and Left Hemisphere CVA Patients

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Communication is frequently disrupted in tramatically brain injured (TBI) patients. But the labels used to describe communication deficits in this population vary. While some call TBI patients aphasic, others (Groher, 1977; Yorkston, Stanton, and Beukelman, 1981; Holland, 1982; Hagen, 1982, 1983; Mayer, 1984; Milton and Wertz, 1985) refute the adequacy of this label.

Finding an appropriate diagnostic label for the communication problems of TBI individuals remains a clinical challenge. The traditional approach for pursuing a diagnosis is through language testing. For example, the Porch Index of Communicative Ability (PICA) (Porch, 1981) has been used to differentiate aphasia from the language deficits in dementia (Watson and Records, 1978); bilateral brain injury (Porch, 1981); right hemisphere brain damage (Deal, Deal, Wertz, Kitselman, and Dwyer, 1979); and malingering (Porch, Porec, and Friden, 1976). The purpose of this paper is to report a comparison of PICA performance by TBI patients and aphasic patients who sustained left hemisphere CVAs, to describe differences in the behavioral profiles, and to discuss whether the two groups can be separated on the basis of their performance.

METHOD

Two groups, 15 bilaterally brain damaged TBI patients and 15 patients who each had a left hemisphere CVA, participated in the study. Potential subjects were screened to exclude those with severe visual deficits, severe dysarthria, and severe apraxia of speech. Ten of the TBI subjects displayed mild to moderate dysarthria. None of the CVA subjects were dysarthric. None of the TBI subjects were apraxic. Four of the CVA group displayed mild to moderate apraxia of speech.

Table 1 presents descriptive data for both groups. There was no significant difference between groups in years of education. Use of t prime (Weiner, 1963) to accommodate the large variance within the CVA group indicated no significant difference between groups for months postonset. The TBI group was significantly younger than the CVA group. Neurologic information confirmed that all TBI subjects displayed bilateral brain damage and all CVA subjects suffered a single left hemisphere lesion. Fourteen of fifteen TBI patients had been comatose. Coma length ranged from one day to four months.

Table 1. Descriptive data for the TBI and CVA groups.

	TBI		CVA		TBI-CVA Mean
Measure	$\bar{X}$	Range	$\bar{X}$	Range	Difference
Age (Years)	28.07	17-48	62.67	49-74	-34.60***
Months (Postonset)	12.47	01-51	30.73	01-106	-18.26
Years of Education	13.03	10-18	13.20	08-18	-0.17

*** = $p < .001$

The Western Aphasia Battery (WAB) (Kertesz, 1981) was administered to each patient in both groups. Results are shown in Table 2. The WAB Aphasia Quotien (AQ) classified 14 TBI patients as aphasic and one TBI patient as not aphasic. All fifteen of the CVA patients were classified as aphasic. One TBI patient profiled as transcortical motor aphasia, 12 profiled as anomic aphasia, and one was unclassifiable. The CVA group divided into one Broca's, one transcorti- cal motor, one Wernicke's, three conduction, eight anomic, and one unclassifiabl Therefore, 12 subjects in both groups were classified as displaying fluent aphasia. One TBI subject and two CVA subjects displayed nonfluent aphasia. Th PICA was then administered to each patient in the two groups.

Table 2. Classification of aphasia on the WAB for the TBI and CVA groups.

CLASSIFICATION	NUMBER OF SUBJECTS	
	TBI (n=15)	CVA (n=15)
Global	0	0
Broca's	0	1
Transcortical Motor	1	1
Wernicke's	0	1
Transcortical Sensory	0	0
Conduction	0	3
Anomic	12	8
Unclassifiable	1	1
Not Aphasic	1	0

RESULTS

PICA Overall and old modality performance (Table 3) was examined with t-tests of group mean differences. None of the comparisons revealed significant differences between groups. Comparisons of PICA new modalities (Table 3) indicated that the TBI group was significantly better in writing, and the CVA group was significantly better in visual matching.

Table 3. Comparisons between the TBI and CVA groups on PICA old and new modalities.

