Linguistic and Behavioral Deficits Following Thalamic Hemorrhage

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INTRODUCTION

Penfield and Roberts (1959) and Fisher (1959) were the first to document "dysphasia" following hemorrhages in the dominant thalamus. Twenty years later, Benson (1979) commented, after reviewing the literature on thalamic aphasia, that the topic remained controversial. Some authorities postulate chronic aphasic-like symptoms from thalamic damage while others believe that severe thalamic damage results only in transient language deficits. Transitory aphasic disturbances were reported following surgical probes by Bell (1968) and Ojemann and Ward (1971) and reinforced interest in the role of the thalamus in language function. In 1977, Rubens suggested that the dramatic recoveries from thalamic hemorrhage might be explained on the basis of the nervous structures being pushed aside rather than destroyed as in ischemic infarcts. Recently Glosser, Kaplan, and LoVerme (1982) commented:

> "A...confounding factor in assessment of the possible neurolinguistic role of the thalamus and adjacent structures has been the general neglect of the study of the recovery process of these lesions, although there is suggestive evidence that behavioral recovery following injury to subcortical areas differs from that observed in cortical syndromes." (p. 97)

The role of subcortical structures and mechanisms in language function has remained poorly delineated because of a lack of longitudinal studies, as cited by Glosser et al., incomplete and nonsystematic test reports, and failure to correlate site of lesion with language performance. Two recent studies by Naeser et al. (1982) and Damasio et al. (1982) have partially resolved the latter issue by carefully describing and documenting the size and extent of the subcortical lesions. The Naeser et al. study related variations in site of lesion to comprehensive test differences, but reported no single, primary type of aphasia syndrome, although subgroups with similar deficits were described. Alexander and LoVerme (1980) reported no definite differences in the aphasia patterns seen from hemorrhages in the putamen vs. those in the thalamus. Indeed, the variability among patients with subcortical lesions and language deficits is considerable and may preclude the possibility of establishing verifiable aphasic subtypes. Glosser et al. (1982) state that their patient, whom they studied for three years, differed in significant ways from other patients with thalamic lesions. This paper provides clinical documentation of a patient who, though similar to certain reported cases, may well add further credence to the thesis that individual variability is the hallmark of thalamic aphasia.

SUBJECT DESCRIPTION

The patient is a 71 year old, right-handed male attorney who was in good health until 2/8/81. He was married to his work and his wife was in

a passive, supportive role. In February, 1981, he had an abrupt onset of dense right hemiplegia with vomiting and aphasia. Computed tomography (Figure 1) on 2/16/81 showed a hemorrhage in the left thalamus with obliteration of the posterior third ventricle and some involvement of the globus pallidus and the internal capsule. Computed tomography (Figure 2) on 4/3/81 is comparable to the scan of 2/16/81, and shows resolution of the hemorrhage. The posterior third ventricle is now seen. The site of the original hemorrhage in the thalamus is demonstrated by a low density area. Physical examinations documented a dense flaccid right hemiplegia with some improvement in the lower right extremity which enabled the patient to walk a few steps in parallel bars. An extensor plantar response was reported on the right. Deep tendon reflexes were 1+ and symmetrical bilaterally. Tactile-proprioceptive sensation was reduced in right upper extremity and right facial area.

Speech and language testing on 4/20/81 revealed reduced gag reflex, impaired lip retraction on the right, and persistent drooling. Tongue movements were grossly normal and brief phonatory samples were of normal quality, though vocal durations were reduced. Previous incomplete speech and language reports from one and two months post insult indicated fluctuating auditory recognition from zero to 100% for single words and limited but intelligible speech on sentence completion items. Considerable variability in recognizing spoken and printed words typified his responses on 4/20/81 with consistent difficulty in comprehending sentence level material. Subsequent testing on the Boston Diagnostic Aphasia Examination (BDAE, Goodglass, Kaplan, 1972) beginning on 5/21/81 revealed repetition to be accurate and intelligible for phrase and short sentence items. The patient had moderate anomia. Conversation was fluent but contained numerous perseverative, paraphasic, and neologistic components. Reading was limited to 50% accuracy for single words and resulted in failure at the sentence level. Writing, using the nonimpaired left hand, revealed limited ability to copy, production of name but not address, and only a few letters of the alphabet with perseveration evident. Surprisingly, he could repeat seven digits forward accurately.

