

A STUDY OF CEREBRAL DOMINANCE BY LATERALITY SCORE AND ORDER OF REPORTING IN DICHOTIC LISTENING TEST

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SUMMARY

The Dichotic listening test was performed on 8 schizophrenics and 8 normal healthy controls. A positive correlation between laterality score and shift of order of reporting from one hemisphere to other was found in right handed schizophrenics during active stage of the disease. Order of reporting alone may be a factor responsible for this shift of laterality in these patients. Further, on follow-up the abnormalities returned back to normal as these patients recovered. This suggests that schizophrenia is a left hemisphere abnormality with temporal lobe dysfunction.

The two sides of human brain are functionally and anatomically different. Research methods based on the cerebral laterality are being used to investigate regional brain functions in psychiatric illnesses, as psychiatric illness is accompanied by a break-down in the inter-hemispheric inhibition, that normally mediates hemispheric specialization (Wexler and Heninger, 1979). The main aim of the present investigation was to assess lateralized hemispheric dysfunction in schizophrenia, using Dichotic listening test.

Simultaneous presentation technique, devised by Donald E. Broadbent, of England in the year 1954, involved simultaneous presentation of one set of spoken words or digits to one ear and different set of spoken material to the other ear. Kimura (1961) used this technique on neurological patients having left temporal lobe damage. In her paper, she was able to conclude that superiority of right ear in normal right handed person was due to better connection between the right ear and the left hemisphere. In her studies

she named the simultaneous presentation technique as "Dichotic listening".

Several studies on cerebral laterality and schizophrenics suggest that dominant cerebral hemisphere is predominantly innovative in this illness (Davison and Bagley, 1969; Wishner and Wahl, 1974; Beaumont & Diamond, 1973; Wexler and Heninger, 1979; Allen, 1983 and Johnson & Crockett, 1982). It is clear from the above studies that schizophrenia is left hemisphere dysfunction or attained asymmetry in acute period. The studies considered that 'total score' and 'laterality score' were sufficient to detect laterality or in computing Cerebral Dominance. Inglis (1965) emphasized the order of recall over laterality score in computing Cerebral Dominance.

The focus of our study was on the 'laterality score' as well as the 'order of reporting'. Both have been used as tool in computing Cerebral Dominance, but they have been used separately. The study revealed a positive correlation

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between laterality score and order of reporting, when measured with same technique on the same group of patients.

METHODOLOGY

The subjects of the study consisted of 8 schizophrenics, diagnosed according to RDC (Spitzer, 1978) and 8 healthy normal controls. The normal controls were hospital employees of the Institute of Medical Sciences, Varanasi. Both the groups were matched on the basis of age, sex and education. The patients with organic brain lesion, alcoholics, epileptics, hysterics and persons having any type of hearing disorder were excluded. All the 16 subjects (8 schizophrenics and 8 normals) were subjected to hearing test (audiometry), after which they were screened on the basis of Annett's handedness questionnaire, for determining handedness. Only right handed subjects were taken for the study. The Dichotic listening test was conducted with the aid of a stereophonic Akai Tape recorder (4 track), stereophonic head phone, and dichotically recorded words on a spool and a scoring sheet with semistructure proforma. There were 20 sets of words synchronised on the spool on each side. Each set consisted of 6 words (3 to left and 3 to right). All the words were in Hindi. The testing was done in a sound proof room.

Patients were tested initially between 7 to 14 days of admission when they were not given any medication. When actively symptomatic, the Dichotic listening test was administered thrice in a day (that made a complete test). Same test (Dichotic listening) was repeated after 4-6 weeks from the first assessment when it was considered that maximum expected clinical improvement had occurred. The test was again administered after 15-16 weeks of their first assessment i.e. at the time of discharge.

All the eight controls were also administered this test three times. They were paid for this experiment.

The number of words correctly identified in each ear constituted the score for each, the items identified incorrectly scored as error. Prior to the test all the subjects were familiarised with the items and procedure by presenting similar words and were required to report verbatim as they could.

The subjects were made to listen few words through stereophonic head phones. There were different words on each side of the track. Subjects had to listen it carefully and reproduce within a pause of 10 secs, what ever they had heard. There was no restriction, however, as to his/her reporting ear wise. One had to report as many words as he or she could. It was noted verbatim along with the order of reporting. Whatever was being spoken by the subject was to be noted, without caring whether it was correct or incorrect. After computing one spool, the same was played again just reversing the track. In other words the right track linked with right ear in first case was linked with left ear and the left track initially linked with left ear was linked with right ear. Finally in the third spell of experiment half set of words was presented in 1st phase procedure and the other half in IInd phase procedure. Same procedure was followed on all the occasions.

Laterality score was calculated by subtracting left ear scores from right ear scores and dividing the difference by the sum of two. Order of reporting was noted from the utterance of words by the subject. If the word presented in left ear, was reported first, it was noted as L1, while from right ear it was noted as R1. Similarly second response was noted as L2 or R2 as the case might be. Only first and second positions were recorded.

Chi-Square test was applied to evaluate relationship between these two responses of same test.

RESULTS :

Baseline Data—Patients Compared with Controls.

On the initial dichotic listening test, patients' laterality scores, tended to be less lateralized than controls giving laterality score of 0.48 in normals as against -0.28 in case of schizophrenics. The order of reporting was just reverse. R1 response 11.29 in normal cases was against 8.59 in schizophrenics. Whereas L1 response was much high in patients (10.04) against the scores of normal which was only 3.41. Chi-Square fourfold table was used to observe correlation between R1 and L1 scores (normals & schizophrenics respectively) and their respective laterality scores. A value of 0.982 significant at 0.05 level of confidence, was observed (Table No. 1). When L1 responses

of normals and R1 of schizophrenics were compared with their laterality scores it was again significant at the same level of degree of confidence i.e. 0.05 level (Table 1).