	TBI		CVA		TBI-CVA
Measure	$\bar{X}$	SD	$\bar{X}$	SD	Mean Difference
OLD MODALITIES					
Overall	12.32	1.64	11.97	1.11	0.35
Gestural	13.24	1.37	12.86	1.96	0.38
Verbal	12.72	1.58	12.28	1.58	0.44
Graphic	10.91	2.31	10.22	1.76	0.69
NEW MODALITIES					
Writing	10.46	2.57	8.40	2.23	2.06*
Copying	11.81	2.48	12.58	1.41	-0.77
Reading	12.51	2.75	12.32	2.30	0.19
Pantomime	11.80	2.14	12.20	1.41	-0.40
Verbal	12.72	1.74	12.28	1.58	0.44
Auditory	13.98	1.41	14.34	0.94	-0.36
Visual	14.66	0.51	14.98	0.07	0.32*

* = $p < 0.05$

Examination of individual writing and visual matching subtests, shown in Table 4, revealed the TBI group performed significantly better ($p < .05$) on writing subtests A, C, and D and significantly worse ($p < .05$) on visual subtest VIII. Only these four of the 18 PICA subtests displayed significant group differences.

Table 4. PICA subtests displaying significant mean differences.

Subtest	TBI $\bar{X}$	TBI SD	CVA $\bar{X}$	CVA SD	TBI-CVA Mean Difference
VIII Visual	14.55	0.74	14.95	0.14	-0.40*
A Writing	8.81	2.92	6.69	1.32	2.12*
C Writing	11.17	2.67	8.95	2.76	2.22*
D Writing	11.47	2.28	9.49	2.72	1.98*

* = $p < 0.05$

Raw score performance (Figure 1), plotted on the PICA Ranked Response Summary shows that ,with the exception of the writing subtests, the TBI and CVA groups have similar profiles. When performance is plotted using left hemisphere subtest percentiles (Figure 2), the differences identified by the t-tests are accentuated. Group mean percentile performance illustrates the group differences on writing subtests A, B, C, and D and on visual subtests VIII and XI.

Bilateral Signs

Porch (1981) suggested that bilaterally or diffusely brain-damaged patients differ in PICA performance from patients who suffer unilateral left hemisphere damage. He lists three signs: 1) a visual-auditory reversal with either subtests VI or X exceeding subtests VIII or XI; 2) disproportionately high verbal ability; and 3) disproportionately low graphic ability, especially on subtests E and F. Using raw scores (Porch, 1985), both groups were examined for these characteristics.

The number of patients in each group showing PICA bilateral signs is shown in Table 5. According to Porch (1981), the auditory-visual reversal is the most consistent of the bilateral signs. We considered this sign to be present if either visual subtest was lower than either auditory subtest. Three of the 15 bilaterally brain damaged TBI patients displayed this reversal, and one of the 15 unilateral left hemisphere CVA patients also displayed an auditory-visual reversal.

Table 5. Number of patients in each group who display PICA bilateral signs.

Bilateral Sign	Group TBI n=15	Group CVA n=15
1) Auditory-Visual Reversal	3	1
2) Inordinately high Verbal Scores	3	1
3) Inordinately low Graphic Scores	13	13
Subtests E and F lower than Other Graphic Subtests	2	0

The terms "disproportionately high verbal ability" and "disproportionately low graphic ability" are used to describe the second and third bilateral signs. However, how different the scores must be from the other modalities to qualify as "disproportionately" different is not specified by Porch. We used the most lenient criterion possible to examine these two bilateral signs. Any difference in scores among modalities was deemed acceptable evidence. For disproportionately high verbal performance, three of the bilaterally brain damaged TBI patients revealed that the verbal modality was their best modality, and one unilateral left hemisphere CVA patient also performed best in the verbal modality. Thirteen of the 15 bilaterally brain damaged TBI subjects had graphic modality scores lower than verbal and gestural modalities, while 13 of the 15 unilateral left hemisphere CVA patients performed poorest in the graphic modality. Two TBI subjects scored lower on one or both of subtests E and F than they did on the other graphic subtests, and none of the left CVA patients scored lower on subtests E and F than they did on the other graphic subtests.

Ten of 15 TBI patients with confirmed bilateral brain damage displayed one of Porch's three bilateral signs, five displayed two signs, and none displayed all three signs (Table 6). In the CVA group, all of whom had confirmed unilateral left hemisphere lesions, 11 of 15 patients displayed one bilateral sign. Two of the 15 CVA patients displayed two bilateral signs, and none displayed all three signs.