Psychologically, the patient initially had frequent drowsy periods when unattended. He showed paranoid-like sensitivity, particularly when references were made to his errors or deficits, and would frequently deny, confabulate, or argue with the examiner.

TEST RESULTS AND TREATMENT RESPONSES

Treatment was initiated on 6/1/81, and consisted of daily speech and language sessions of one-hour duration. Treatment was terminated on 12/23/81. Table 1 presents test results. Auditory comprehension improved on the BDAE from 47 in May to 94 in November (possible score = 120). A positive change was also noted in reading and, to a lesser extent, in writing on the Boston Diagnostic Aphasia Examination. Subtests of the Reading Comprehension Battery for Aphasia (LaPointe and Horner, 1979) (Table 1), revealed mild fluctuations in single word performance and continuing difficulty in comprehending sentences and paragraphs. The Porch Index of Communicative Abilities (Porch, 1967) administered on 9/30 and 12/2 indicated a 10 percent overall improvement (Table 1).

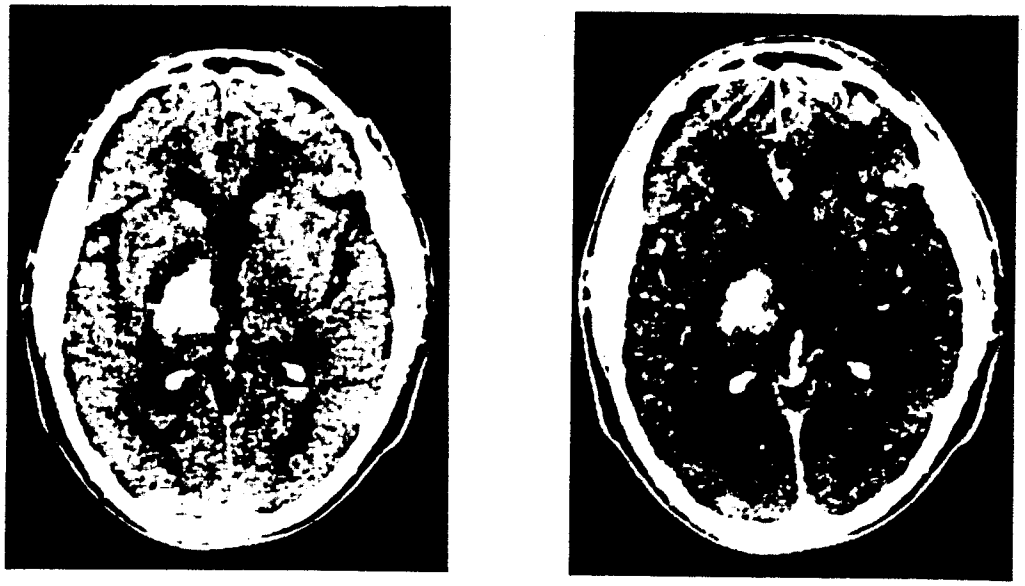

Figure 1. Computed tomogram, February 16, 1981 (a) without contrast and (b) with contrast shows left thalamic hemorrhage with obliteration of the posterior third ventricle. There is some involvement of the internal capsule and the globus pallidus.

