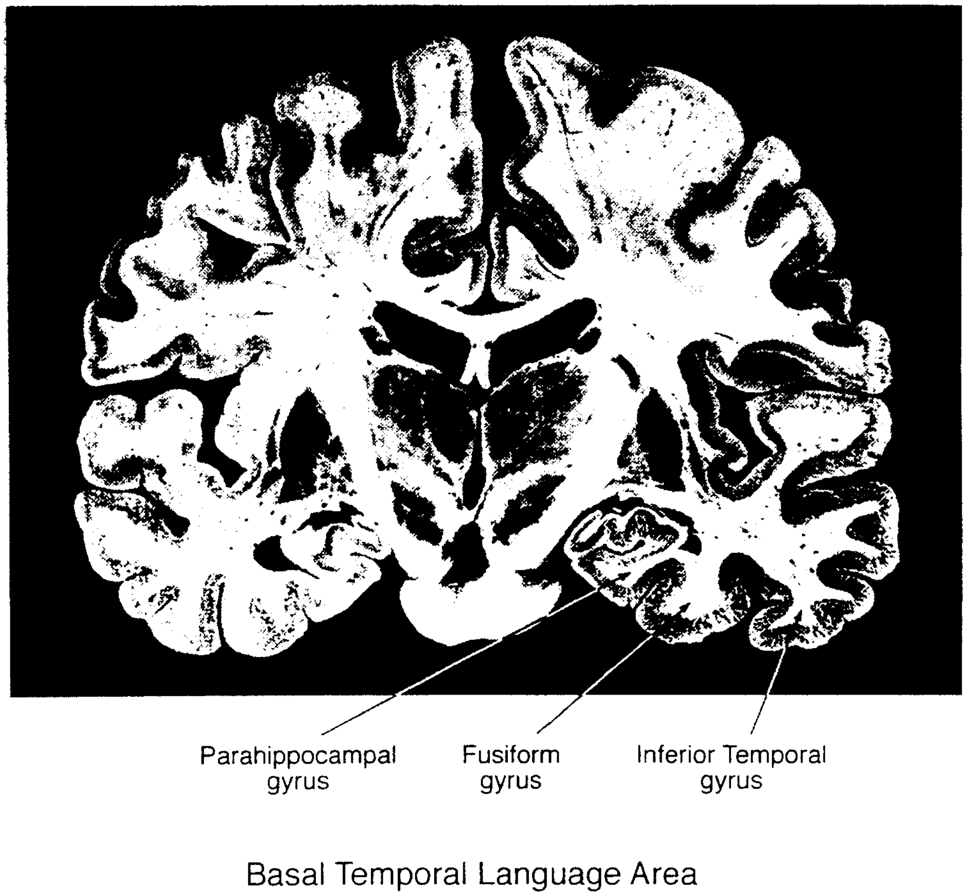
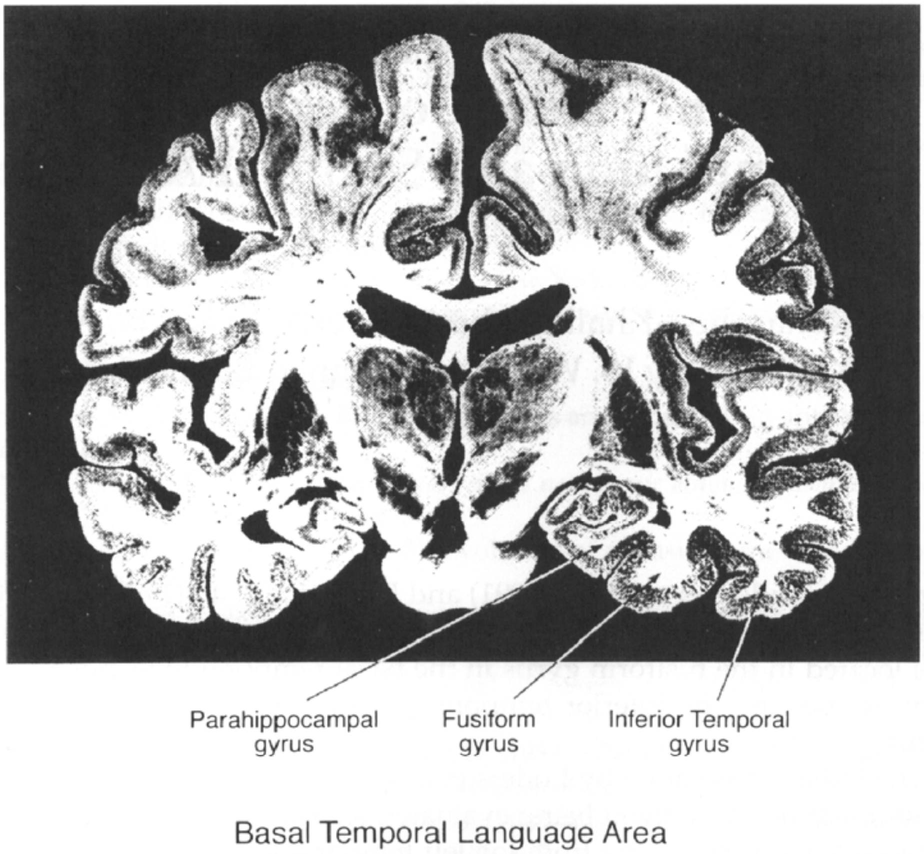