Table 6. Number of subjects displaying 1, 2, or 3 bilateral signs.

Number of Bilateral Signs	Number of Subjects	
	TBI n=15	CVA n=15
1 Bilateral Sign	10	11
2 Bilateral Signs	5	2
3 Bilateral Signs	0	0
Total	15	13

Discriminant Function Analysis

To determine whether PICA performance differentiated TBI patients from left hemisphere CVA patients, a stepwise discriminant function analysis was performed. This is a multivariate statistical method that determines the best combination of measures for discriminating between two or more groups of individuals (Fletcher, Rice and Ray, 1978). The measures included in the analysis were the 18 PICA subtests. From these, the discriminant function analysis selected 5 subtests--VIII, A, IV, VI, and XI--which, in combination, best discriminated the two groups. Based on these 5 measures, the discriminant function analysis correctly classified (Table 7) 13 of the 15 TBI patients (87%), and 14 of the 15 CVA patients (93%), for an overall accuracy of 90%. The two TBI subjects and one CVA subject who were misclassified on the discriminant function analysis were each classified as displaying anomic aphasia on the WAB, and each displayed one bilateral sign, inordinately low graphic performance

Table 7. Group classification by discriminant function analysis.

Actual Group Membership	Predicted Group Membership	
	TBI	CVA
TBI	13	2
CVA	1	14

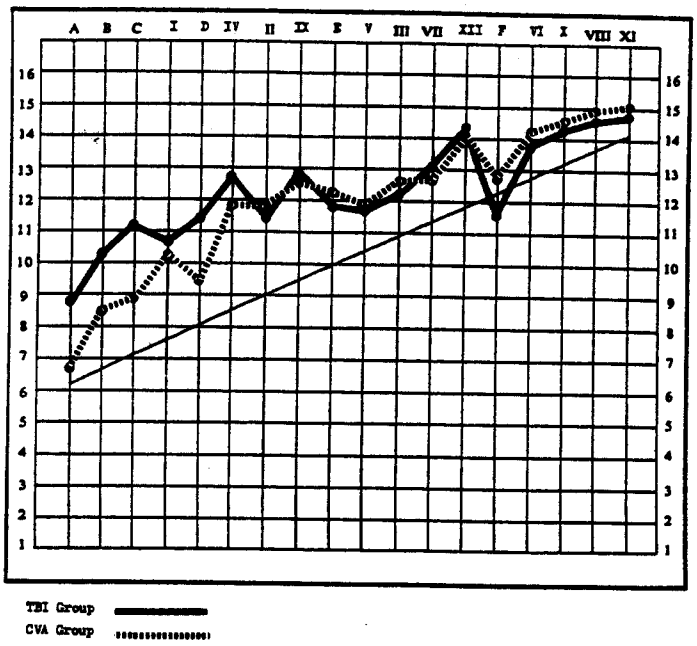

Figure 1. PICA raw score Ranked Response Summary for the TBI and CVA groups.

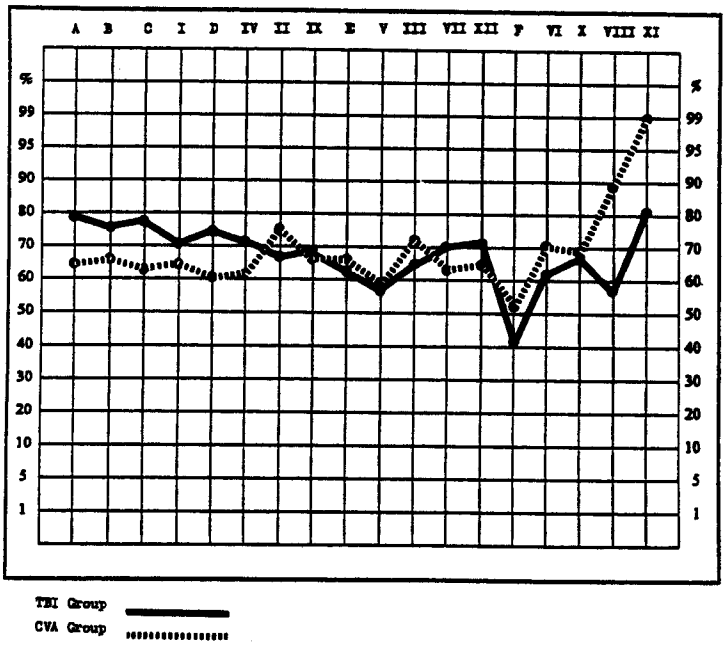

Figure 2. PICA percentile Ranked Response summary for the TBI and CVA groups.