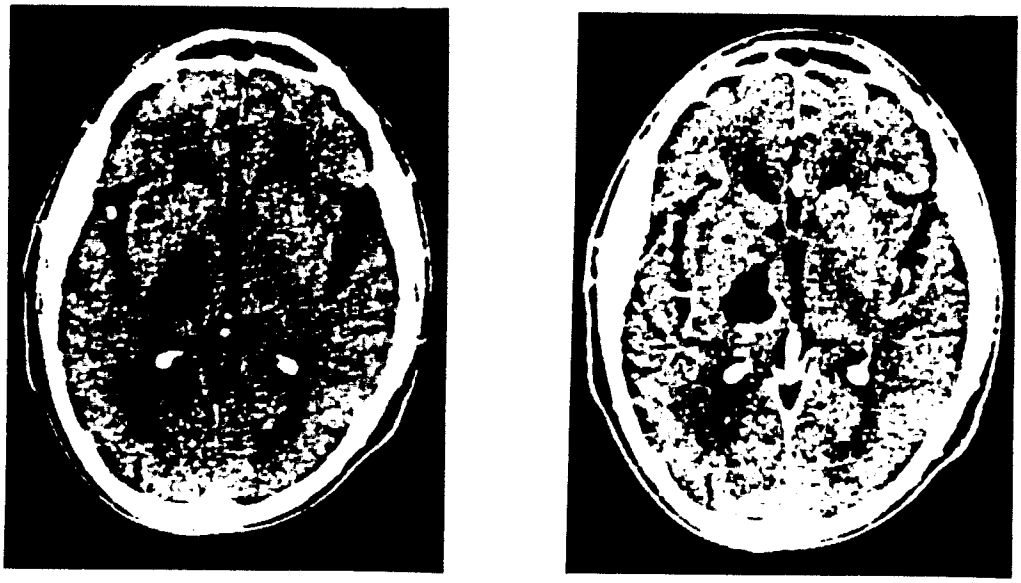

Figure 2. Computed tomogram, April 3, 1981 (a) without contrast and (b) with contrast, comparable with examination on February 16, 1981, shows residual lesion in the left thalamus with some enhancement after administration of contrast material.

Table 1. Subject's speech and language test performance.

Boston Diagnostic Aphasia Examination

Dates	Auditory Comprehension	Oral Expression	Understanding Written Language	Writing
5/21/81	47	151	15	1
6/10/81	76.5	124	21	11
8/31/81	92.5	172	33	15
11/24/81	94	188	32	22

Reading Comprehension Battery Serial Scores (Selected Subtests)

Dates	I	II	III	IV	V	VI
4/21/81	5	8	6	2	-	-
6/26/81	4	5	7	6	-	-
9/09/81	6	9	7	-	-	5
11/16/81	2	8	5	6	-	8

Porch Index of Communicative Abilities

Date	Overall	Auditory		Verbal			
		VI	X	I	IV	IX	XII
9/30/81	43%	12.2	10.9	6.8	8.3	9.5	14.8
12/02/81	53%	11.5	12.6	6.6	10.7	12.1	14.8

	Reading		Graphic	Gestural
	V	VII	A-F	II & III
9/30/81	8.0	13.3	7.85	9.9
12/02/81	10.5	14.0	8.68	10.9

Repeated language samples consisting of conversation in response to the BDAE "Cookie Thief" picture and to Base 10 simple action pictures were recorded on audio and videotape. Typical verbal responses over time are presented in the Appendix. Connected speech attempts revealed (1) semantic perseveration; (2) amnestic difficulties in recalling current and past events, vital information, and names of treatment therapists despite practice and cuing; (3) paraphasias, mostly verbal; (4) misnaming of objects and action with great variability; (5) hypophonia and reduced articulatory precision, particularly as length of utterance increased and treatment session lengthened; (6) repetition of correct response or reading aloud of correct answer without integration of concept; (7) frequent failure to alert and attend without additional cues and structure. The authors are indebted to Dr. Marilyn Newhoff, San Diego State University, who offered an informal analysis of the language samples. She noted a tendency to either omit verbs

or over-use them; associative or related word use that revealed loss of semantic constraints, perseveration, misuse of pronouns and functors; ascribing animate functions to inanimate objects; and premorbid influences of interests, intellect and role-dominance affecting descriptions of pictures and features that he selected for comment (e.g., man pouring coffee for woman was negated).

Improvement was noted in the patient's ability to recognize errors and to a lesser extent in his ability to self-correct these errors. Transfer of self-correction to real-life situations was disappointing, although the patient often would stop when errors were recognized. A definite reduction in his paranoid-like sensitivity was noted and the patient could discuss, in tangential fashion, some of his problems in communication. Memory deficits remained to a significant degree, as well as impaired functional communication, as described by Ojemann, Blick, and Ward (1971). Personal conversation about his premorbid professional activities resulted in the best language use.

The speech and language characteristics of our patient have certain similarities to those described by Benson (1981), who stated that patients with subcortical lesions are typified by disheveled appearance, hypophonic voice, memory disturbances requiring considerable cuing for recall, "dilapidated cognition," and lowered activity levels. Most of these behavioral descriptions could be applied to our patient. The necessity for supplying cuing and structure to initiate and sustain alertness and attention suggests subcortical deficiencies in activating and selection of salient stimuli. Semantic perseveration was noted by Glosser et al. (1982) as quite characteristic of their patient. However, our patient had persisting dyslexia, in contrast to their patient, whose reading rapidly returned to normal. Our patient's intermittent dysarthria, consisting of hypophonia and imprecision of articulation, has also been cited by others (Bell, 1968; Naeser et al., 1982). The overall recovery of our patient over the period of ten months was somewhat less dramatic than that reported for other thalamic lesion patients. Perhaps more time in treatment would have produced more substantial changes. Our patient's bizarre language suggests a possible link between this type of aphasia and the language heard in certain psychotic patients, and this we speculate may be due to the anatomical proximity of "emotional centers" to the thalamus.