Figure 1. The basal temporal language area (BTLA) is located in the fusiform gyrus in the basal temporal lobe. It may extend into the inferior temporal gyrus and the parahippocampal gyrus.

stimulation. We wonder whether the basal temporal cortex *is* important for language, and if it is, should it be spared during epilepsy surgery? The purpose of this paper is to report a retrospective examination of 16 epileptic patients who had electrical stimulation of the basal temporal cortex preoperatively, subsequent surgical intervention for the relief of intractable seizures, and pre- and postsurgical language evaluations.

METHOD

Sixteen patients, 13 females and 3 males, who were surgical candidates to relieve intractable seizures were selected for study. Selection criteria included: the patient had received preoperative stimulation of the BTLA,



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METHOD

Sixteen patients, 13 females and 3 males, who were surgical candidates to relieve intractable seizures were selected for study. Selection criteria included: the patient had received preoperative stimulation of the BTLA, had undergone surgical resection for the relief of seizures, and had received pre- and postsurgical neuropsychological evaluations. As shown in Table 1, age at surgery ranged from 7 to 44 years, with a mean of 30.3 years. Age at onset of seizures ranged from 8 months to 34 years, with a mean of 12 years. Fifteen patients were right-handed, and one was left-handed. Epileptic focus was in the left temporal area in all patients.

Patients received pre- and postoperative testing with the Wechsler Adult Intelligence Scale–Revised (WAIS–R) (Wechsler, 1981) and the Boston Naming Test (BNT) (Kaplan, Goodglass, and Weintraub, 1983) as part of a comprehensive neuropsychological test battery. Preoperative WAIS–R Verbal IQ ranged from 72 to 102 (M = 86.4), and BNT total correct ranged from 22 to 54 (M = 43.3). Clinical reports by the attending neurologist indicated that six of the 16 patients demonstrated some language disturbance preoperatively. Identification of language disturbance was based on observation of naming and word-finding difficulty.

Fifteen of the 16 patients had preoperative Wada testing to establish cerebral dominance for language. Thirteen patients displayed left hemisphere language dominance, two patients displayed bilateral language representation, and language dominance was unknown for one patient.

All patients were evaluated with electrical stimulation, including the basal temporal cortex, preoperatively. As shown in Figure 2, electrical stimulation utilized two grids—64 electrodes to map the lateral surface of the hemisphere and an array of 20 electrodes to map the basal temporal cortex. All 20 electrodes were utilized in 12 patients, and a strip of four electrodes, extending mesial to lateral, was used to stimulate four patients. All stimulation was bipolar to isolate and specify areas of interference.

All patients underwent surgical resection for the relief of intractable seizures. Resection involved the basal temporal cortex in 12 patients and spared it in four patients. Wernicke's area was spared in all patients.

Table 1. Patient Descriptive Data

Variable	*N*	*Mean*	*Range*
Age at surgery (in years)	16	30.3	7 – 44
Age at onset of seizures (in years)	16	12.0	.67 – 34
Preoperative WAIS–R Verbal IQ	16	86.4	72 – 102
Preoperative Boston Naming Test total score	14	43.3	22 – 54

Note: WAIS–R = *Wechsler Adult Intelligence Scale–Revised* (Wechsler, 1981).