DISCUSSION

Our results indicate that PICA performance by TBI patients shows similarities to and differences from PICA performance by aphasic patients with a single, left hemisphere CVA. First, both groups display similar raw score profiles on the PICA Ranked Response Summary. However, plotting performance in left hemisphere subtest percentiles will indicate differences between TBI and left hemisphere CVA patients. Second, group comparisons on PICA modalities and subtests indicated significantly poorer performance in the Visual modality and significantly better performance in the Writing modality for the TBI group. Third, Porch's three bilateral signs did not differentiate bilaterally brain damaged TBI patients from patients with a unilateral left hemisphere CVA. Fourth, discriminant function analysis indicated that the groups displayed different patterns of performance on the PICA. Five PICA subtests were selected by the analysis which, in combination, discriminated between TBI and CVA patients with 90% accuracy.

Are TBI patients aphasic? The Western Aphasia Battery suggested that 14 of our 15 TBI patients were. Discriminant function analysis of PICA performance suggested that 14 of our 15 patients were not. How one looks for something may influence what one finds. Depending on the measures and analyses employed, performance between groups may appear similar, yet the problems may be qualitatively different. Our results concur with Sarno's suggestion (1980), "The boundaries which usually help to identify and classify patients with linguistic deficits after brain damage do not seem to hold to the same degree for head trauma patients as they do in the stroke population" (p. 692).

The presence of aphasia in traumatically brain injured patients frequently is identified by impaired performance on aphasia tests. For example, Levin, Grossman, and Kelly (1976) discussed "aphasic disorder" in TBI patients based on performance on the Multilingual Aphasia Examination (Benton, 1967). Sarno (1980, 1984) divided TBI patients into three groups, aphasia, dysarthria with subclinical aphasia, and subclinical aphasia, and examined their performance on the Neurosensory Center Comprehensive Examination for Aphasia (Spreen and Benton, 1969). Neither Levin et al. or Sarno compared performance by their subjects with that by left hemisphere CVA aphasic patients. Perhaps a comparison would have revealed differences between communication deficits following TBI and aphasia following a left hemisphere CVA. Holland (1982) and Wertz (1982) warned that poor performance on an aphasia test does not necessarily signify the presence of aphasia.

Sarno (1980) suggested that whether the linguistic disorders in the TBI population are "truly aphasic in the traditional sense is beside the point." Perhaps, but it may depend on what the point is. The diagnostic label, aphasia, has important ramifications. It implies the presence of specific behaviors, a prognosis, and a means of management. Holland (1982) observed that "If the language problems seen in traumatically brain injured patients don't look like aphasia, sound like aphasia, act like aphasia, feel, smell or taste like aphasia, then they aren't aphasia" (p. 345). We looked, listened, touched, sniffed, and tasted with the PICA. Our results indicate that communication deficits subsequent to bilateral head trauma can be differentiated from aphasia subsequent to a left hemisphere CVA.

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DISCUSSION

Q: Since some of your TBIs did not show the signs that Porch believes indicate bilateral damage, do you know whether any of them may have had a focal left hemisphere lesion producing aphasia and thus not giving the reversal that you might expect?

A: Some patients may have had focal lesions from subdural hematomas, but all patients had confirmed bilateral damage.

Q: Could they have had a focal lesion?

A: Some displayed subdural hematomas which would indicate focal damage, but, in addition, all had bilateral damage.

C: That may be why one of Dr. Porch's suggestions about bilateral signs was not present, the auditory-visual reversal.

C: Dr. Porch's bilateral signs predict bilateral brain damage. They have nothing to do with the presence of a focal left hemisphere lesion co-existing with bilateral brain damage. Isn't that correct, Dr. Porch?