Table 1—B present the R2 and L2 responses of schizophrenics and controls along with their laterality scores. Here again the differences are significant at the same level of significance (0.05). When the L2 and R2 responses of schizophrenics and normals were compared Chi-Square value was 0.97 and when R2 of schizophrenics were compared with the L2 of normals it was again significant (the value being 0.54) at 0.05 level of confidence.

Order of Reporting Changes with Laterality Scores following Clinical Improvement (Table 2)

Following treatment and clinical improvement there was a major change in order of reporting and laterality scores of patients. Initial schizophrenics mean laterality score (-0.28) was a negative

TABLE 1—Laterality scores and order of reporting in schizophrenia and normals

	Laterality Scores	Order of Reporting		Q Square Schizo. & Normal	
		R ₁	L ₁	L ₁ Vs. R ₁ (Schizo. Vs. Normal)	R ₁ Vs. L ₁ (Schizo. Vs. Normal)
Schizo.	-0.29	8.59	10.04	0.982*	0.964*
Normal	0.48	11.29	3.41		

*— $p < 0.05$

TABLE 1-B

	Laterality Scores	R ₂	L ₂	Q Square Schizo. & Normal	
				L ₂ Vs. R ₂ (Schizo. Vs. Normal)	R ₂ Vs. L ₂ (Schizo. Vs. Normal)
Schizo.	-0.29	4.16	7.41	0.976*	0.547*
Normal	0.48	8.83	2.78		

*— $p < 0.05$

TABLE 2—*Laterality Scores and improvement in Schizophrenia*

Period	Mean Laterality Scores		Mean Order of Reporting		
		L ₁	R ₁	L ₂	R ₂
Baseline (1-2 week)	-0.28	10.04	8.59	7.41	4.16
Follow up (15-16 Week)	0.48	2.62	11.29	4.94	8.04

TABLE 3—*Significance of response in schizophrenic and control group*

	L ₁	R ₁	R ₂	L ₂
	Schizo. Vs. Control	Schizo. Vs. Control	Schizo. Vs. Control	Schizo. Vs. control
"t" Value	5.76	8.20	5.26	3.82
Significance level	0.01	0.01	0.01	0.01

laterality score, while on retest (last testing) it came to be 0.48. Initial one was showing negative laterality score whereas with clinical improvement it came to a positive laterality score.

Similar trend was observed with regard to order of reporting. Initially or in baseline data, left ear responses were better than the right one. The mean of L₁ responses at first testing was 10.04 and gradually started decreasing and at 15-16 weeks stage it dropped to 2.62. The reverse was true with R₁ responses which showed 8.59 in initial testing and 11.29 in last testing. It is evident that the order of reporting from left ear and right ear have shown descending and ascending trend respectively. Similar trend has been found in second place order of reporting i.e. with R₂ L₂ response.

Difference between Patients' and Normals' responses :

The initial score of left ear first response i.e. L₁ in Patients & Normal group

showed a significant ($p < 0.01$) "t" score of 5.76. The same trend of result was seen in the R₁ responses of schizophrenics & controls, the "t" score value being 8.20 which was again highly significant at the same level of significance.

The responses, reported at the second place also showed a significant level in "t" score i.e. 5.26 and 3.85, in L₂ and R₂ responses respectively. Baseline data shows a significant difference between patients and controls.

A conspicuous change was observed after clinical improvement in schizophrenics responses. When the L₁ and R₁ responses of controls were compared, there was no change at all. The same trend was seen in second order responses.

The correlation between the laterality scores and recovery related changes are presented in Table 1 and 1-B. Thus, an increase in right ear advantage of dichotic listening test would lead to a positive change score, while a reversal

on laterality score on the same test i.e. a decrease in symptomatology would lead to a negative change score.

DISCUSSION

The alteration in cerebral laterality following clinical improvement on Dichotic listening test, noted by Wexler and Heninger (1979) and Johnson and Crockett (1982), was replicated here with a new comparison of laterality score and order of reporting.

Present study shows that the laterality scores of schizophrenics registered a significant change over a period of time, showing a shift from left ear advantage to right ear advantage at third assessment. Normal controls have not shown any such change (Table 2).

It is mentioned in several studies that the crossed relation in sensory functions are stronger than uncrossed, and it is also clear that whenever a damage or dysfunction takes place in that particular hemisphere's lobe, the crossed related sensory functions will definitely be disturbed. At the same time, it is also to be considered here that schizophrenia is accompanied by breakdown in inter-hemispheric inhibition. The inferred hypothesis is that schizophrenia is left hemispheric dysfunction and leads to poor performance of right ear, during illness, on Dichotic listening. Due to that poor performance on Dichotic testing a negative laterality score (-0.28) has been found, with the left ear's order of reporting being preferred to that of right ear's. Because of poor performance on right ear or better left ear responses, only laterality score is negative, negative laterality scores mean greater number of left ear responses in

comparison to right. But with the better number of responses even the order of reporting is also changed.

In the present study, a significant correlation has been found in laterality scores and order of reporting in Dichotic listening test. These two factors are indicative of the same thing i.e. left ear advantage or cerebral laterality in general, they can be used together and will prove a good check for each other.

By following up cases with repeated use of Dichotic listening test, an improvement was observed viz. negative laterality scores in schizophrenia were converted into positive scores, left ear advantage and left ear order effect were also converted into right ear advantage and right ear order of reporting.

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