CLINICAL IMPLICATIONS

This patient report has theoretical and clinical significance in documenting:

a) Disordered language associated with a lesion restricted to the left thalamus similar to deficits described by Glosser et al., 1982, (p. 106) as "...fluent, anomic, circumlocutory, tangential, and associative."
b) Protracted language problems as Mohr et al. (1975) report, as opposed to the rapid recovery that Rubens (1977), Benson (1979) and others have postulated for patient's with thalamic lesions.
c) An intermittent, variable pattern of dysarthria (i.e., hypophonia) that is interesting to contrast with the unilateral upper-motor-neuron dysarthrias described by Darley, Aronson, and Brown (1975) but probably not related to respiratory inhibition reported by Ojemann and Ward (1971).

d) Variable language profile, linguistic performance, and attention level that may implicate the role of the thalamus in alerting and maintaining the functional integrity (tone) of cortical language areas. Do these reflect part-perception or stimulus-boundedness or the transcortical sensory (echolalic) behavior cited by Cappa and Vignolo (1979)?
e) Emotional (particularly paranoid-like) characteristics and bizarre language show some relatedness to subcortical sites which, if disturbed by lesions or drugs, interfere with emotional well-being.
f) The site of lesion has implications for short-term verbal memory (Archer et al., 1981). Talland (1965) reported that Korsakoff patients showed decreased activation and "premature termination of memory search." Our patient showed reduced activation to verbal stimuli in all language modalities, impaired retrieval of appropriate semantic units (particularly nominative) and failure to continue self-stimulated language searches.

CONCLUSIONS

A key question for this conference is, How may our treatment provide more appropriate stimulation to activate and time retrieval cues that enhance recall and improve language and general communicative functioning in these types of patients? We recommend that continued attention to, and documentation of, behaviors associated with subcortical lesions be reported to further our understanding of language disturbance and dominant hemisphere pathology.

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APPENDIX

Oral Description — Boston Cookie Thief Picture

5/19/81
While he is purefying his (jargon)...He is purefying his element. If you see the swing over the doorstop it is unstable---Now the question is are there too many...jargon...in or too many...jargon out An the apple... jargon...is absolutely understandable. Now the can-cannot be understood at all She is standing as if she is standing on the corner-I don't understand what she is doing
(Response to Card 2--"The drawing doesn't become statistical")

8/26/81
Well, some people are being playing jokes. First of all this board is above the center of gravity. And she is drawing cookies out of the-out of the jar. The girl here is saying just be quiet about this about keeping jar a joke quiet. The girl is apparently washing dishes or dashing dishes, but uh it's difficult to see which way is which on the dishes. It-uh-she's pouring water into ozone-ozone that-that occurs to me. Uh-actually its-she's pouring water into liquid which is weary-weary great water may water exceeds the level of-of the level of the o-ozone it would come out all sides; why it comes out on only one side it don't care. The, she is actually a photographic scene and it's s-separated by a form which is separated partly on a newspaper. No manual shown at all. And that's all I see.

11/17/81
Well, I think I'll start backwards. This girl has a ss-s-s-soda pop-pppper. She is doing dishes for her neighbor. She apparently not very experienced. He has three dishes watering behind her and three dishes of si-silver. Uh-She has those so that their overlapping position. The reason that you're able to form a contusion is that you haven't seen the side a silver door-a silver bowl (distorted)--Well, the silver dollar is a spoon (jargon) good as anything--There's three shelfs left at that water instead one corresponds there's no ramimecation this wall goes straight over that way None of the other pictures re so simple. The back is tor-toward those children. Theres-there-there lips are sealed toward each other. See this one here. Distorted jargon...did you get it? The boy-the girl-the girl's are spread in the center of gravity and bepore that you see in the center of gravity is where nah for that. He is topping over-and he is in a jar that's on the-under ah silver platter. Maybe it's not silver and but it's silver anyway and I-I-I don't know whether he has anything cooking in that jar or not. It doesn't say whether there is anything empty in that jar or not. One he's handing a cookie to the child whos...(jargon) while he's topping over. and that's the end of this then.