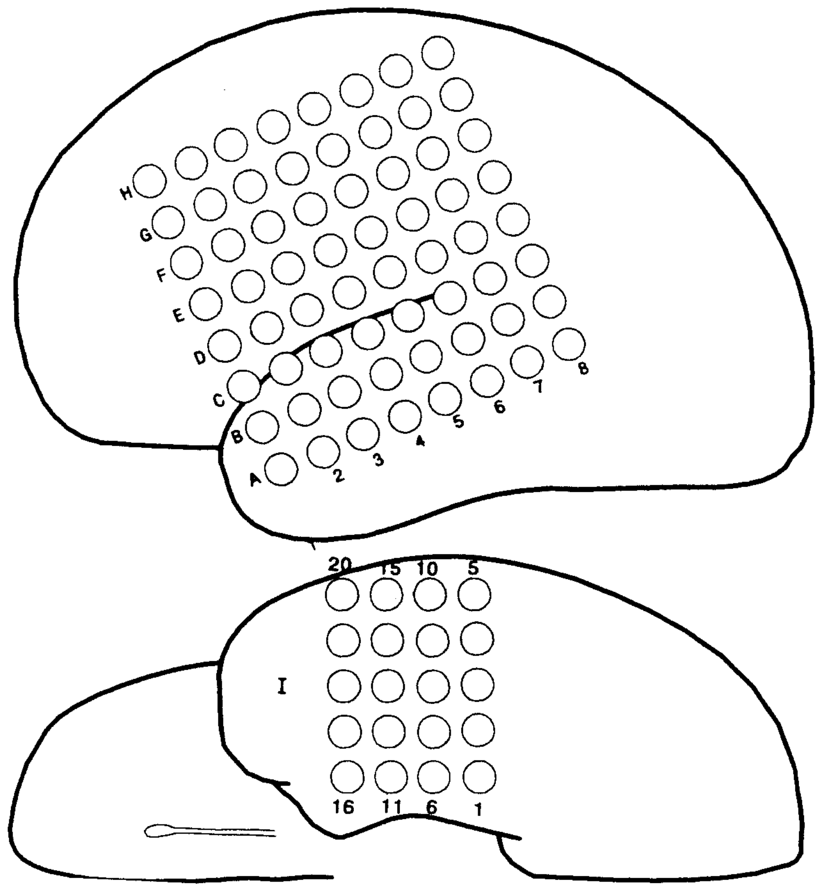

Figure 2. Grids utilized in preoperative electrical stimulation. Sixty-four electrodes are employed to map the lateral surface of the hemisphere, and 20 electrodes are employed to map the basal temporal cortex. All 20 electrodes were used to map the basal temporal cortex in 12 patients, and a strip of four electrodes, extending mesial to lateral, was used to stimulate four patients.

RESULTS

Table 2 shows that during stimulation of the left hemisphere basal temporal cortex, 11 patients displayed language disturbance and five patients did not. Of the 11 patients who displayed language disturbance during stimulation of the basal temporal cortex, nine were left hemisphere dominant for language, as indicated by Wada testing; one had bilateral language representation; and Wada testing was not done for one. Of the five patients who did not experience language disturbance during stimulation, Wada testing indicated four had left hemisphere language dominance, and one had bilateral language representation.

Table 2. Wada Dominance and Number of Patients Showing Language Disturbance During Left Hemisphere Basal Temporal Stimulation, Number of Patients with Left Hemisphere Basal Temporal Area Resection, and Number of Patients with Language Disturbance During Stimulation Who Did and Did Not Have Subsequent Basal Temporal Resection

	Disturbance		*BTLA Resection*	
Wada Dominance	*Yes*	*No*	*Yes*	*No*
Left Hemisphere	9	4	10	3
Bilateral	1	1	1	1
Unknown	1	0	1	0
Language Disturbance During Stimulation (N = 11)			7	4

Note: All patients, N = 16; disturbance during stimulation, N = 11; patients with resection, N = 12.

Table 3. Number of Patients Showing Postoperative Change in WAIS–R Verbal IQ and Boston Naming Test Performance

		Postoperative Change		
Measure	*N*	+	−	*None*
WAIS-R Verbal IQ	13	3	8	2
Boston Naming Test	12	0	11	1

Note: Postoperative Change (+ = improved; − = worse; None = no change); WAIS–R = Wechsler Adult Intelligence Scale–Revised (Wechsler, 1981).

As shown in Table 2, resection involved the left hemisphere basal temporal cortex in 12 patients and spared it in four patients. Of the 12 patients who had basal temporal resection, 10 had left hemisphere language dominance, one had bilateral language representation, and dominance was unknown in one. Of the 11 patients who displayed language disturbance during stimulation of the basal temporal cortex, seven had basal temporal resection, and four did not.

Postoperative reevaluation ranged from 2 to 5 months postsurgery. Postoperative WAIS–R Verbal IQ performance was available on 13 patients, as shown in Table 3. Of these, eight displayed a 2- to 8-point drop in Verbal IQ,

Table 4. Number of Patients with Postoperative Language Change; Language Interference Present During Basal Temporal Stimulation; and Having the Basal Temporal Area Resected or Spared During Surgery

	Postoperative Change									
	WAIS-R Verbal IQ					*Boston Naming Test*				
BTLA	*N*	+	–	*0*	*NA*	*N*	+	–	*0*	*NA*
Present – Resected*	7	3	3	0	1	7	0	6	0	1
Present – Spared	4	0	2	1	1	4	0	2	1	1
Absent – Resected*	5	0	3	1	1	5	0	3	0	2

Note: Postoperative language change (+ = improved, – = worse, 0 = no change, NA = results unavailable).
*Surgery included the basal temporal cortex.

three displayed a 1- to 8-point increase, and two showed no change. Postoperative BNT performance was available on 12 patients. Of these, 11 displayed a 3- to 19-point drop in BNT performance, and one showed no change.

