

Lüders, H., Lesser, R.P. Jr., Hahn, J., Dinner, D.S., Morris, H.H., Wyllie, E., and Godoy, J. (1991). 'Basal temporal language area' Brain 114, pp. 743-754.

BACKGROUND

Penfield and Roberts (1959) defined three speech areas by intraoperative electrical stimulation:

- 1) anterior - Broca's area
- 2) posterior - Wernicke's area
- 3) superior - supplementary motor area

No additional reports of language interference when stimulating (3)

Previous report (Lueders et al. 1986) of language deficit in one subject under stimulation of the occipitotemporal (fusiform) gyrus of the dominant temporal lobe

Present study a report on stimulation of BTLA in 26 patients

METHODS

Subjects

29 subjects with intractable epileptic seizures being evaluated for surgical treatment of epilepsy – 26 included in study

14 to 36 years of age

Subdural Electrode Grids

16 or more electrodes implanted over BTLA of dominant hemisphere in each patient

21 patients had one 4 x 4 electrode grid implanted under the dominant basal temporal region

3 patients had 4 x 4 electrode grids implanted under both basal temporal regions

2 patients had one 4 x 6 electrode grid implanted under the dominant basal temporal region

Speech and Language Evaluation

Boston Diagnostic Aphasic Examination
Boston Naming Test
Revised Token Test
Word Fluency Test
"assorted informal measures"

RESULTS

Stimulation of BTLA produced interference (defined as "speech arrest or slowing down [of speech] during the `reading aloud test'")

Speech interference under stimulation in three areas (dominant hemisphere only):

- 1) BTLA: 8 out of 22 cases (36.36%); average of 3.6 electrodes (range 1-7)
- 2) Broca's area: 15 out of 22 cases (68.18%); average of 2.7 electrodes (range 1-15)
- 3) Wernicke's area: 14 out of 22 cases (63.63%); average of 4.0 electrodes (range 1-16)

Degree of interference a direct function of intensity of stimulation

No interference with rapid movements of tongue or fingers when stimulating electrodes where speech arrest occurred

More detailed testing undertaken in three patients

Interference under stimulation in the following tasks:

- reading single words (3 out of 3)
- following written commands (2 out of 2)
- following oral commands (2 out of 2)
- following simple one-step commands (Token Test, verbal comprehension) (1 out of 3)
- confrontation naming (3 out of 3)
- word repetition (2 out of 2)
- sequential tasks

counting (0 out of 1)
counting by threes (1 out of 1)
days of the week (1 out of 1)
months of the year (1 out of 1)

- writing simple letters (2 out of 3)
- (written) spelling and reading of own output (1 out of 1)
- copying simple words (0 out of 2)
- reading these copied words (2 out of 2)
- simple written math problem (1 out of 1)
- oral math problems (2 out of 2)
- Koh's block tasks (0 out of 2)
- copying geometric designs (0 out of 3)
- imitating facial expressions (0 out of 1)

Epileptiform discharges in

- all electrodes eliciting language interference (4 patients)
- some electrodes eliciting language interference (2 patients)
- no electrodes eliciting language interference (2 patients)

= showing language interference under stimulation of BTLA (8 patients)

Anterior border of BTLA 3-3.5 cm from anterior pole of temporal lobe

Posterior border of BTLA 4-7 cm from anterior pole of temporal lobe

Surgical Resection

BTLA spared: 5 patients
BTLA removed: 2 patients
BTLA infarcted postsurgically: 1 patient

No significant change in language function: 3 patients
(2 resections, 1 infarct)

infarcted patient had a mild receptive aphasia postoperatively
which disappeared in six months

Mild improvement in language function: 2 patients (BTLA spared)

Mild losses in language function: the other 3 patients (BTLA spared)

DISCUSSION

Speech arrest can be caused by:

- 1) a positive motor effect (contraction of muscles necessary for speech)
- 2) a negative motor effect (paralysis of speech muscles)
- 3) alteration of consciousness (seizure)
- 4) specific interference with a language process (with no positive or negative motor effects and no change in consciousness)

Possibility that results merely due to (1) - (3) in this study excluded by extensive testing (p. 748)

- no observation of (1) or (2) in BTLA

- (1) exclusively found in perirolandic area and supplementary motor area

- (2) found in premotor region (particularly in Broca's area)

- patients able to perform complex nonverbal functions under equivalent levels of stimulation at these electrodes
[rules out (3)]

- language interference at electrodes with no epileptiform activity
[rules out (3)]

BTLA located exclusively in occipitotemporal (fusiform) gyrus

No language interference in inferior temporal gyrus

Indicates BTLA separate from Wernicke's area,

BUT white matter of BTLA in contact with white matter of Wernicke's area

No sign of fluent aphasia after resection of BTLA

Why were there twice as many instances of interference in Broca's and Wernicke's areas (relative to interference in BTLA)?

- BTLA more posterior than grid?

==> no, BTLA more anterior, with a posterior margin only 7 cm from anterior temporal pole

- BTLA of smaller size than classic language areas?

==> no, BTLA and Broca's area covered by same number of electrodes

- BTLA really a displaced Wernicke's area due to epilepsy?

==> no, the main epileptogenic focus in BTLA, not Wernicke's

also, independent Wernicke's area located where it should be in 6 out of the 8 patients with a BTLA

- BTLA dispensable because of compensatory mechanism?

==> probably: those with BTLA removed or infarcted showed no long-term deficits

In search of Wernicke's "Wortschatz" (speculation):

"This suggests that the patients had no access to the verbal engrams which establish the link between symbolic verbal material and the corresponding nonverbal expressions." (p. 751)

Speech arrest AND comprehension deficits in all 3 language areas under stimulation