(1) SPEAKER		(2) TIE	
6/2/81	I did some that. I lectured (jargon) miking a speech between talks. Mostly it's audience	6/2/81	Well, she's getting him dressed and she's putting on his final stroke.
6/9/81	Tape. Kids are here.	6/9/81	I confess she (jargon). She's making a command and she's doing it in long term opposition to. I don't know what she's doing it for.
7/28/81	He's-he's showing his tie. He's locking his tie. He's introducing his old theme song. his-his-his	7/28/81	She's knocking his tie. I said knocking it. I didn't. I got the - a kocking in there because I get the kocking in very often.
8/26/81	Well, the first picture is.. Are all these pictures supposed to be fools that I've seen? Alright...I won't need you re-repeat the picture. The thi-this structure is a professor of something, he doesn't say what - he doesn't say is. He uh-is addressing a miniature setting of 12 students, a bare-a fourth-a forth student berry	8/26/81	This is a picture of um-m -m a girl marrying making up with her boy-friend, and uh she is making up uh his kisses along with the uh dozen or so ru...(jargon). I cannot expect myself...

8/26/81 (cont)	appearing handsome image. A do not indicate the subject on which he talk (jargon) is discuss		
10/19/81	Oh, a man holding a stick. It's a man holding a stick. No, he's not holding it, he's- he's holding the stick up. He's trying to get people lined up for his story without telling what his story is. The rest is automatic.	10/19/81	And this is m -my man. This is a man h -who is hoeing his sweater. How it ga-gi, how gi grow up except by growing up. His tie needs to be finished, and as soon as it is the wife will correspond with the corresponding wick- with a kiss.
11/9/81	"Here's a picture of a man... jargon...Speaking before a society"	11/9/81	Here's papa saying goodbye in the form of a hemlock.

DISCUSSION

Q: In terms of the extension of the lesion into the globus pallidus, and the extension of the lesion anterior from the pulvinar possibly occluding the anterior-lateral-ventral nuclei, what can you tell me about that?

A: Our neuroradiologist was not able to really delineate differential involvement within the thalamus. He certainly said that the pulvinar is completely involved as far as he could tell, but in terms of speculating about anterior or dorsal-medial nucleus, he really couldn't.

Q: The reason I'm asking that is if you're looking at thalamic function and what it may do in terms of speech, I think it's critical that you consider the projections into the thalamus, the intra-thalamic connections and the projections out. And anterior-ventral-lateral nucleus you're going to be carrying information into motor cortex in both cerebellar and basal ganglia, and may relate to some of your hypophonia-dysarthria component. The pulvinar, on the other hand, gets all of its input from within the thalamus, so that may account for some of your language phenomena that your're seeing.

Q: You mentioned fluctuating comprehension and I thought I was hearing some fluctuating production problems as well. On the sample we have here are we getting a representative sample, or are we getting the worst in terms of his speech? I'm interested in the fluctuating attention in thalamic patients, and I wonder whether he ever fluctuated.

A: Having worked with this man for a period fo five months in treatment, I feel that the sample was representative of his responses to <u>these</u> pictures. This particular patient was very uncomfortable with this type of stimuli. He is able to perform a little better than what

you're seeing here, depending on the context of the situation. We did this as a sampling measure to attempt some standardization; however, what gave us the best results was to take him out of the treatment room as soon as possible, because his main goal was to go home. And anything that we could relate towards that goal assisted this man in treatment. So if we took him to his hospital room or attended conversations with his wife, it's my observation that the quality of his productions improved. But when it was specific to stimuli such as this he produced more tangential, neologistic responses. As the utterance increased so did the neologistic responses, the hypophonic vocal quality and imprecise consonant articulation. And I must tell you that this was amenable to treatment during sessions, and the most effective way to was by alerting and cuing this particular patient by simply saying, "You're garbling, I don't understand you. Be concise." He liked us to use a vocabulary that was on his level; he was a patent attorney prior to insult. So there were situations in which his speech production was more appropriate and functional.

C: I'd like to address the issue that the insult could not be isolated within the thalamus. I think that's a really important point. And I think it's extremely important if you're looking specifically at thalamic function. But one of our primary objectives was to attempt to demonstrate some speech, language, and behavioral differences which we do not "typically" see in most aphasic patients, so that you might anticipate them.