As indicated in Table 4, seven patients displayed preoperative language disturbance during stimulation of the basal temporal cortex and had it resected during surgery. Postoperative WAIS–R Verbal IQ was improved in three of these patients, worse in three, and unavailable for one. Postoperative BNT performance was worse in six patients and unavailable for one. Four patients displayed language disturbance during stimulation and did not have basal temporal resection during surgery. Postoperative WAIS–R Verbal IQ was worse in two of these, unchanged in one, and unavailable for one. Postoperative BNT performance was worse in two, unchanged in one, and unavailable for one. Five patients did not display language interference during preoperative stimulation and had basal temporal resection during surgery. Postoperative WAIS–R Verbal IQ was worse in three patients, unchanged in one, and unavailable for one. Postoperative BNT performance was worse in three of these patients and unavailable for two.

Clinical observations, Table 5, indicated some language disturbance—primarily naming and word-finding problems—in four patients pre- and postoperatively. Of these, one showed interference during stimulation and had basal temporal resection, two showed disturbance during stimulation and did not have basal temporal resection, and one showed no interference during stimulation and had basal temporal resection. Two patients were reported to have language disturbance only preoperatively. Of these, one did not show interference during stimulation and had basal temporal resection. The other patient showed language disturbance during stimulation and did not have basal temporal resection. Four patients were

Table 5. Clinical Impressions of Language Disturbance—Primarily in Naming and Word Finding

Language Disturbance	*Number of Patients*
Pre- and postoperatively	4
Preoperatively only	2
Postoperatively only	4
Neither	6

observed to have language disturbance only postoperatively. Of these, two showed interference during stimulation and had basal temporal resection, one showed interference during stimulation and did not have basal temporal resection, and one showed no interference during stimulation and had basal temporal resection.

The six patients who were not observed to have language disturbance either pre- or postoperatively are of interest. Of these, four showed interference during stimulation and had basal temporal resection. Two showed no interference during stimulation and had basal temporal resection.

DISCUSSION

Our retrospective data do little to resolve the enigma. There appears to be no systematic relationship between language disturbance during electrical stimulation of the basal temporal area and language disturbance following surgical resection of the basal temporal area. Moreover, our data indicate no systematic relationship between age at onset of seizures or age of surgery and the presence of language disturbance during BTLA stimulation, or following BTLA resection. The BTLA was present, based on language disturbance during stimulation, in 11 of our 16 patients. Those who had basal temporal resection experienced an average 1-point drop in WAIS–R Verbal IQ performance and an average 6-point drop in BNT performance. Those who did not have basal temporal resection experienced an average 3-point drop in WAIS–R Verbal IQ performance and an average 7-point drop in BNT performance. The largest postoperative drop in WAIS–R Verbal IQ, 8 points, and BNT performance, 19 points, occurred in the same patient. He displayed language disturbance during stimulation of the basal temporal cortex, but he did not have basal temporal resection during surgery.

We continue to wonder whether the basal temporal area is important for language, and if it is important, should it be spared during epilepsy surgery? Essentially, are we discussing the basal temporal area or the basal temporal *language* area?

The BTLA has been observed only in epileptic patients. To our knowledge, there are no reports of behavioral deficits in patients who have experienced focal damage in the BTLA as a result of other etiologies. It is possible that the BTLA exists only in patients with intractable seizures. However, all of these patients do not demonstrate the presence of a BTLA during electrical stimulation.

Retrospective data are not desirable data. If we are serious about demonstrating the presence or absence of a basal temporal language area, a systematic, prospective investigation is necessary.

Particular care must be taken in interpreting data obtained from electrical stimulation. Luders et al. (1986) caution that speech arrest during electrical stimulation may result from a positive motor effect when stimulation causes contraction of muscles that participate in speech. Conversely, speech arrest may result from a negative motor effect that occurs when stimulation paralyzes muscles that participate in speech. And, speech arrest may result from alteration of consciousness when stimulation induces a seizure. To demonstrate, the basal temporal area is a language area, stimulation, as observed by Luders et al. (1986, 1991) and in 11 of our 16 patients, must disrupt language—auditory and reading comprehension, oral-expressive language, and writing.

Thus, it is necessary to develop a battery of sensitive, reliable, language measures; administer this systematically pre- and postoperatively and during electrical stimulation preoperatively; and control for other consequences of electrical stimulation. Moreover, it is necessary to reevaluate patients, systematically, at specific points in time postoperatively to determine whether language disturbance, if present, persists.

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