C: Yes. The observation I made about bilateral signs holds up quite well, and it's quite sensitive to bilateral damage. I never specified where the big, focal lesion is or where it isn't. In fact, you'll get bilateral signs with hydrocephalus, or brain stem lesions, or basal artery thrombosis, or anything that compromises both sides of the brain. If the patient has bilateral traumatic lesions, the PICA will show bilateral signs. However, as edema clears and the patient is left with a focal lesion on one side, then the pattern will shift to a unilateral pattern. So, it would be interesting to follow TBI patients over time to see whether they change from a bilateral pattern to a unilateral pattern. As far as the exact criteria for "disproportionately high verbal" and "disproportionately low graphic," they are "sort of high" and "sort of low." Dr. Katz and I are struggling with this, because we want a computer to make that determination. I hope we will have exact criteria soon.

C: I still suggest that a focal lesion in the left hemisphere could confound the ability of the bilateral signs to classify a patient as truly aphasic or traumatically brain injured.

C: PICA bilateral signs do not indicate whether a patient is aphasic or TBI. They are supposed to indicate whether brain damage is unilateral, left hemisphere or bilateral.

C: We wondered why most of our TBI subjects did not show the auditory-visual reversal or disproportionately higher verbal scores, and why both groups displayed disproportionately lower graphic scores. Perhaps the etiologies in Dr. Porch's bilateral group differed from our group. Perhaps different bilateral etiologies will behave differently. Our bilateral group all sustained traumatic brain injury. Perhaps Dr. Porch's bilateral signs were based on a variety of bilateral etiologies.

C: I wonder if the lesson from the results of this study, and a number of other studies that we've heard here and at other times, is that maybe we should stop using tests designed to assess aphasia to differentiate aphasia from other problems. Most of the tests we've talked about, the PICA, the Boston, the Western, are tests that presume a diagnosis of aphasia and then set out to assess the severity and perhaps type of aphasia. None of these tests were devised to distinguish aphasia from any other disorder. I think that we should stop using brute force methods to make a test do something it wasn't designed to do.

C: However, these two groups, left CVA and TBI differed on the PICA. Perhaps the lesson is that a test will differentiate among groups if you look at the data appropriately. The traditional PICA analyses did not differentiate, but discriminant function analysis of PICA performance did.

C: Yes, but you could probably talk to each patient for a few minutes and know they were different without any sophisticated discriminant function analysis.

C: Some tests fail to differentiate. Others do. The PICA classified 90% of our subjects. That is pretty good. We mentioned a variety of studies where discriminant function analysis of PICA performance was equally successful in differentiating among groups.

C: Yes, but you could get 100% discimination by doing a clinical evaluation.

C: Only if I agree with you.

C: That's exactly the point. If you really want to look at the difference between bilateral TBI patients and stroke patients with unilateral lesions, there are better tests.

Q: And, you're proposing a "clinical examination?"
A: Well, clinical examination is one, but there are quantitative measures. If, for example, you're trying to establish right hemisphere damage, I don't think that most of the language tests are really designed to look at the right hemisphere. There are a number of tests that are much more specific to right hemisphere damage.

C: Right, but we give language tests, and we're asking what we can see with the test we give. If one test will differentiate among disorders and localize brain damage, we don't need to use up patient time with other tests. That's one of the questions we're asking. You suggested that a "clinical examination" would result in 100% identification. I don't agree with that at all. Why do we have these discrepant views in the literature--people calling demented patients aphasic, people calling right hemisphere patients aphasic, and people calling TBI patients aphasic? Thus, we will/can get 100% identification only if I agree with you. Folks just aren't agreeing.

C: That's a giant problem. A lot of studies of so-called aphasia are contaminated with bilateral patients, and so on. I want to respond to the comment that tests designed to look at aphasia shouldn't be asked to look at other

things. There are two ways of designing tests--a priori, where you design a test to look for something and you tend to find it, and a posteriori. We said we didn't know what these patients should look like. So, we developed large batteries and tested a lot of patients. Schuell found unilateral groups and a bilateral group. I found a unilateral profile and a bilateral profile. The two differ, and the neurologic exam doesn't necessarily pick up these subtle signs. A patient may be sent to us as having a left hemisphere lesion, but we may see bilateral signs on the PICA. They re-examine, look at the history, and in a few weeks they verify that the patient really has bilateral involvement. There aren't many times that we have a chance to assist with localization in speech pathology, but the tests of aphasia are one of the things that permit us to do that.